A Decade of Higher Education Assessment

Articles and Presentations 2008-2018

David Dirlam and colleagues

Transformative Learning Needed for Higher Education Assessment

David Kirk Dirlam[1]

Learning can either be incremental or transformative. The former has been studied for a century and a half. It occurs gradually through practice and for the most part obeys "laws of learning" established in tens of thousands of articles. It has led to assessments based on rating scales, with numbers like those used by Amazon.com or with adjectives that form SWELL rubrics (Sequences Which Expand Little by Little). Transformative learning, on the other hand, was first carefully described by Jack Mezirow only a generation ago. Based on a 500-session study, some colleagues and I (see Dirlam, 2017) found that Mezirow's (1991) 10 phases fit into four time periods: Disorientation, Examination, Enabling, and Performing. These, we called the DEEP modes of commitment. The resulting transformation involves a deep shift in perspective leading to a more open, permeable, complex, sustainable, and better-justified meaning-perspective (c.f., Taylor and Cranton, 2012).

Transformative Learning for Individuals

To understand how transformative learning relates to higher education assessment, in general and AALHE in particular, we must start with how transformative learning in individuals relates to developmental rubrics. Then we can consider how it works in development beyond the person.

The Theory Behind Developmental Rubrics

The basic idea of developmental rubrics is that there is a transformation between each of four modes of practice: beginning, exploring, sustaining, and inspiring. First beginning modes are transformed into exploring modes. *Beginners* take just a few minutes to try an activity. To *explore* they need not just more of what they did but a whole new mode of practice. When children begin to draw their first person, they scribble. Exploring drawings use stick people. Beginning collaborators are reticent. Explorers assert themselves. Beginning writers tell about themselves. Explorers correspond with a friend.

After several months of exploring, some students begin to experiment with yet another whole new mode. This time, the goal is to devote a few years to getting good enough at the mode of practice to *sustain* it, especially in a professional or work context. Drawings look like folk art. Collaborators take on roles based on each other's skills. Writers address small groups of known people.

A decade later a few people work to make yet a third transformation. Now, the *inspiring* goal is to discover, innovate, or establish new interpretations that are broadly copied. Such changes are transformative rather than incremental.

Transformative changes are due to three fundamental characteristics of modes of practice: growth rate, competitive strength, and resource level. Beginning practices do not grow

[1] I am grateful to Jane Souza for an insightful discussion of an early draft of this Emerging Dialogues contribution.

and do not compete with other practices. Exploring modes of practice grow very fast, but also do not compete with more advanced modes. If learners fail to acquire the advanced modes, their exploring modes consume so many resources that they may abandon the practice altogether. Sustaining practices grow a little slower but are more competitive.

Inspiring practices take a long time to establish, but when they get established, they are the most competitive of all. Once a person starts making discoveries, innovations, or new interpretations, it is so exciting that they do not want to revert back even to sustaining work. The salient transformations for higher education are beginning (first day of introductory course), exploring (lower division or associates degree courses), sustaining (upper level course), or inspiring (graduate courses). This theory is developed in detail in Dirlam (2017). For developmental rubrics, each dimension has four modes and each transformation between modes requires the DEEP modes of commitments.

Examples of Incremental and Development Rubrics

Many people use AAC&U's Value Rubrics, which have helped to move academic assessment toward multidimensional thinking that becomes interred in the simple minded grades. But incremental rubrics miss the opportunity to stimulate transformative learning.

Comparing a dimension from the Value Rubrics for writing to one created with transformative learning in mind reveals how assessment can address either incremental or transformative learning. The first example is from the AAC&U Value Rubrics and the second from a group of faculty involved in a writing across the curriculum program at Wilmington College. That faculty had been trained in using *cascading* developmental interviews[2] to create rubrics.

AAC&U Value Rubrics. The "Goal-Oriented Organization" dimension from AAC&U Value Rubrics are primarily incremental. Instructors could use them to encourage students to do more of something (e.g., pay attention to the context and purpose), but they do not suggest how to transform their practices.

Context of and Purpose for Writing. This includes considerations of audience, purpose, and the circumstances surrounding the writing tasks:

- **Capstone 4.** Demonstrates a THOROUGH UNDERSTANDING of context, audience, and purpose that is responsive to the assigned task(s) and focuses all elements of the work.
- **Milestone 3.** Demonstrates ADEQUATE CONSIDERATION of context, audience, and purpose and a clear focus on the assigned task(s) (e.g., the task aligns with audience, purpose, and context).
- **Milestone 2.** Demonstrates AWARENESS OF context, audience, purpose, and to the assigned tasks(s) (e.g., begins to show awareness of audience's perceptions and assumptions).

[2] The cascading process begins with a group meeting where an experienced developmental interviewer conducts one interview and a group member does another. The group finishes the interviews in pairs on their own; they combine the results into one set of rubrics; and after sufficient use they meet to refine definitions.

- **Benchmark 1.** Demonstrates MINIMAL ATTENTION TO context, audience, purpose, and to the assigned tasks(s) (e.g., expectation of instructor or self as audience).

Wilmington college writing across the curriculum. Rubrics designed for transformation are developmental and contain ideas that instructors could use to motivate change. In the Wilmington College Writing Across the Curriculum dimension below, it's easy to imagine an instructor saying to a student that they have captured the topic, but now they might start thinking about what they want to accomplish in each part of the paper. This would be a whole new practice for the student, not just more of a continuing one. It's also easy to imagine a student thinking, "It never occurred to me that I have to tell the readers how every section relates to the purpose."

Goal-Oriented Organization. This concerns what the assignment accomplishes:

- **Beginning:** DISCONNECTED: States a topic but no particular goal. If a thesis or goal is evident, it may not connect to body. Little to no logical progression of ideas or conclusion.
- **Exploring:** TOPIC-DRIVEN: Assignment is topic-driven rather than goal-driven, and assignment goal is not present throughout body.
- **Sustaining:** PLANNED: Fulfills objective through a logical presentation of evidence. Knows the function of each part of the paper in relation to assignment goal.
- **Inspiring:** AUTHORITATIVE: Persuades the reader while remaining grounded in an objective discussion of evidence. Work is cohesive and offers new insight.

To implement the new practice, the student would need to examine their writing practices by reflecting, assessing their own thinking, and talking with others. They would also have to plan how to connect each section of their writing to their overall purpose and rehearse it by doing it over and over. Experienced teachers intuitively know how to start their students on a new mode of practice with a dilemma, help them examine it, enable them to use it, and support their performance. The DEEP modes of commitment play over and over in each transformation between modes within every dimension of a field of expertise. The developmental rubrics, and even their one-word titles, help teachers plan more systematically and communicate more easily about the transformations.

Transformative Learning Beyond the Person

The writing rubrics help to distinguish incremental from transformative learning. But the distinction goes far beyond writing. Over 300 faculty from over 50 disciplines found it easy to describe half or even a whole dozen of dimensions of transformations first from beginning to exploring, then to sustaining, and ultimately to inspiring modes of practice. Besides the educational use, there is another application of transformative learning that is as far reaching and thought provoking as its influence on student development. Communities and organizations widely dispersed across time and space also transform.

Theory of Transformative Learning in Communities

In 1999, Dirlam, Gamble, and Lloyd rated over 900 articles written from 1930 to 1992 and randomly selected from *Child Development* and *Developmental Psychology.* They found that historical development of the research practices followed exactly the same pattern as individual development. It also depended on growth rate, competitive strength, and resource level. Because of this remarkable similarity, we can expect that transformative learning applies to historical changes in communities of people across decades as well as it applies to individuals over a few months or years.

Example of Transformative Learning in Higher Education Assessment

Because the same dynamics work in individual as in historical development, we can expect that the transformative sequence would work as well. Can we use the DEEP modes of commitment to understand how assessment should change? For example, we are still exploring how to use the literature on learning in higher education assessment. So a good question for this example becomes, how might we use the DEEP modes of commitment to transform assessment into a more sustainable mode of using the literature on learning.

Disorienting dilemma. Higher education is falling behind. Industry after industry has entered the *Age of Intelligence.* They are doing deep analyses of massive datasets. Right now, however, higher education has no way even to share stated program outcomes from multiple institutions. Instead, we rely on opinion leaders and cherry picked articles—the same strategies that people use to undermine global warming and conservation efforts. People have begun to argue that there has been no progress in assessment in the last 20 years. If so, they claim that our field has not learned in either way. As long as we rely on opinion leaders and cherry picked articles, we can expect even worse political undermining than global warming and conservation have suffered.

Examining. Accreditation agencies define standards statements without documentation of the massive social science literature on learning and teaching. Programs often define outcomes without so much as an analysis of journal names in their fields. Regardless of these weaknesses, there is no way even to access an unbiased collection of the outcomes for any field.

Individuals and associations are proclaiming lists of a few handfuls of “high impact practices.” These are based on a study that included less than one-millionth of the possible course designs that would result from even a simple analysis. One such analysis used a combination of 5 options for each of 6 dimensions (locations, instructor roles, social contexts, preparation expected, resource required, evaluation basis) that were used for one of 5 durations (none, day, week, month or daily). That results in nearly a quarter billion patterns. That a few handful of practices should be proclaimed for all occasions reveals the absurdity of relying on the best-marketed practices.

Enabling. There are a few hopeful signs. Peggy Maki (2017) has published a book calling for real-time assessment. We have known for more than a half century that longer delays of feedback produce less learning. The typical “close-the-loop” delays the feedback so much that

no current student benefits from it. It becomes an autopsy of the learning it claims to assess. Just becoming aware of the need for real-time assessment is progress. But the progress is empty unless instructors assess their students in real time. Jack Mezirow's wonderful analysis of transformative learning is becoming better known. But progress is likewise empty unless instructors use it to inspire individual students.

In small classes transformative use of developmental rubrics happens spontaneously as soon as faculty have used the rubrics often enough to remember them. For large classes, Rachel Yoho has developed a fascinating machine-learning approach for providing real-time assessment. She created a set of assignment-related rubrics, had faculty use them to assess student papers and then, gave the graded papers one at a time to "train" the computer. She found that the program learned to assess as reliably as the humans, but could do so quickly enough for a large class to get feedback within minutes.

Performing. Your AALHE Board has undertaken two initiatives that are designed to move higher education assessment into better use of the literature on learning. The first is the Knowledge Development Task Force, which reports to the President and will initially be chaired by Teresa Flateby and me. If you are an AALHE member and interested in joining this Task Force, please contact either of us at David Dirlam (ddirlam@changingwisdoms.com) or Teresa Flateby (tflateby@georgiasouthern.edu).

Its mission is to identify and facilitate ways to advance the development of a body of knowledge devoted to assessing and improving student learning in higher education. Some strategies include create a bibliography of knowledge development sources relevant to AALHE, identify key strategies from them, create one or more key databases. The members will work to identify advances in the last two decades including content analysis from library databases of disciplinary journals. Such analysis would involve (1) scientific methods for establishing improvements in student learning, (2) the design of assessment procedures, (3) the interpretation of assessment practices and results, (4) the academic leadership above assessment, (5) the leadership of assessment research, and (6) seeking to identify problems that could be solved in the next decade. Once problems are identified, it would be important to envision solutions, specify the resources needed for them, select solutions for proposing to AALHE board, and facilitate the implementation of the selected solutions.

The other initiative is for an AALHE Database of Learning Identifiers. If this gets the go-ahead, we will seek to build the sort of massive database that will lead to real understanding of the kinds of learning that programs aim to create across the U.S. and perhaps even beyond.

Conclusions

Transformative learning is not just for individual students. Organizations need it as well. Right now, higher education needs a transformation to more complex, open, permeable, sustainable, and better-justified approaches to understanding, assessing, and above all fostering learning. Use of the literature is one dimension. There are numerous others. AALHE and its Emerging Dialogues invite the dilemma recognition, examination, enabling, and performance of new modes of assessment practice.

References

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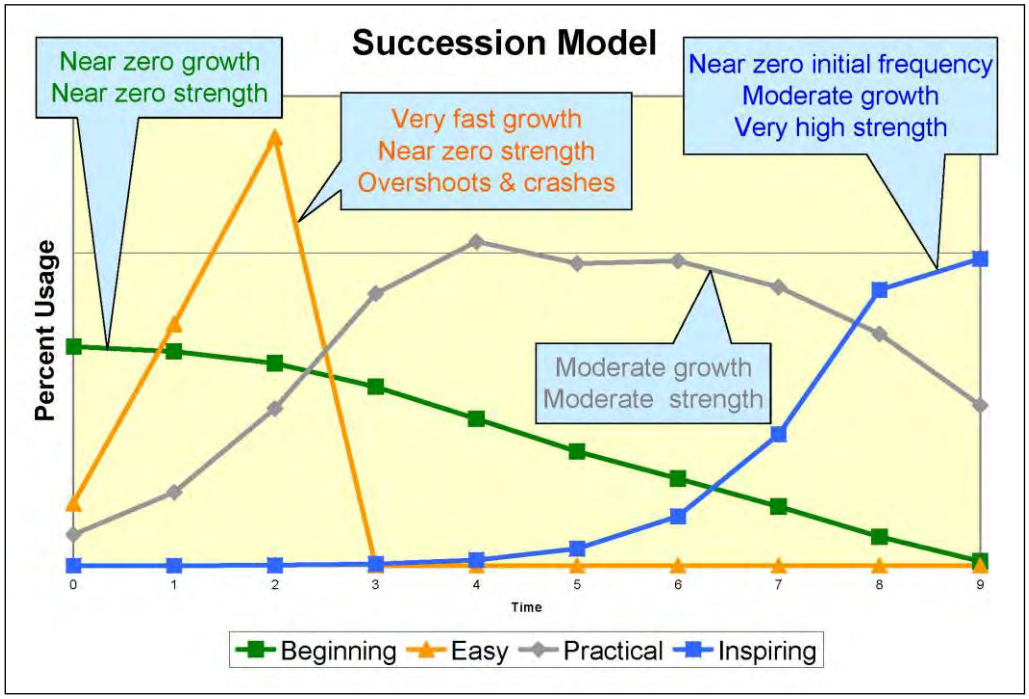
Developmental Interviewing Tool

This tool is intended for to help you and a developmentalist create a development theory of your field. The result will be a learning outcome network for the program where you have your primary appointment. We seek to discover several dimensions of four types of commitments learners make: (1) to try, (2) to learn a little, (3) to earn a living in the field and (4) to contribute to or make discoveries within a field. We call these commitments (1) Beginning, (2) Easy, (3) Practical and (4) Inspiring. Each commitment is realized within a different time frame: no time to begin, a few months to learn easy strategies, a few years to learn practical strategies and a decade to make regular contributions to a field. Fast growing, easy strategies often overshoot resources and cause the activity to be abandoned.

We focus on what students do. What do beginners do and how does this differ from the easy strategy learners? What do people need to do to earn a living in your field? How does this differ from what experts or masters to make discoveries? We will take notes and you will have a chance to edit our notes. The edited notes from all the experts in your program will be combined to make a single set of abstract rubrics for the program. These will be edited for reliability and validity as they are used.



* Based on tests that used over 1,200 drawings (age 5-19), 300 stories (age 5-13), 900 research articles (1930-1992)

	Strategy Name Drawings Examples Research Participants	**Beginning** Scribbles Test & Experimenter	**Fundamental** Stick people Test alone	**Practical** Sketches Sig. other & no test	**Inspiring** Fine art Sig other & test
Experience Organizing Principles	**Beginner Use**	Common	Rare	Rarer	Extremely rare
	Growth	Almost none	Extremely fast	Moderate	Slow
	Competitive Strength	Almost none	Very low	Moderate	Very high
	Commitment	Try	Learn	Become proficient	Make contributions
	Dispersion	Personal (1-3 relationships)	Collaborative team (5-12 people)	Work group or social relationships (100-250)	Marketplace (1,000-millions)
	Learning & Dispersion Times	Immediate	Weeks to months	A few years	Decade +
Other Useful Ideas	**Effects**	Peripheral Participation	Take little practice; get some reward	Enable living wages but no excitement	Enable Discoveries
	Helpful Prompts	What do people do before any instruction?	If a student overuses these at work when about to graduate, you feel discouraged.	Save this "sandwich filling" for last.	What did students do that surprised you with its appropriateness?

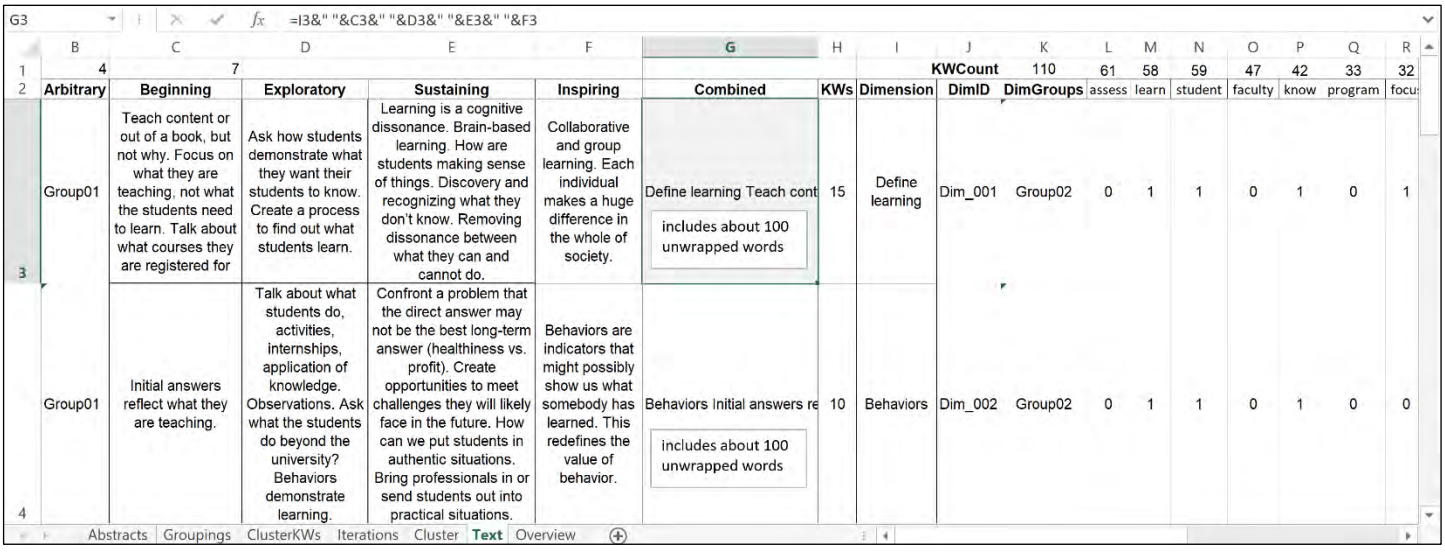
David K. Dirlam, Ph.D., Author of *Teachers, Learners, Modes of Practice: Theory and Methodology for Identifying Knowledge Development,* New York: Routledge, 2017

AALHE KDTF INTERVIEW ANALYSIS

David Dirlam[1]

How we made useful developmental rubrics from developmental interview records

Situation	Goal	Solution
Phase 1. Discover Keywords in the Text (see G3↓ in the figure below using the workbook, *KDTF Interviews Word Analysis.xlxs*)		
14 interviews gave 9,767 **words** in 107 dimensions	Reduce the words needed to group dimensions into 5 - 16 clusters.	To list the words, copy the text into MS Word, remove punctuation, replace spaces with ^p, sort, copy to Excel, and have it count.
1,815 different **word counts**	Find the most meaningful words.	Eliminate function words and diverse word forms. Then count roots.
875 **roots**	Reduce number of roots.	Choose roughly 100 most common roots.
Phase 2. Use N-CRIX to Discover Clusters of Dimensions (mine text data like big corporations with *Clustering-KDTF.xlxs* in figure) [2]		
112 **keywords** (L2→)	Assign each dimension to a cluster.	Assign to clusters arbitrarily (B3↓).
25 **arbitrary clusters** with 4 or 5 dimensions each	Measure how strongly each dimension is connected to its cluster (see L3↓→).	For each pair of dimensions in each cluster, Excel compares the observed number of common keywords (o) to the expected number (e) using $(o-e)^2/e$, then averages over all dimensions in the cluster.
107 **connection strengths** (in new "Cluster" sheet)	Find a better cluster to assign each dimension to.	Excel ranks each dimension's connection strength to each cluster, then improves clusters by reassigning it to its lowest ranking cluster.
Up to 25 **improved clusters**	Measure the system quality.	Excel finds the average of the average ranks for improved clusters.
1 **system average rank**	Account for every dimension move changing all expected values.	A macro reassigns dimensions to their best fitting cluster until the average system rank does not get smaller (see "Iterations" sheet).
14 **coherent clusters**	Account for some dimensions assigned to a lower ranked cluster.	Interpret definitions to reassign one dimension at a time to a cluster (K2↓) that improves the average rank of all clusters.
14 **interpreted clusters**	Name the clusters .	The "Cluster keywords" sheet finds keywords that discriminate best.
Phase 3. Refine the Definitions for Levels within Clusters		
14 **named clusters** with ~800-word definitions	Get levels for each of the clusters.	Combine the definitions for each level for each cluster (see "Groupings" sheet).
56 **cluster levels** (4 levels for each named cluster each with ~200 word definitions)	Shorten the definitions of levels.	Write 40-word abstracts (see Abstracts sheet): keep common details with least words and emphasize verbs. If N-CRIX misplaced a dimension with unusual wording, exclude it.
Phase 4. Improve Sharing of Meanings Among KDTF Contributors (see results in attached pages)		
Experts attend to different parts of **level abstracts**.	Distinguish the generality of parts of definitions.	Move the more detailed sentences to an EXAMPLES section. Move negatives to positives at lower levels.
Even **20 word definitions** are difficult to talk about.	Make the levels easier to remember and discuss.	Name each level with one or two keywords.
Some ambiguity left with **named definitions**.	Better share the meanings.	Engage in ratings workshops: Read articles, discuss discrepancies, decide if definition needs improvement or a rater missed something. If the former, revise definitions by consensus.



[1] See Knowledge Development Task Force (KDTF) contributors noted in the attached developmental rubrics.

[2] Network Clustering through Ranked and Interpreted Connection Strengths (N-CRIX). For free copies of the two MS Excel workbooks and help using them, contact **ddirlam@changingwisdoms.com**. Also, see chapter 4 of *Teachers, Learners, Modes of Practice: Theory and Methodology for Identifying Knowledge Development.* (get flyer for 20% discount or order from www.routledge.com/9781138641181).

Developmental Rubrics for the Assessment of Learning in Higher Education

June 7, 2018

AALHE Knowledge Development Task Force (KDTF)[i]

Modes of practice for all multiple choice items: a. Beginning, b. Exploring, c. Sustaining, and d. Inspiring. The modes of practice are levels only of complexity and not of quality. Less complex modes will usually be included within more complex modes. Together, the two "usefulness" items at the end act as a holistic rating of quality. Each description for each mode within each cluster has several procedures, the less general listed as EXAMPLES. But the article should clearly contain the defining procedures of the mode you assign to it. Most items refer to what readers were advised to do with the articles, However, items listed under "Specifying What Was Done" and "Methods Used" refer to what was done. Compare levels above and below to make sure that the one you chose has the best fit. These rubrics have been tested on randomly selected articles from the last 20 years. We propose them also as tools for guiding the development of and evaluation of program assessment processes.

Cluster	Beginning	Exploring	Sustaining	Inspiring
FRAME THE PROBLEM				
Function Of Assessment	PRECONCEIVED: Irrelevant or weeding out students who aren't learning. *EXAMPLES: Rigid preconceived ideas like valid and reliable, multiple choice testing, that misses what students find interesting. Have no data, just a plan.*	EVALUATING: Ways to uncover if teaching is working. Look for and read assessment literature about needs and effects rather than outcomes. *EXAMPLES: Engage in convenience sampling using open-ended responding or performance checklists as outcomes.*	CLARIFYING: Identify student learning, both intended and unintended effects of programs. *EXAMPLES: Support good citizenship. Help students meet expectations and fulfill future career needs, even by using flawed (but reasonable) samples. Identify threats without always finding solutions.*	ADAPTING: Create learning organizations by identifying how to change institutional environments to meet current demands. *EXAMPLES: Identify unexpected kinds of learning (how to thrive) and their future contributions by collecting samples (authentic or virtual) that represent student behavior enough for the inferences made.*
ENVISION SOLUTIONS				
Knowledge and Learning	RECALL: Memorized answers regarding discipline specific content and regenerated on tests. *EXAMPLES: Focus on what instructors are teaching or hope students will understand better. Understand assessment as testing resulting in grades.*	ACTION: Clarified expectations of students' knowledge, values, and skills using measurable, observable, performance-based assessments. *EXAMPLES: Use writing, speaking, and doing scored with defined expectations like rubrics. Create processes to discover student learning using actions, behaviors, or applications resulting from knowledge retention.*	PRACTICE: Practices that are foundational for student futures, demonstrated in authentic situations in ways that students want to show. *EXAMPLES: Use qualitative methodologies like interviews or conversations. Confront problems with conflicting direct vs. long-term applications (healthiness vs. profit).*	PROCESSES: Lifelong improved thinking and learning processes. *EXAMPLES: Select, respond to experience, analyze, interpret, create, imagine, plan, make, rehearse-evaluate-refine, perform, present. Develop theories for assignments that "scaffold" understanding.*
Conceive Teaching	DISSEMINATING: Knowledge dissemination and assessment steps. *EXAMPLES: Lecture on facts. Collaboration means asking for interest in projects or giving lectures. Attend a required presentation from the center.*	INTERACTING: Interaction, feedback, adapting to student needs, interests, and ability to repeat back. *EXAMPLES: Collaboration means coming together to talk about what instructors do with students. Bring a problem to the teaching-learning center.*	DEVELOPING: Create learning environments where students discover and expand their capabilities. *EXAMPLES: Link pedagogy to development. Use rubrics in instruction. Collaboration means discovering together how to help students, being analytic, open, respectful, unafraid to explore.*	LIFE ENRICHING: Include projects, life preparation, correcting misunderstandings, developing social knowledge to challenge traditional interpretations. *EXAMPLES: Take risks to ensure students grasp foundational concepts. Work on goals nonjudgmentally from different perspectives. Provide solutions that build on one another. Adjust instruction using student data, cues, behaviors, or curiosity.*
SPECIFY WHAT WAS DONE				
Help People Organize	CONVERSATIONAL: Have conversations that champion assessment and talk about strategies. *EXAMPLES: Focus on how well textbook content was disseminated. See policy as a way of getting people started and program reviews as needing a basis in assessment.*	PURPOSEFUL: See policy as helping develop a realization of assessment's usefulness and forcing faculty to consider their purpose. *EXAMPLES: Create resources that people can access. Connect theory from their field or their own experience. Realize there may be differences.*	SYSTEMATIC: Develop a system for guiding people in assessment. *EXAMPLES Facilitate everyone's assessment, create projects they find useful, and identify components or criteria for fuzzy things. Build relationships. Develop culture. Teach people to self-assess and improve.*	MODEL-BASED: Build structured models that help people attach theory within their field or knowledge of their own development to the model, seek new ways to apply it, and distinguish important concepts. *EXAMPLE: Help institutions become learning organizations.*

Cluster	Beginning	Exploring	Sustaining	Inspiring
Develop Learning Measures	AMBIGUOUS: Produce ambiguous outcomes from multiple loose definitions. *EXAMPLES: Use grades. Assign numbers to outcomes and sum weights. Find percents of students achieving SLOs. Write narrative descriptions. Select tools that nominally sound like what programs want to measure.*	GENERIC: Provide generic measures only loosely connected to PSLOs and identical for multiple criteria. *EXAMPLES: Measure inter-rater and test-retest reliability. Add options to use multiple measures to define the quality of learning happening.*	ARTEFACTUAL: Use classroom artifacts from representative students assessed by faculty using tools with measurable reliability that discriminate levels of student experience defined by outcomes. *EXAMPLES: Help faculty or students identify parts of tests or rubrics that relate to their objectives.*	MULTIPLE: Compare multiple measures of student performance. *EXAMPLES: Articulate student outcomes. Align them with measures. Co-create measures with faculty. Create high quality instruments close to what faculty envision for the program.*
Quality of Learning Measures	OPINIONS: Measures indicate assessors' own satisfaction or ease of use. Rely on face validity. Overlapping categories only generally relate to learning. Measure learning assuming that their own categorizations are fixed. *EXAMPLES: One dimensional, product rating scales and subjective grades.*	PARAMETERS: Argue for statistical validity without considering other demonstrations of learning. Consider intra-rater reliability. *EXAMPLES: Standardized tests, which combine distinct information into a single score, and multiple-dimension, Likert scales.*	SUCCESSIONS: Measures indicate relative strengths or frequencies over time of competing practices, strategies, or institutions Consider cultural, gender, behavioral, and economic, contexts. Defend content validity by descriptive completeness. Consider inter-rater and test-retest reliability *EXAMPLES: Developmental and historical recording and coding.*	NETWORKS: Measures indicate links between categories that identify insights and innovations affecting diverse, independent adopters. Ecological validity emerges from consensus-building with common experiences. Consider cross-context reliability. *EXAMPLES: Collaborative communities, action research, and diffusion of innovation.*
APPLY METHODS				
Collect Data	SUMMATIVE: Assess programs by rating work from only one course (usually at the capstone level). *EXAMPLES: Throw information into cells. Use averages and say students are above average. Look at the minima needed for accreditation.*	FORMATIVE: Collect data for outcomes at entry, midpoint, and capstone courses. Map outcomes to courses. *EXAMPLES: Include in syllabi kept on file. Refresh curriculum map biennially. Interrelate SLOs, curriculum maps, instruments (validated rubrics, tests), and data collection design.*	PROGRAMMATIC: Collect data at least once per course. Map learning and development across the curriculum. *EXAMPLES: Align assessment vertically (scaffolding levels) and horizontally (across sections). Check on improvement longitudinally. Tweak methodology (multiple raters). Define schedules that cycle through outcomes.*	INTERACTIVE: Collect data from spontaneous faculty-student interactions in all courses. *EXAMPLES: Seek data complex enough to inform curriculum improvements and build common understandings of developmental levels of learning. Faculty complete course design surveys with multidimensional checklists stored in common database.*
Analyze	SUMMARIZING: Apply any approach that summarizes the data. *EXAMPLES: Rely on mean scores to generalize to individuals in the population. Focus on one or two comments. Take descriptions at face value. Miss essential aspects (what, how, when, where). Expect people to ignore methods.*	DIFFERENTIATING: Differentiate approaches for different purposes and populations. *EXAMPLES: Do thematic analysis. Turn rubrics and category scores into numbers and average them. Consider multivariate, mixed, and reliability methods. Make conclusions from invalid methods.*	CATEGORIZING: Drive the sustaining of practice through utility, intelligibility (understanding), familiarity, acceptability, meaningfulness, and accessibility of approaches. *EXAMPLES: Create categories and count frequencies. Look at frequency distributions. Use qualitative data.*	SYNTHESIZING: Demonstrate Impact by applying advanced analytical research tools that are not normally used by instructors. *EXAMPLES: Use big data analytics, Bayesian analysis, grounded theory, or network theory.*
IMPACT OF IMPLEMENT				
Create Meaning	CONVENTIONAL: Focus on form of learning outcomes over function as descriptors. *EXAMPLES: Copy their imagined assessments like institution's grade, compliance, policies like ensuring everybody does it. Generate questionnaires with too few/many questions (often Likert scale). Run amateur focus groups.*	ACCESSIBLE: Make assessment accessible to all including those uncomfortable with directed learning. *EXAMPLES: Promote data appropriateness for questions asked. Shift assessment to faculty. Examine learning environments and things standardized tests miss. Develop institutional capacity and cultural awareness to assess learning meaningfully.*	INFORMATIVE: Design sustainable assessment processes to produce information. Seek outcomes and measures that enable observations of complex learning and transcend each participant's knowledge. *EXAMPLES: Promote discerning how disciplinary learning transcends content. Differentiate learning qualities. Deliberate higher education's purpose.*	ENGAGING: Reframe assessment, curriculum, and instruction as designed, guided and integrative processes of creative engagement with learning experiences, past, present, and future. *EXAMPLES: Use transformative moments to both measure learning and assess experiences. Enable student contributions to the design.*

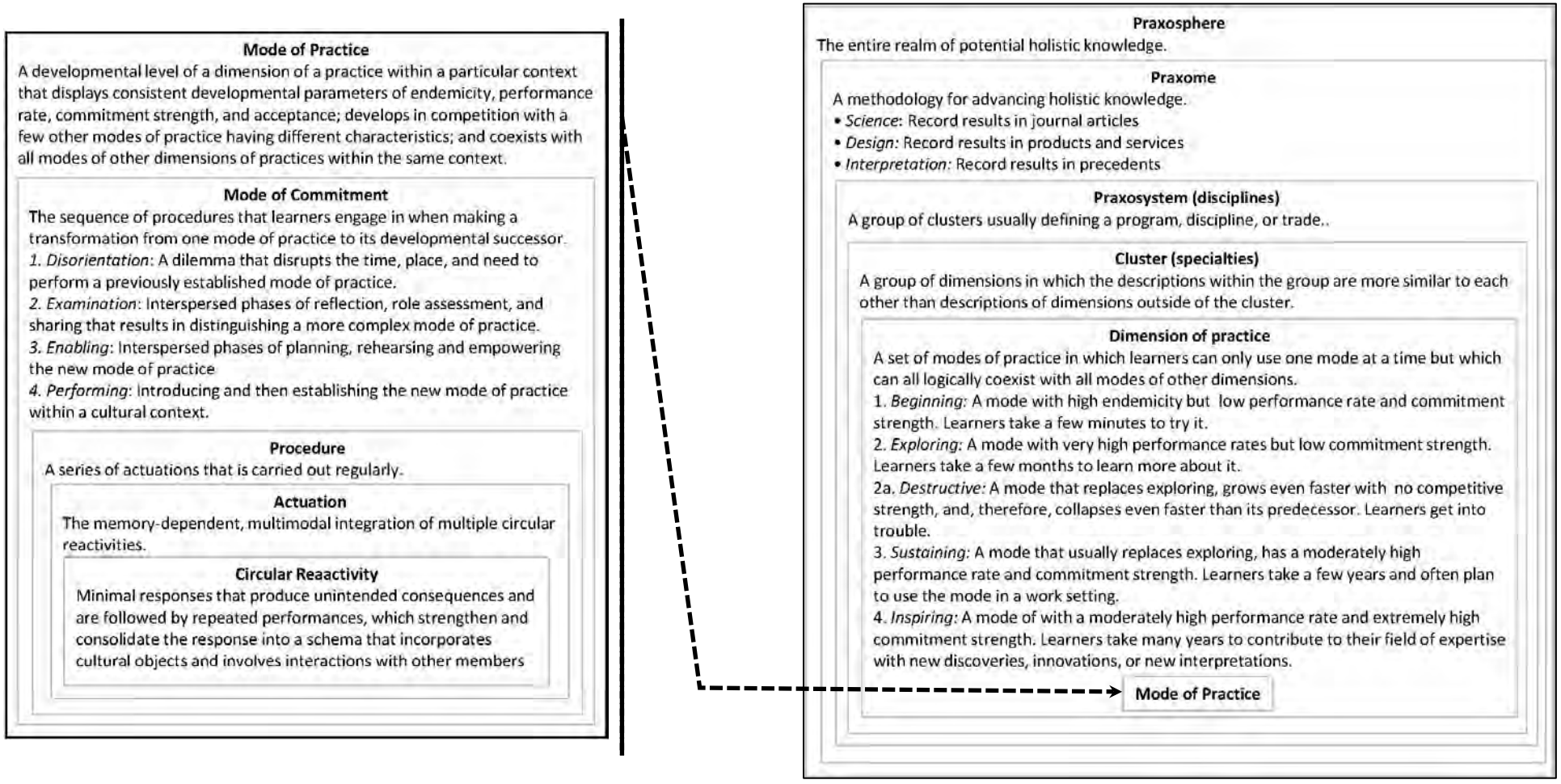
Cluster	Beginning	Exploring	Sustaining	Inspiring
Apply Results	CONFIRM: Seek test scores, assignments, surveys, dropout rates, and grades relating to factual knowledge that confirm their approach. *EXAMPLES: Seek external benchmarks to show how student achievement measures up with others on a test.*	QUESTION: Ask questions leading to deeper dives into other data sources and meaning. *EXAMPLES: Consider historical records. Ask why some students are unhappy with grades or feedback, how to improve performance, if student numbers and quality are optimal.*	COMPARE: Examine qualitative information that integrates meaning-making beyond knowledge and skills. *EXAMPLE: Use student comments and focus groups to improve beyond evaluation-point scores. Consider relevance, purpose, transfer, and usefulness. Include enrollment, faculty reinforcement of standards, and course durations.*	INTEGRATE: Obtain regular assessment integration into the instructional process. *EXAMPLES: Present assessment questions during instruction through technology, interactive media, or adaptive testing (questions vary based on student responses).Ask about assignment content validity and common understandings of outcomes (inter-rater reliability).*
Identify Innovations	PROCEDURES: Help faculty identify program outcomes and assessment plans (methods, data collection schedule). *EXAMPLES: Comply with college, federal financial aid, or accreditation requirements. Use story format to describe what was done, found, and value gained by students from the program.*	CRITIQUES: Critique areas for potential curricular innovation or assessment improvement. *EXAMPLES: Discover consistent findings and work with stakeholders to create new approaches. Demonstrate program accomplishments. Describe trends using outcomes, means of assessment, results, and use of results.*	ENHANCEMENTS: Identify questions about programs and curriculum that assessment could elucidate, especially what instructional approaches are most effective. *EXAMPLES: Compare new with prior results. Relate program recommendations to them. Find common themes across problems. Integrate academic, co-curricular, and program review.*	COMMUNITY: Show how assessment relates to institutional and public priorities. *EXAMPLES: Find and test new ways to have impact on students that endure for decades and generate emergent effects. Use societal trends and research literature to identify program needs.*
Report	COMPLYING: Write an annual report with statement, methods, evaluate, results (unrelated to SLOs), which only the writer sees. EXAMPLES: Check off completion for accreditation or institutional board without considering implications or seeing the benefits.	DISCONNECTED: Report diffuse results at program meetings with somewhat disconnected suggestions *EXAMPLES: Propose hiring more faculty or increasing time on topics of deficiency. Copy SLOs from similar programs or identify hoped-for students gains. Program reviews build assessment commitment.*	PREDETERMINED: Faculty consider results to guide curricular/ instructional interventions to increase only student behaviors they intended. *EXAMPLES: Results may reflect cohort snapshots of student learning but untied to student experience. Develop SLOs post-hoc, but represent program. Report results and propose improvements to non-programs stakeholders.*	ENVISIONING: Help faculty clarify vision articulated in SLOs of program impacts on learner knowledge, thought, or action. *EXAMPLES: Develop deeper, "aha" understandings of faculty-learner connections across multiple categories (social relationships, jobs, courses). Propose interventions linked to SLOs and results.*
Query				
Process Leadership	LEADER FOCUSED: Design the assessment frame by a themselves- using their own mental model of assessment. *EXAMPLES: Validity and personal biases are not considered.*	CONVENTIONAL: Research and advocate for using published frameworks. *EXAMPLES: Collect data using validated rubrics. Conduct collaborative workshops starting with published rubrics to create localized versions.*	COLLECTIVE: Create ownership of the whole curriculum. *EXAMPLES: Build around the curriculum map to enhance validity, with a regular review cycle. Perfect it over time. Design program review so that departments refer to their curriculum maps. Seek to*	PROCESS LED: Use processes systematically that give faculty something they feel intrinsically tied to. *EXAMPLES: Use data in different ways. Design curricula that build development as well as transfer knowledge and practice across the curriculum and often to life, through creative and effective teaching strategies.*
Institutional Involvement	UNSTRUCTURED: Use unstructured processes, guided by threats and external requirements *EXAMPLES: Use the accreditation threat. Describe the process in general terms but apply it to only one expertise. Promote the benefits of assessment. Limit planning to putting learning outcomes in courses.*	RECOGNIZING: Identify institutional inhibitions to the culture of assessment *EXAMPLES: Point to lack of commitment and rewards. Seek recognition for assessment as research for tenure. Deliberately set aside resources. Define expectations for quality assessment and consequences for not meeting them.*	ADMINISTERING: Help institutions recognize they need a clear sense of learning. *EXAMPLES: Seek everybody being involved so that assessment permeates the educational experience and student commitment. Use assessment to manage resources. Get on administration and Faculty Senate meeting agendas.*	PLANNING: Foster understanding that assessment helps to plan, implement review findings, discern what's missing, and document progress. *EXAMPLES: Integrate university level learning outcomes into all disciplines. Faculty members do course reflections. Use results formatively throughout the term and for annual reviews.*

[i] AALHE Knowledge Development Task Force, David Dirlam and Teresa Flateby, co-chairs. Interviewees and rubrics refiners included the co-chairs plus Frederick Burrack George Smeaton, Yuerong Sweetland, Arthur Hernandez, and Joseph Sullivan. Interviewees also included Moreen Carvan. Catherine Wehlburg, Susan Perry, Jennifer Sweet, and Keston Fulcher.

Praxomics Nested Hierarchy of Units*

David Kirk Dirlam

The study of knowledge that includes potential or actual agents, purposes, situations, cultures, and planned or performed actions by focusing on modes of practice, their constituent components, and their superordinate groupings as studied through scientific methods, product and service design, and interpretation of text and experience.

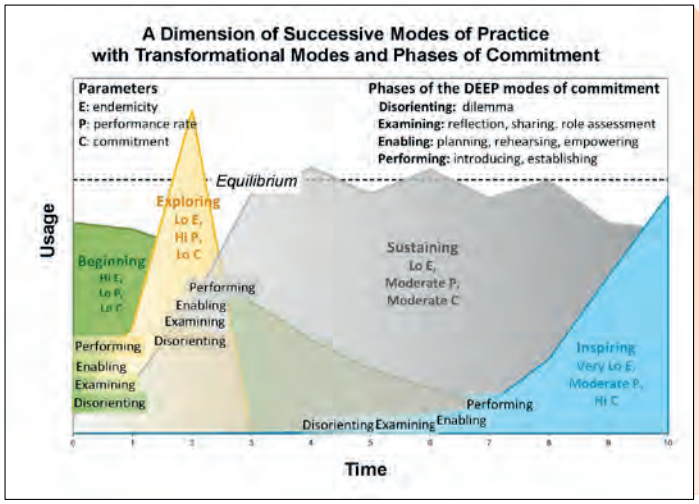


* From Dirlam, D. K. (3/6/2017). *Teachers, learners, modes of practice: Theory and Methodology for Identifying Knowledge Development. New York: Routledge/Taylor & Francis*

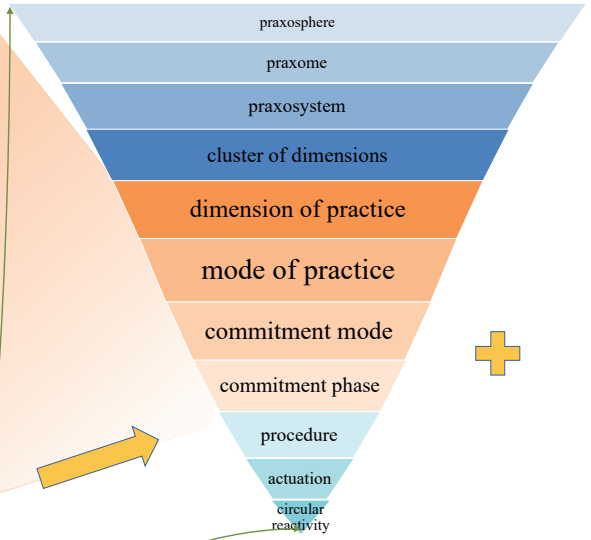
Organizing Cognitive Research Questions with an Eleven-Level Nested Hierarchy of Practice*

North Carolina Cognition Conference, NCCC, 2017

David Kirk Dirlam, Ph.D.



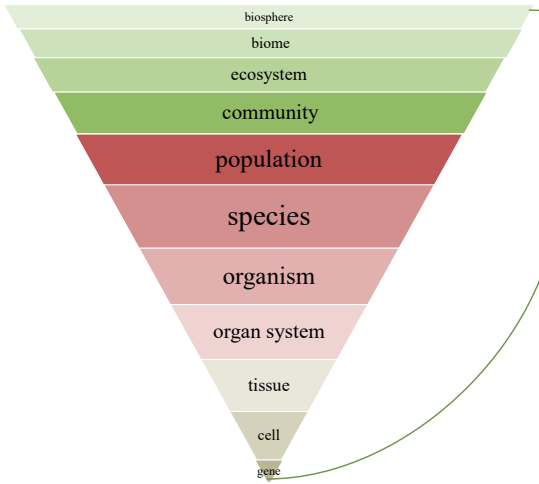
The Nested Hierarchy of Practice



Methodological Implications

Cognates	Observables	Inferables
Holistic knowledge	Integration of known praxomes	Civilization
Progressive methodology	How experts make discoveries, innovations, or precedents	Culture which individuals seek to preserve and enhance
Discipline	Common discipline or trade (c.f. 4-digit ISCO code)	Formation of community with which individuals identify
Specialty or sub-discipline	Keywords used for description	Common identification as specialty
Course levels	Beginning, exploring, (destructive), sustaining, or inspiring practice	Endemicity, performance, and commitment.
Competency	Deliberate practice (c.f. Ericsson)	Giant component of integrated procedures
Learning goal	DEEP modes of commitment	Vision, implementation, collaboration
Learning outcome	Phases within DEEP modes of commitment (c.f. Mezirow)	Intentional response
Learning objective	Repetitive performance	Long term memory
Schema	Integration of sensorimotor systems	Short term memory
Conditioned social response	Cultural objects and persons	Sensations and surprise (c.f. Piaget)

Biological Analogy



Selected Praxomics Research Questions

Praxosphere: How can we quantify changes in the praxosphere?
Praxosphere. What criteria will distinguish human from machine modes of practice?
Praxome: Are there more praxomes (progressive methodologies) than science, design, and interpretation?
Praxosystem: How are resources replenished and stored for different modes of practice?
Cluster: Do inspiring modes of practice sustain exploration?
Dimension: What is the rate of flow of the common modes of practice from one dimension to another?
Mode of Practice: Are mutually beneficial modes of practice affected by the design of praxosystems?
Mode of Practice: What impact does the flow of common modes of practice have on discovery, innovation, and interpretation?
Mode of Commitment: How do the modes of commitment change over time?
Mode of Commitment: What characteristics of procedures facilitate or inhibit adaptation to new modes of practice?
Phase of Commitment: What starts, stops, or redirects transformative learning?
Procedure: Can the rate of oscillation between modes be an indication of acquisition problems?
Actuation: How have the actuations changed across time and cultures?
Circular Reactivity: How many circular reactivities are there?

* from Dirlam, D. K. (2017). *Teachers, Learners, Modes of Practice: Theory and Methodology for Identifying Knowledge Development.* (see www.routledge.com/9781138641181)

How Modes of Practice Revolutionize Learning and its Assessment

David Kirk Dirlam, Ph.D.

Author of *Teachers, learners, modes of practice: Theory and methodology for identifying knowledge development.* Routledge / Taylor & Francis, 2017.

Abstract: Current concepts of learning fail to reliably discriminate outcomes, competencies, and objectives or to establish a methodology to enrich that discrimination. This presentation distinguishes:

- Research methods for cells, species and ecosystems.
- Research methods for outcomes, objectives, and competencies.
- Problems with communicating to faculty what to do with outcomes, objectives, and competencies.
- How faculty roles would change if their terminology, theory, and research methods resembled biology's clarity.

The presentation rigorously defines modes of practice, describes their use in developmental interviews, and distinguishes practices from commitments. Next, it discusses what people need to get started using modes of practice. The presentation ends with a discussion of future uses of the mode of practice concept for collaboration, course design, cultures of learning and teaching, research on the nested hierarchy of practice, and the organization of knowledge into praxomes of science, design, and interpretation.

Introduction

A few weeks ago I visited Colonial Williamsburg in preparation for writing a new book on *Taming intelligence: Tools for managing knowledge explosion and technological unemployment.* As I stopped in each trade shop, I asked the artisan what happened to their trade during the industrial revolution that followed 1776. Apprentice weaver Aubrey Moog told me about the Englishman, John Kay and his flying shuttle. The shuttle is a device for passing thread through the alternating long strands of the warp. On a large, industrial loom, it took two weavers to pass the shuttle. They used it like a relay baton with a handoff between weavers on each side of the loom. After John Kay added wheels, one weaver could throw it through the alternating strands of the warp. Soon, manufacturers created much wider looms. Even with these, a single weaver would both pass it across and catch it on the opposite end. And the pass was many times faster than the handoff. The decreased labor costs and larger products proved very lucrative for manufacturers. Despite their landslide profits, they ganged up on Kay. They created "the Shuttle Club" to resist paying him for his patented device. To make matters worse, the weavers, half of whom lost their jobs, burned his house down. He died mostly destitute in France.

If job gain is all that higher education offers, bootcamps[1] or online courses[2] could become the flying shuttles for higher education. The explosion of knowledge will not go away and artificial intelligence will accelerate technological unemployment. If job gain is all we accomplish, we can expect higher education institutions to become as empty as European cathedrals, their ivy towers relics of a past way of life.

Most higher education institutions insist that their missions are not just employment. Nearly all promote some version of lifelong adaptation, collaboration, and service. The public as well as accreditation and government institutions are becoming increasingly aware that our current approaches are vague and haphazard. To accomplish our missions, faculty need to document learner practices, enable transformative learning, and teach students how to manage complexity. This will require a revolution in higher education

[1] Ranging from computer coding to higher education assessment.

[2] E.g. Khan Academy, Udacity, or Coursera.

that integrates learning and assessment in a much more planned, tested, and systematic way than now. The revolutionary approach that accomplishes this is Real Time Developmental Education (RTDE).

Goals of this Presentation

Few of us are aware of how sadly inadequate our current terminology is for describing learning. So, the first goal of explaining RTDE must be to make clear the failure of our current terminology.

Only hit-and-run approaches make failures clear without offering alternatives. So, the next goal is to introduce a dozen new terms for describing learning. These include a dozen key concepts. There are five modes of practice, four types of transformative teaching, and three levels of complexity.

We need *modes of practice* because people no longer trust teachers simply to grade learning with a five-point rating of their students' accomplishments. Parents, employers, and co-workers must be able to distinguish what they have learned. Descriptions of how the five modes of practice differ from one dimension of learning to another accomplish this.

We need *transformative teaching* because "Needs improvement" is no longer adequate for describing what a student needs to do to acquire the next mode of practice in any dimension of learning. Transformative teaching involves supporting students in making four successive commitments needed to establish any new mode of practice.

We need *levels of complexity* because it takes much more time and effort to acquire some dimensions of learning than others. We cannot adequately compare the impact of educational approaches until we have a clear basis for comparing the complexity of what has been learned. Three levels of complexity begin to make such comparisons possible.

For anyone who has experienced them, learning the vocabulary in introductory courses in languages, sciences, or the arts barely enables students to explore the field further. So the third goal of this Presentation is to show how to use the twelve concepts during the real work of education.

No revolution endures without continual development. So the fourth goal of this Presentation introduces three seminal projects designed to inspire advances in RTDE.

Beginning the Change

Goal 1: How Bad are our Descriptions of Learning?

When there are no contexts for comparisons, it is easy to lapse into using terminology without reflection. To help us reflect on our current concepts, we can put them into a context from the history of science. For at least a century and a half, chemists have not bothered with the classifications of elements that ancient civilizations produced. Those included air, earth, fire, and water. Even people with little education could reliably tell one from the other. It would seem ridiculous for an expert to call earth "water" or air "fire." So what happens when we use our current elements of learning? Competencies, outcomes, goals, and objectives are popular terms. Even experts sometimes call outcomes "objectives" or competencies "goals."

Greek elements led to little improvement, but a new terminology changed chemistry. There was so much progress in identifying chemical elements in the first century after the discovery of oxygen that Mendeleev was able to create most of the modern periodic table nearly 150 years ago. Like the Greek elements, many reviewers[3] claim that little or no progress has been made in basing education on

[3] E.g., see Morcke, A., Dornan T, and Eika, B. (2013). Outcome (competency) based education: an exploration of its origins, theoretical basis, and empirical evidence. *Advances in Health Science Education, 18*, 851–863.

outcomes, competencies, goals, or objectives since Tyler first proposed the idea in 1949. The problem is that we began with no terminology that adequately distinguishes types of learning.

It is not just the concepts, but also the methods and equipment. Chemists do not confuse particles, elements, and molecules. Likewise, biologists do not confuse cells, species, and ecosystems. In both cases they also study them in radically different ways. To study cells biologists use microscopes, cell culture, staining, centrifuges, protein extraction and many other methods. To study species they use description, reproduction, hybridization, evolution, and paleontology. They study ecosystems through production, energy flow, nutrient cycling, and biodiversity. But if we try to tell the different ways we study competencies, outcomes, goals, and objectives, we come up empty. Our descriptions of learning are bad.

Goal 2: The Twelve Key Concepts of RTDE

Five modes of practice

We can tell what people have learned by observing what they usually do. Learning is either gradual or transformative. Gradual learning results in incremental improvements in the speed and accuracy of performance of a mode of practice. Transformative learning produces a discontinuous change to a more sophisticated mode. Experts readily identify how sophisticated each learner's modes of practice are. Dirlam (2017) reported on 300 interviews of experts in several scores of disciplines. These showed that learners progress through five fundamentally different modes of practice. A fascinating finding was that such progress holds for highly complex, historical processes occurring over many decades as well as for individual learning occurring over a few years.

Whatever the scale of development, *beginning* takes a few minutes to try something. Next, *exploring* takes a few months to learn the basics of a field. It takes a few years to become proficient enough to *sustain* learning. Reading any daily newspaper provides evidence that some learners follow *exploring* or *sustaining* practices with *destructive* practices. Finally, to perform *inspiring* modes of practice requires many years of work on discovery, innovation, or reinterpretation.

Four modes of commitment

The late Jack Mezirow identified 10 phases of transformative learning. As reported in last year's proceedings, (Dirlam, 2016) analyzed 500 ratings of one-on-one student learning sessions. The 10 phases occurred at only four different times. The descriptive terms given these four time periods were *disorientation*, *examination*, *enabling*, and *performing*. Together they became the DEEP modes of commitment. Examination included Mezirow's phases of reflection on a disorienting dilemma, assessing one's role in it, sharing it with others, and discerning a new course of action. Enabling involved planning, rehearsal, and empowerment. Performance can be either initiating or establishing.

Three praxomic levels

Praxomics is a new discipline proposed in Dirlam (2017) that is concerned with the description and analysis of practices. It distinguishes 11 levels of complexity for practices that are analogous to biology's 11 levels of units ranging from genes and cells to ecosystems and the biosphere. For practices, the 11 levels fall into 3 major categories. Learning vocabulary is different from having a conversation, which is different from writing a published paper. Following a recipe is different from planning a menu, which is different from managing a restaurant. Playing notes on a musical instrument is different from playing an entire piece for an audience, which is different from staging a performance by an ensemble. In each case, the first activities are merely *repetitive*. But since the next require changes with the settings, they are *adaptive*. For the third types, *collective* activity of an entire group is necessary.

Goal 3. Exploring How to Use the New Terminology in Education

How would assessment change if the terms, theory, and methods were as clear as biology's? The first answer is that we would use a straightforward, easily learned theory of development. We would replace global stage theories with multidimensional successions of practices. There would be no global concept of dimension, since we would understand that no one advances to the later levels of the thousands of dimensions involved in human expertise. We would recognize that each dimension would not change in lock step with other dimensions. Rather it would develop based on the unique patterns of the initial prevalence, growth rate, and competitive strength of each practice in the dimension. Furthermore, we would recognize that each mode of practice does not change instantaneously into its successor. Rather a complex process produces the change through first examining the old practice and then enabling the new. During this process, vacillation between the old and new practices is common. In short, we would replace oversimplified concepts of development with concepts that match our experience.

Figures 1 and 2 capture the general theory of development outlined above. Figure 1 gives a single dimension of development. Figure 2 puts multiple dimensions together. On the left, there is a developmental survey for dimensions of drawing development. On the right are data from ratings of over 1,200 drawings made by pupils aged 5 to 19. The dotted lines show the curves for the values of initial prevalence, growth rate, and competitive strength that fit the raw data best.

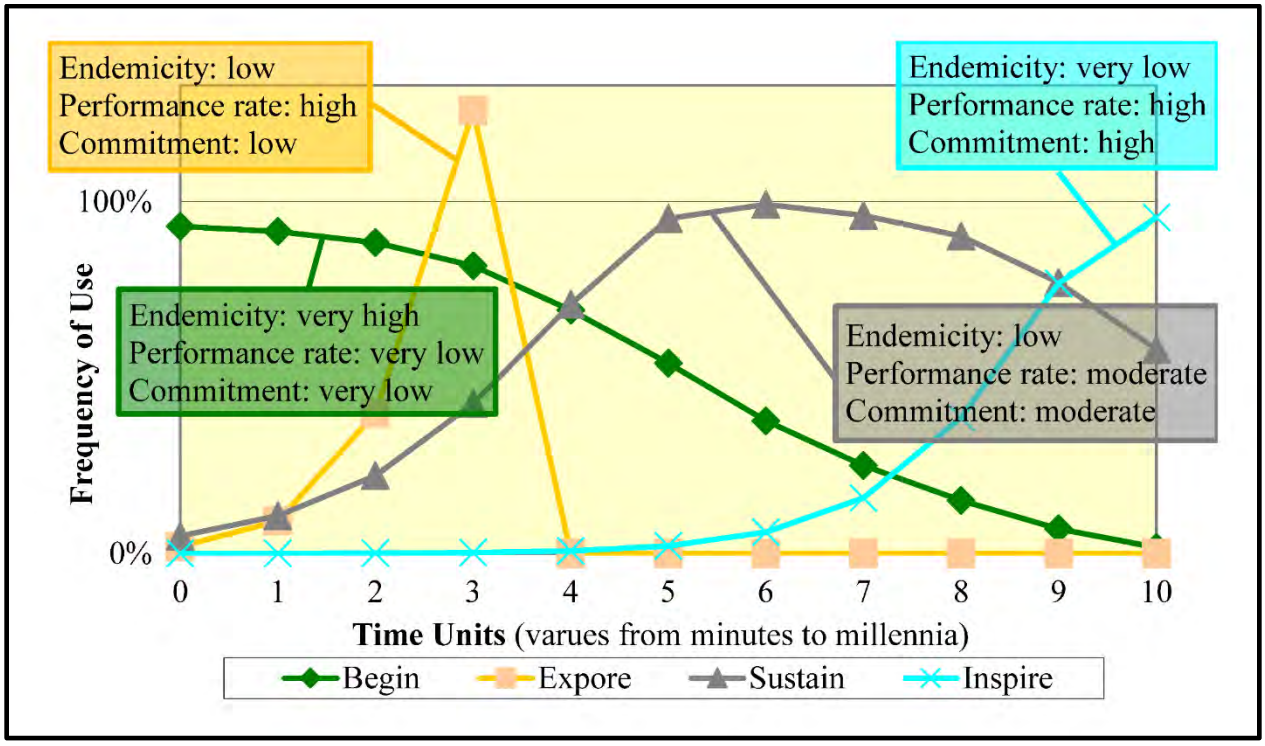


Figure 1. One Dimension of Successive Modes of Practice

The next answers to how assessment would change have to do with methods. One outcome of interviews with 80 designers in 20 fields of design was a powerful concept of the development of collaborative skills. From designing a building or creating an interactive game, collaboration begins when students discover what a peer knows that they do not. There is a division of labor in higher education that interferes with such discovery. Instructors define objectives, program faculty define outcomes, and national organizations create tests and rubrics. The first change in methods would be to enable collaboration by aligning these functions. All instructors in a program would agree on the developmental dimensions through a process of cascading developmental interviews, where each both interview one

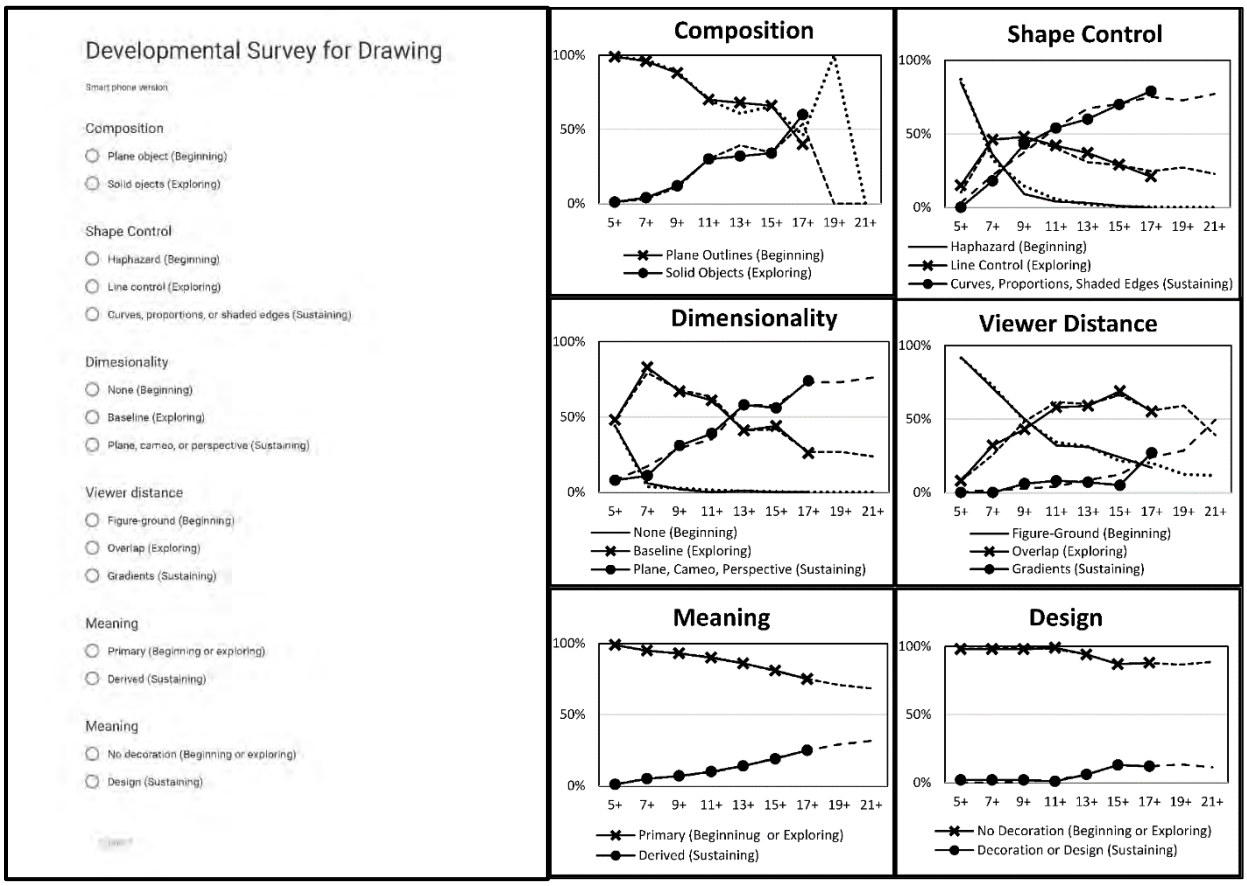


Figure 2. A six dimensional developmental survey for drawing beside data from over 1,200 drawings.

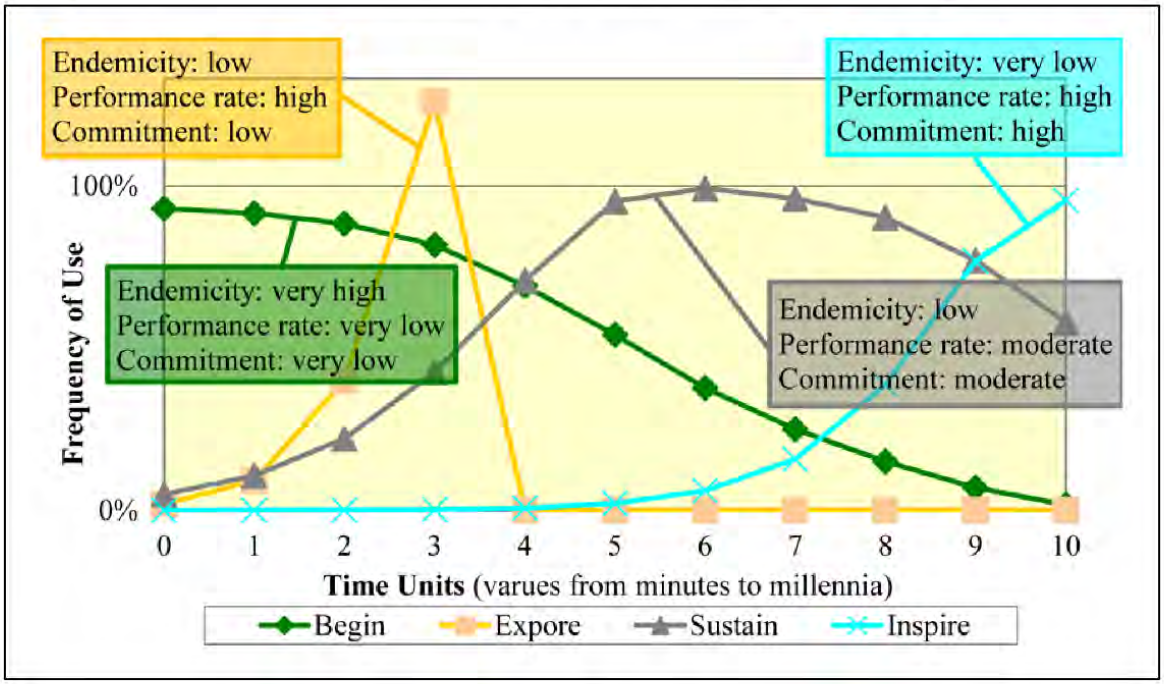
colleague and are interviewed by another. Then course offerings and levels would be defined in relation to the collaborative dimensions. In addition, all courses would use the same developmental survey to record the developmental progress of each student in the program, for all students at all levels.

Decades ago, colleagues used developmental surveys for student writing and even for the historical development of developmental researcher's strategies. In the last decade we have added over 60 different programs with our results detailed in Dirlam (2017). One of the more striking findings from this work is a new conception of general education. It started with ninety developmental interviews of liberal arts faculty in 30 disciplines spread across the three divisions of sciences, humanities, and social sciences. Nearly 600 dimensions came from these interviews and data analysis resulted in 25 clusters. Since 8 of those clusters were common to all three divisions, a logical result might be to frame general education according to those clusters. Table 1 shows the 8 clusters. Notice that neither bootcamps nor online education offer much in service or research.

Figure 3 shows the developmental interview tool. Some interviewees like to see it ahead of time. We usually begin the interviews with a five-minute description. It helps faculty to think about beginning as the first day of an introductory course in the program. Exploring includes the lower (associates) level courses that depend on the introduction. Sustaining is what the program expects for the baccalaureate level. Inspiring occurs for a few dimensions at the masters level and for all dimensions at the doctoral level. During the next five or ten minutes, most interviewees brainstorm. That is a good time to write down ideas they have mentioned as possible dimensions.

Developmental Interview Tool

This tool will help you and a developmentalist create a development theory of your field. When combined with interviews of other experts, the result will be developmental rubrics for the whole program. We seek to identify several dimensions of four modes of practice that learners use: (1) *beginning*, (2) *exploring*, (3) *sustaining* and (4) *inspiring*. Fast growing, exploring strategies may overshoot cultural support and cause the activity to be abandoned. Each dimension focuses on a different aspect of what learners do and how the four practices differ. You will have a chance to edit the notes taken during the interview.



Mode of Practice Examples: Drawings Research Analysis	**Beginning** Scribbles Descriptions	**Exploring** Stick people Descriptive stats	**Sustaining** Sketches Difference stats	**Inspiring** Fine art Math Models & Networks
Learning Time	Minutes	Months	Years	Decade+
Dispersion	Personal (1-3 relationships)	Collaborative team (5-12 people)	Work or friendship groups (100s)	Marketplace (1,000s-millions)
Effects	Peripheral Participation	Take little practice; get some reward	Enable living wages but no excitement	Enable Discoveries
Helpful Prompts	What do people do in first class?	Overuse by graduates would be discouraging.	Save this for last.	Use by learners would be exciting.

Figure 3. The developmental interview tool.

Table 1. Clusters of Dimensions for General Education[4]

	Beginning	Exploring	Sustaining	Inspiring
		SERVICE CLUSTER		
COMMUNICATE Use language appropriate to an audience	Colloquial or reticent	Disciplinary or familiar group	Specialized and non-specialized	Contextualized and engaging
COLLABORATE Work together on projects	Superficial	Compartmentalizing	Exchanging	Generating
APPLY KNOWLEDGE Use understanding	Egocentric	Interactive	Comparative	Panoramic
SERVE Self, others, and choices	Impulsive	Responsive	Principled	Foresightful
		RESEARCH CLUSTER		
IDENTIFY PROBLEMS	Disconnected	Borrowed	Paradigmatic	Transforming
FIND SOURCES	Haphazard	Perfunctory	Disciplinary	Comprehensive
DESCRIBE FINDINGS	Superficial	Differentiate examples	Differentiate systems	Transmute systems
INTERPRET FINDINGS	Unitary	Multiple	Embedded	Systematic

The key interviews for a program make it possible to create a developmental survey. Faculty should meet to discuss the first draft of such a survey and eliminate errors. At that point, however, changes should be kept to minimum until they have used the survey for a term or two. After that, they will have had enough experience to know what they need to change. Faculty often want to add a new level for "in between" performances. Such suggestions should be diverted to how to change the definitions to eliminate such results. Increasing the number of distinctions actually reduces inter-rater reliability.

Sustaining RTDE

Once a few programs have started to use developmental surveys based on developmental interviews, the approach expands more reliably through cascading developmental interviews. Assessment offices create these by interviewing a few faculty in front of a group. Then, if they discuss the developmental interviewing rubrics (Appendix B), it provides a chance to review effective interviewing strategies. Next, one of the group interviews another and the group discusses the rubrics for that interview as well. Participants then schedule the remaining interviews.

When program faculty collaboratively edit developmental ratings while adhering to the modes of practice model, they use them more effectively. Those who created the definitions in the first place are more likely to revise and retain them. Cascading interviews are a very effective way for helping all faculty understand the theory and method.

Once the interview notes are collected in one place, faculty can either combine the interviews themselves or ask the assessment office to do it for them. Observations of use suggest that 6-12 dimension with a unique name for each are most effective. A unique label for each mode of practice in each dimension greatly facilitates collaborative discussion with both colleagues and students. The definitions of the modes become unwieldy over 40 words. Developmental rubrics distinguish modes of practice not the gradual learning within a mode. To capture transformative learning, each level must define a different mode of practice, not just a different proficiency within a mode. Clues for the latter are adjectives used to make

[4] See Appendix A for detailed definitions of the practices for each level of each cluster

SWELL rubrics (Sequences Which Expand Little by Little). The assessment office can next create digital surveys from the final rubrics that faculty can fill out in a minute or two per student.

Education becomes "real time" when such developmental rubrics are used often per student per course. Notice that this approach completely by-passes the acclaimed "closing of the loop." Such "autopsy assessments" do nothing for the students who participated in them. RTDE in some settings, on the other hand, has been found to double the speed of learning.

The way that RTDE speeds up learning is by changing student commitments. If you look back at the curves for modes of practice, you do not find a single progression that swells learning from start to fulfillment. Rather, there are three or four curves for each dimension. That means two or three dramatic changes. Those are new commitments. According to Jack Mezirow (1991), those new commitments arise from disorienting dilemmas. In the words of Abraham Joshua Heschel (1996), new commitments arise from unique events. But new commitments do not create modes of practice instantaneously. Rather they first engender examination in the form of reflection, assessing one's role in creating the dilemma, sharing with others, and then discerning what to do next. Even that is not enough. For once the new mode of practice has been chosen, planning, rehearsing, and empowering are needed even before one tries to perform it. The first public performance is a milestone. But look at any point of time in the graphs and you will find considerable oscillation between the old and new practices.

So what are the roles of instructors in helping students establish new commitments? Some obvious trigger points are in creating dilemmas, discussing them, helping to discern new approaches, and empowering efforts to try. Great teachers intuitively understand these trigger points. Thanks to the research on transformative learning, we have a great opportunity to expand the population of great teachers.

Inspiring Advances in RTDE

It may seem premature to talk about advancing RTDE when so few people are already using it. But the process has all the characteristics that define disruptive innovation. Robert Zemsky's (2013) *Checklist for Change* has been out for four years now. In it, he passionately urged for a 90-credit-hour baccalaureate (90-CHB). In talks around the nation, he experienced two objections. First, institutions could not define their degree outcomes in a defensible way. Second, financial officers were frightened because it was hard enough to fill seats with a four-year curriculum. A 90 CHB would increase the difficulty by one third.

According to Christensen (2016), this is exactly the sort of circumstance that enables disruptive innovation. Tight profit margins and an apparent reduction in offerings are attractive only to marginal players. But what if such a marginal player in higher education risked it and could prove that the result was every bit as good as the current higher-priced model? Placed between boot camps and the traditional 120-credit hour baccalaureate, such an approach could quickly up-end the higher education marketplace. At that point, institutions with the best 90-CHB programs would have a considerable advantage. So this section proposes three projects designed to help AALHE members gain such an advantage.

Goal 4. Three Seminal Projects Designed to Inspire Advances in RTDE

Creating an AALHE database of learning identifiers

The first proposal is to help create an AALHE Database of Learning Identifiers (ADLI). Catherine Wehlburg, Susan Perry and I did a showcase presentation on the project at this year's AALHE conference. It is detailed elsewhere in these Proceedings. Basically, we proposed to collect systematic evidence of the distribution of learning identifiers by Carnegie type and geographic location and of the changes in them over time. Such a database would identify exploring modes of practice from the lower level courses and 2-year programs, sustaining modes of practice from upper level courses in 4-year programs, and inspiring modes of practice from graduate programs.

ADLI would generate the improved transparency that the federal government seeks. It would include learning identifiers from all levels and types of higher education institutions and programs. Such a database would also provide powerful support for any institution trying the 90-CHB.

Creating an accelerated development curriculum

The second potential innovation is to use RTDE to help programs create the accelerated development curriculum, a 90-CHB program founded on the principles of RTDE. It is possible that Christensen's model might actually work differently in higher education than it does in business. In business, it is the marginal institutions that are in the best position to innovate. But many institutions in higher education is driven as much by donations as purchases. An institution with a highly selective student body and high endowment might be in a position to greatly expand its reach through an accelerated development curriculum.

Using praxomics for course and program design

The third innovation is to apply praxomics to course and program design. Recall from above that praxomics is concerned with the description and analysis of practices and distinguishes repetitive, from adaptive, from collective activities.[5] Each of these broad types contain several levels of units. Repetitive activities range from conditioned responses to memory-guided responses and from there to procedures, like recipe following. Adaptive activities range from the phases and modes of transformative learning to the modes and dimensions of practices. Collective activities are those that require collaboration, including specialties and disciplines up to the entire methodologies and the human knowledge they engender. Appendix C provides the 11 praxomics terms along with their nearest common terms and definitions.

Surely a course that improves repetitive activities does not have the same stature as one that improves adaptiveness. After, repetitive activities are those that programmers are most likely to computerize. But adaptiveness may well depend on how repetitive activities are combined. Furthermore, as any Google or Amazon user knows, programs are becoming better and better at adapting. The praxomics levels that are most resistant to computerization are the collective ones. It is difficult to imagine robots creating professional societies and innovative designs, scientific discoveries, or new interpretative precedents. RTDE that focuses on such high level practices will help humanity prosper.

Conclusions

From a new vision of higher education assessment emerges a new vision of higher education itself. This new vision is one in which more attention is paid to the development of expertise in each individual student. Faculty also collaborate in much greater detail with deeper understandings of how to distinguish transformative from gradual learning and how to support both. The resulting clarity about development speeds up the necessary acquisitions. The need for such speed is every growing due to the social changes being produced by the explosion of knowledge and ubiquitous technological re-employment. Accelerating development through Real Time Development Education is a disruptive technology whose time has come.

[5] Appendix C provides definitions and common-language analogs for the 11 levels embedded in these three categories of praxomics units.

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APPENDIX A. Development Rubrics for General Education

	Beginning	Exploring	Sustaining	Inspiring
		SERVICE CLUSTER		
Communicate **Use language appropriate to audience.**	**Colloquial or reticent** Use colloquial, at-home language, dress, and posture. Feel unworthy to participate.	**Disciplinary or familiar group** Use vocabulary from their disciplinary reading. Explain to a familiar group what they did and what they found out, but read notes or PowerPoint directly.	**Specialized and non-specialized** Practice enough so that they can converse with their audience. Make interesting presentations to both specialized and nonspecialized groups.	**Contextualized and engaging** Identify audience interests, engage deeply and quickly, and use multiple media with appropriate pacing. Generate insights and choose contexts to make their conclusions easier to understand and remember than previous work.
Collaborate **Work together on projects**	**Superficial** Work with other students on a project, paper, or presentation. Get a poor outcome because it was not coordinated. Work with their friends or make new friends. Talk with one another without progressing beyond talk. Defend themselves instead of adapting.	**Compartmentalized** Complete projects and present to groups they know. Split into separate roles and end up with separate parts and some social loafing. Learn that talking with someone facilitates future conversations and grows social capital. Win moments by making others lose. Acknowledge problems and change based on feedback.	**Exchanging** Manage social relationships to balance contributions of each group member. Identify their expertise and resources. Ask questions and spontaneously solicit feedback. Exchange information, ideas, and values. Seek agreement on problem definitions. Make sure they understand what the others said. Recognize that making anybody lose makes everybody loses.	**Generating** Work on multiyear deadlines for implementable and documented solutions. Maximize group member contributions to achieve better results than any individual could produce. Recognize opportunities to engage with others that contribute to solving organizational problems. Develop enough shared information to provide new agreements or policies, understanding some things will be excluded.
Apply Knowledge **Use understanding,**	**Egocentric** Think their own values are the best. Interpret or create a work largely in subjective ways. Freeze or talk too much with clients about matters extraneous to a meeting. Avoid the tough stuff, engage in an argument, or become authoritarian.	**Interactive** Use interactive communication to help others. Discuss social and human components to understanding disciplines. Use simple typographies to classify peoples' problems. Feel pressure to get client agreement. Realize without knowing a remedy how situations can hook them into Beginning strategies.	**Comparative** Organize and see subtleties among frameworks by using logical causality, historical sequences, transitions of same, different, opposite, and impacts of situational history and politics. Separate their own from client frameworks through interacting in client settings. Manage situations in preventive, not corrective ways.	**Panoramic** Use conversation and model actions to help solve moral problems collaboratively. Understand how singular frames of reference limit understandings and solutions. Explain other people's views from their vantage, helping them see alternatives while understanding and respecting their autonomy.
Serve others **Provide support for self, others, and choices**	**Impulsive** Do what they do at home. Envision something social that they don't know how to get based on meeting someone different from themselves or an urge for independence. Keep the vast majority of the profits for themselves. Determine what evidence is available in full text related to broad topic.	**Responsive** Seek to provide both extrinsic and intrinsic rewards, believing people will not support them unless they are rewarded in turn. Pose questions about and provide answers to what their audience needs. Review search results for currency, reliability, authority, purpose/point of view. Argue a point of view with supporting evidence.	**Principled** Articulate a personal creed. Seek opportunities consistent with it. Support their art with another kind of job. Commit to a new level of productivity. Support local economies. Provide oral or written demonstrations of their views with confidence and comfort. Consider how sources support or refute their argument; developing counterarguments if necessary.	**Foresightful** Support the development in others of more diverse relationships within their own cultures. Make decisions based on long-term implications for all stakeholders including themselves. Advocate for change as active community members. Identify what is important, not just to the topic but to their audience's lives. Identify all resources necessary for comprehensive reviews.

	Beginning	Exploring	Sustaining	Inspiring
	RESEARCH CLUSTER			
Identify problems	**Disconnected** Be way too general to come up with an answer. Consider research as something other people do. Offer explanations of phenomenon or refer to studies without defending their choices or offering supporting evidence. Think theory is useless. Have no methodology. Mention some individual and societal costs. Confuse risk factors and consequences. Describe marketing as selling, advertising, commercials, pricing.	**Borrowed** Undertake real-world problems identified by others Compare the efficiency of methods for solving them. recognize when they fit findings. Identify theories. Distinguish independent from dependent variables, correlation from causation. Recognize research design logic: question, literature review, concept identification, measurement, application, dissemination. Pinpoint individual and societal costs and risk factors.	**Paradigmatic** Pick a problem area. Replicate studies. Identify flaws, follow-up studies, and solutions to real-world problems. Apply any theory to any sub-discipline. Identify confounds, alternative explanations, and ways research might help themselves or others. Distinguish individual, local, and societal risk factors. Identify innovative programs. Articulate the "prediction problem" (theories are poor predictors).	**Transforming** Work on novel problems requiring a sequence of studies to narrow down answers. Consider where studies might have gone wrong. Apply findings or conclusions to expand current knowledge and advance the field. Figure out new problems, methodologies, or theoretical approaches. Evaluate by building up, like grounded theory, through collecting evidence, coding it, identifying categories, and suggesting applications.
Find sources	**Haphazard** Use a search engine, such as Google, with no thought to vocabulary or popular disciplinary books, magazines, and their textbook. Find and report secondary sources such as Wikipedia, WebMD, and public pages. Affirm a point of view without being able to add reasons for it. Respond to haphazard pictures with personal judgments and stories of experiences.	**Perfunctory** Select key terms haphazardly for building search strategies in library catalogs, databases, or web. Browse relevant stack areas. Use sources provided in courses. Distinguish primary from secondary sources and peer reviewed from unreviewed sources. Cite others or perfunctory reasons for arguments. Collect isolated bits of information.	**Disciplinary** Select databases appropriate to the topic or research question. Do comprehensive and efficient searches related to particular topics, using citations in sources, or review articles, and multiple modifiers to refine searches in databases. Look at mass media from multiple disciplines and theories. Discuss articles with others. Write critiques as well as summaries. Integrate across disciplines.	**Comprehensive** Search beyond local resources using WorldCat and ILL. Assemble publishable bibliographies including foreign-language articles. Know how much a comprehensive overview requires. Keep up with advances. Critique books, journals, and articles to advance the discipline. Collaborate with groups, knowing others' work well enough to send relevant articles. Invent new conceptual tools to study innovations.
Describe findings	**Superficial** Describe easily observable characteristics without identifying relevant processes. Search Google, copy verbatim, and judge quality by whether they liked it. Include irrelevant information about projects and omit an important section (e.g., question, strategy, result, or conclusion). Assume readers know the background. Try to solve a major social problem in a page.	**Differentiate examples** Identify how one concept or institution affects another. Identify some similarities and differences from their own of a few other perspectives on diversity, economic development, health, war and peace, and globalization. Communicate a research question within a context. Describe factually their method, results, and conclusions.	**Differentiate systems** Discuss how institutions, people, processes, groups, and social movements interact to produce outcomes. Differentiate how diverse systems of thought or institutions produce conflicting actions or environmental outcomes. Anticipate counterarguments from other perspectives in culturally sensitive ways. Describe their own projects, identifying anomalies, unusual results, implications, limitations, and future research directions.	**Transmute systems** Create unconventional, complex, specific, and interdisciplinary comparisons that reveal new insights. Challenge assumed relations between institutions, people, processes, and groups. Describe how systems work, why and who they fail, and with what political influences. Identify improvements in ways to test conclusions. Observe patterns of features and factors related to them. Maximize information with minimal words.
Interpret findings **Create understanding**	**Unitary** Accept authority and everyday understanding, unreflectively and uncritically. Equate power with the ability of one person to impose their will on others. Respond to images, media, books, or articles with only I like, or dislike, the subject matter. Write down their end result without showing their thinking. Equate theory with generalization.	**Multiple** Put information in broader contexts and ask what its utility is. Criticize everyday understanding. Distinguish correlation from causation. Generate definitions and counterexamples. Deconstruct, then reconstruct to solve problems. Identify rational and passionate grounds for differences of opinion between articles. Differentiate power as coercion, social capital, persuasion, overwhelming evidence, bureaucratic position, wealth, or resource control.	**Embedded** Consider how conceptual structures affect information. Alternate between creative and critical modes regarding interrelated sets of difficult concepts. Identify which sources contributed most to their own understanding. Situate articles within diverse disciplinary schools of thought. Read for a deeper sense of empathy. Relate institutional processes and power structures to member quality of life	**Systematic** Build conceptual structure by viewing distinctions across other concepts. Juxtapose ideas. Connect body with mind, praxis with theory, individual instances with the systems that created them. Identify reasons behind others' customs. Enliven places in books with matches to familiar places. Attack chronological snobbery (new ideas are better). Collaborate and help organize others' efforts.

APPENDIX B. Developmental Rubrics for Developmental Interviewing[6]

Dimension	Beginning	Easy	Practical	Inspiring
Identify Participants	**Protected** Interview friends or family	**Volunteers** Interview interested and willing experts encountered in daily life	**Career** Interview workplace experts needing to identify developmental patterns	**Marketplace** Interview ever expanding varieties of expert groups
Use Succession Graph	**Levels** Mention only the 4 strategy names. (levels). Interviewees apply it to themselves.	**Decision & Time** Focus on the decision and practice time (Ignore the graph and needs). Interviewees apply it to a few individuals they know well.	**Dialog** Dialogue about the graph with quick and flexible recall of all details. Use it to generate questions. Interviewees apply the tool broadly.	**Enrichment** Add or modify the table or preface to facilitate interviewee comprehension or incorporate his/her ideas. Interviewees enrich the graph or definitions with new concepts.
Collaborate	**Introduce** Introduce selves to interviewees. Explain why they were invited to participate. Expect interviewees to take care of themselves or do not think about protecting them.	**Disclose** Talk about selves, explaining why they are interested in conducting the interview. Explain that the interviews will not be confidential. Explain how they will help the interviewer.	**Take Interest** Explain how the interview will help both participants. Learn major settings of the participants' experience. Create opportunities to make formerly unarticulated voices audible to a small, known group of users. Build rapport by showing interest in interviewees' responses, being sympathetic, affirming.	**Authenticate** Explain how the interview will help people that the interviewee cares about. Authenticate the interviewee's expertise by making constructive use of it for broad audiences. Use developmental principles and interviewee knowledge to create more than either could create alone.
Define Dimensions	**Brainstorm** Ask interviewee to brainstorm the things people need to learn to become expert in their field.	**First Emotional** Ask interviewees to remember frustrating things advanced learners do. Then ask about the development of the first thing they mention.	**Multiple Emotional** Ask interviewees to remember frustrating things advanced learners do, list dimensions as they talk, and work on the list one dimension at a time after they are ready.	**Insightful** Ask interviewees to remember frustrating things advanced learners do, separate out dimensions as they talk, and pick unique insights from other dimensions to expand later.
Discover Commitments	**Grades** Be satisfied with grading analogies that use qualitative adjectives.	**Practice Times** Accept descriptors based on the amount of practice time it takes to achieve each level.	**Commitments** Record notes after discerning how the answer relates to one of the four commitments (try, learn, become proficient, or contribute).	**Innovations** See commitments unique to the expertise being discussed which have the potential to change the expertise.
Discover Practices	**Avoidance** The interviewees try to avoid particulars by asking questions or telling what they did or felt.	**Impressionistic** Record impressions of what learners feel, think or have "talent" in.	**Behavioral** Help interviewees focus on what people do. Ask for examples and then ask them to generalize.	**Activity** Help the interviewees recall the typical settings and interactions of experts.

[6] Reprinted from Dirlam et al. (2010) and Dirlam (2017)

Dimension	Beginning	Easy	Practical	Inspiring
Listen and Use Notes	**Recorded** Record the interview	**Sequenced** Record or take notes. Follow persistently the developmental order of questions even when the interviewee goes in a different direction. Ask more than one question at once.	**Interpreted** Use notes to pick up on potentially useful leads. Help interviewees interpret experiences that can be useful to others. Let them speak for themselves, unless they want help finding a word or idea.	**Constructed** Allow interviewees to process at their own pace and participate in constructing the meaning of the interview. Use notes to work together to create a way to express complex ideas, making sure the interviewees contribute more to constructing the narrative than the interviewer.
Improvise	**Closed** Ask questions that can be answered by a single word or phrase.	**Formulaic** Ask for elaborations, using formulaic questions like, "What do you mean by that?" "Can you tell me more about that?" Be satisfied with abstractions or adjectives.	**Development Focused** Help interviewees focus on developmentally relevant information, especially, ask interviewees to describe what people actually do.	**Yes, and…** Help interviewees frame their narrative by affirming their thoughts and feelings, encouraging them to expound, and connecting their ideas with development by affirming interviewee contributions and added something to them.
Produce Flow	**Pushing** Keep the talking going even if they have to do it themselves.	**Pulling** Put words in interviewees' mouths even if it means interrupting them.	**Patient** Wait patiently, realizing that people take time to come up with ideas.	**Open** Provide an atmosphere conducive to open and undistorted communication by being receptive to being changed and describing the change when it happens.
Use Results from Others	**Personal** Talk about family, friends, etc.	**Leaders** Talk about researchers or disciplinary leaders.	**Other Interviews** Talk about other interviewees but give the interview back to the interviewee to modify.	**Community Building** Talk about ideas from other interviewees to help guide the interviewee as examples (but avoid implying that the "right answer" is known or providing so many ideas that it overwhelms them). Let the interviewees know that a "collective collage" of the interviews will be returned to the community for editing.
Clarify	**Imitative** Record whatever the interviewee says	**Stock** Use paradigm questions such as "What does that mean?" or "Can you give examples?"	**Lexical** Get definitions of disciplinary jargon and enough examples for non-experts to get an idea of disciplinary concepts.	**Expansive** Use analogies from their developmental expertise to help users connect with both the interviewees and the interviewers discipline

APPENDIX C. Praxomics Terms

Praxomics term	Nearest common term	Definition
		REPETITIVE PRACTICES
Circular reactivity	Conditioned response	Responses that produce unintended consequences, strengthen and consolidate the response into a schema through repetition, incorporate cultural objects, and involve interactions with other members of a culture.
Actuation	Schema	The memory-dependent, multimodal integration of multiple circular reactivities—each involving cultural artifacts and social interactions.
Procedure	Learning Objective	A series of actuations that are carried out together regularly .
		ADAPTIVE PRACTICES
Phase of commitment	Course outcome	A set of ten components of transformative learning identified by Mezirow that are involved in various modes of commitment and with each phase consisting of multiple procedures that ultimately result in identifying and resolving disorienting dilemmas.
Mode of commitment	Course goal	The sequence of steps that learners engage in when making a transformation from one mode of practice to its developmental successor (the DEEP modes include Disorientation, Examination, Enabling, and Performing).
Mode of practice	Competency ≅ Sustaining mode	A developmental level of a dimension of a practice within a particular context that (1) displays consistent developmental parameters of endemicity, performance rate, commitment strength, and acceptance; (2) develops in competition with a few other modes of practice having different characteristics, usually including Beginning, Exploring, Sustaining, and Inspiring modes; and (3) coexists with any modes of other dimensions in the context.
Dimension of practice	Program outcome	A set of modes of practice in which learners can only use one mode at a time.
		COLLECTIVE PRACTICES
Cluster of dimensions	Specialty or sub-discipline	A group of dimensions in which the descriptions within the group are more similar to each other than descriptions of dimensions outside of the cluster.
Praxosystem	Discipline	A group of clusters usually defining a program, discipline, or trade.
Praxome	Progressive methodology	A methodology for advancing holistic knowledge, such as science, design, or interpretation.
Praxosphere	Holistic knowledge	The entire realm of potential holistic knowledge (including potential or actual agents, purposes, situations, cultures, and planned or performed actions).

Real-time Developmental Assessment for Transforming Students and Teachers

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Abstract. Closing the loop with academic autopsies produces delayed results, displaced rewards, faded memories of criteria, and missed learner transformations. Reflection on student accomplishment results in remembering major projects. Critical assessment of "closing the loop" reveals it often requires faculty to act on questionable data. We need to replace short-term stressful exams with student triumphs from extended work, base faculty changes on data they respect, and focus on transformative learning of individual students and cohorts that teachers and learners retell years later. Real-Time Developmental Assessments (RTDA) use developmental rubrics on a class-by-class basis to identify important student transformations. Such rubrics are behavioral, multidimensional, based on a succession model, and scalable across times and spaces. The succession of modes of practice within each dimension is *beginning* with momentary attempts, *exploring* over months, *working* over years, and *contributing* over decades. Performing RTDA requires teachers to know the DEEP modes of commitment required for learners to move from one mode of practice to its successor. These are Disorienting dilemmas, Examining to distinguish successor modes, Enabling, and Performing new modes. Such instruction results in Accelerated Development Curricula (ADC), which save learners, institutions, and society time, and money. Institutions are challenged to test this model.

Keywords: Real-Time Developmental Rubrics, Accelerated Development Curricula, Transformative Learning, Modes of Practice.

We have been urged to "close the assessment loop" for decades. Typically, this means that we identify measurable student learning outcomes, assess them, analyze assessment results, identify and implement program improvements, and repeat the cycle.

DISORIENTING Dilemmas

Closing the assessment loop is so limiting that it might be better called "tighten the assessment noose." Dilemmas with the approach begin with *delayed results,* often a year before faculty realize any benefits of program assessment. This produces both *displaced rewards* and *faded memories.* Many students who provided work for program assessment fail to benefit from the improvements, learn their own results, take tests and surveys related to their classroom experience, or become motivated to provide their best performance. Faculty may even forget the criteria or fail to value the results. The most important dilemma, however, has to do with m*issed opportunities*. Major learning transformations that students undergo remain undetected. As teachers, we love to tell the stories of the moments when a student came up with a brilliant idea in one of our classes that transformed their careers. The "closed loop" misses those moments.

In an AALHE discussion this year that contrasted assessment in medicine with that in higher education, Joan Hawthorne accurately defended end-of-program assessments saying that autopsies do benefit other people. The term *Academic Autopsy* is a wonderfully graphic way to label end-of-program efforts. At least, with such a label people would not be tempted to imagine

that they benefit the person being assessed, even if they do offer some benefit to other students.

EXAMINING Alternative Modes of Assessment Practice

Reflection reveals that many assessment professional are uncomfortable with the mode of practice called "closing the loop"? Contrast students mentored through a year-long research project that resulted in presentation in their discipline with students pondering under time pressure alternatives to tedious questions on some disciplinary autopsy test. Surely we would prefer to have them remember their research, design, or interpretative triumph than even a few of the judgmental items on a standardized test?

The next step in examining the "closed loop" is a *critical assessment* of what it requires faculty and assessment professionals to do. Since teachers are rarely learning researchers aiming to bear the scrutiny of journal editors, a rather depressing question is "How much uncertainty about evidence should teachers accept before changing a program honed over the last few decades?"

A much more satisfying question is "What kind of evidence would be valued and sought after by students, faculty, and assessment professionals?" An obvious answer includes improvement in (a) student learning and development and (b) faculty satisfaction and institutional sustainability. For students, this means faster, more accurate, more effective performance in multiple dimensions of progressively more complex tasks. For institutions this means to sustainably compete in fulfilling student needs at reasonable costs, with attractive lives for employees.

This year's AALHE conference had many presentations that *shared* ideas of what to do with weak data. Audiences enjoyed those that poked fun at "closing the loop." In contrast, imagine sharing the stories of student and institutional transformations with other faculty or assessment professionals. We remember transformational stories for decades, because we keep telling them. But the ones we tell are not often enough about all or even most of our students and few of our students remember much from any regular course they took from us. Students who participate in whole cohorts that made enduring changes in their communities remember their projects. Stories about individuals and isolated courses are not enough, if we cannot also identify what we have accomplished for all the students served by our programs.

A last step in examining the closed-loop dilemma involves *distinguishing* what we are doing from what we might do. Could we replace short term stressful challenges (e.g., tests) with student triumphs from extended work (e.g., portfolios with developmental feedback)? Could faculty replace the institutional demand to base changes in long-refined programs on weak data with transformations in performance of individual students and cohorts on progressively more complex tasks that faculty and students retell for years afterwards?

Real-Time Developmental Assessment as the Alternative to the Loop

What sort of assessment would focus on student triumphs from extended work that faculty mentor, retell for years afterwards, and identify what was accomplished for all the students a program served? To accomplish such assessment, requires that we identify transformations learners and cohorts of learners make. To do this, we must first discover each program's model of development. What are the transformations within what dimensions of our fields of expertise that we plan for students to accomplish?

With clear answers to program concepts of development, it is possible to create developmental rubrics. But developmental rubrics have restricted use if they are only applied at the end of courses as academic autopsies. If instead, they are used within minutes or days of discovering a transformation in disciplinary mode of practice that a student identifies, considers, works on, or accomplishes, they can help both teachers and learners to remember the stories.

To be transformational on even a single dimension of a program with a dozen or so dimensions a course must be designed to reveal developmental transformations. A "talking at" approach (i.e., the typical lecture) cannot work. Teachers achieve deep satisfaction from designing courses for any of the three types of transformations in learners: (1) from opening their first book in the field to seriously exploring it, (2) from exploring it to performing well enough to keep a job in the field, or (3) from keeping a job in a field to making a contribution to it. To do so, they need not only to understand the modes of practice within the dimension(s) they are teaching, but also the changing commitments that occur before such transformations are consummated.

In order to be most effective, developmental rubrics and courses designed for transformative learning need to be program-wide. A program where each teacher creates their own developmental rubrics and each course is taken by both second year and fourth year students produces an incoherent and easily forgotten curriculum. In contrast, if every program teacher uses the same developmental model, students learn the meaning of the transformations from the perspective of each teacher. With records of student progress, the impact of each course section and the reliability of each rating can be identified. But more important, students can learn to assess their own performances.

When learners reliably identify their own knowledge development, it accelerates that development in several ways. A common language to describe thirty to fifty modes of practice within a field facilitates students assessing their progress as well as sharing that progress with each other. With such clear distinctions, they plan better, know what to rehearse, and empower each other to perform. The resulting accelerated development saves students and institutions money, which ultimately improves the satisfaction of learners and teachers as well as the sustainability of the institutions.

SACSCOC Vice President Liaison Officer, Steve Sheeley, likes to quote the piano teacher who had a sign on her door "Practice on any day that you plan to breathe." That sign encapsulates the meaning of "real-time." Well-known assessment author and speaker, Peggy Maki, is just finishing a book called *Real-Time Student Assessment.* Effective teachers have a model of their target outcomes that they use on a daily basis to respond to students. It becomes assessment when it is articulated in student learning outcomes and recorded for later analysis. Real-Time Assessment becomes *developmental* when there is a clearly articulated model of the succession of modes of practice needed to work in or contribute to a discipline. When such a model is shared by every teacher in a program it creates a compelling community of practice that students remember as well as their personal projects long after they have completed the program. *Real-Time Developmental Assessment* (*RTDA*) allows users to focus on student triumphs from extended work that teachers retell for years afterwards and identify what was accomplished for whole cohorts of the students that each program served.

ENABLING the Use of Real-Time Developmental Assessment

Enabling a program to use *RTDA* begins with a plan to create the program's model of development. The developmental interviewing method works. The basic plan is to learn the succession model of development, try a few developmental interviews, initiate cascading interviews with faculty, evaluate early interviews using the appended Developmental Interviewing Rubrics[1], and support their real-time use during teacher-learner interactions.

Using the succession model to create rubrics is addressed in last year's proceedings (Dirlam, 2015) which detailed four principles to "Help Faculty Make Better Rubrics:"

1. The *behavior principle*: rubrics should include descriptions of examples of complex behavior that typify learner activities at particular levels of development.
2. The *dimensions principle*: aim for 8-12 dimensions of development, so that learners can perform any possible combinations of the levels in any pair of dimensions.
3. The *succession principle:* use the model of the dynamic succession of behaviors produced by their initial frequency, growth rates, and competitive strengths.
    a. *Beginners* just try something.
    b. *Explorers* have learned some fundamentals that they tend to overuse.
    c. *Workers* have learned enough to hold a job in the field.
    d. *Inspiration* involves making innovations, discoveries, or new interpretations that get dispersed to others.
4. The *scaling principle:* apply to extremely diverse scales of times and spaces ranging from short conversations to periods of historical changes.

It is helpful to rehearse the interview process with a few friends before introducing the approach to faculty. Some who have tried it have asked for a sample interview protocol, which is included in the Appendix. Interviews should periodically be followed by a review using the appended Dirlam and Covitz rubrics for developmental interviewing (Table 1). Next, groups should be empowered to conduct *cascading interviews.* An experienced developmental interviewer conducts an interview in front of faculty. Ratings using the interviewing rubrics are discussed and the interviewee interviews another teacher in the group followed by rating and discussing that interview. That person interviews another and the rubric is applied and discussed a third time. At that point each member of the group is ready to conduct developmental interviews.

Some readers assume that having one experienced interviewer produces the best results. This may not be the case. Even though the experience is less, cascading interviews work, because those involved learn the process. Ultimately, the goal is for teachers to internalize the rubrics enough to use them while interacting with students. Having faculty conduct interviews helps them take ownership of the process especially for improving the rubrics with use.

Once all the interviews have been done, they need to be combined into a large set. If there are less than 100 dimensions, careful reading can sort them into 8-12 clusters. Abstracts of each mode of practice of each cluster are then written. Next, teachers use the rubrics to rate a sample of student artifacts from the program and make notes on any rating difficulties. All raters then

[1] These are appended. They were originally compiled by Dirlam and Covitz in 2010 and often alluded to, but have not previously been included in a readily accessible document.

meet to resolve the questions with improvements to the wording of the rubrics.

An empowering motive for developmental interviewing is that no interview ends without the interviewer acquiring a better understanding of what the interviewee knows that they do not. They also help faculty to collaborate on clarifying the goals and developmental steps of their program. For students, they facilitate learning what they are supposed to accomplish. Ultimately, they help institutions create *Accelerated Development Curricula* (ADC).

PERFORMING with Real-Time Developmental Assessment

Transformations to more complex modes of practice emerge through a sequence of activities, called the DEEP modes of commitment (named for the acronym of Disorientation, Examining, Enabling, and Performing). *Disorienting dilemmas* occur when learners are faced with challenges to their currently established modes of practice. These are followed by *Examining* the practices, through reflection, assessment, and sharing with other learners that culminates in distinguishing a new, more complex and effective mode of practice. Once the new mode of practice has been clarified, the learner commits to a process of *Enabling* it through planning, rehearsing, and becoming empowered to engage in it. The final commitment begins, like opening night of a play, when the learner *Performs* what they have learned. Note in Figure 3 of the Appendix, how at any particular time point, users alternate between several modes of practice. Thus, establishing the commitment occurs gradually through frequent use of the new mode of practice with positive feedback and fewer and fewer lapses into its predecessor.

Figure 1 outlines the DEEP Modes of Commitment that enable the transformation from one mode of practice to the next, more complex and effective mode. The phase names described below were defined by Mezirow (1991) and Taylor and Cranton (2012). They are grouped into four commitments below because they occurred at the same time in a study of 500 ratings by several professionals of hour long, one-on-one sessions in a series with individual learners.

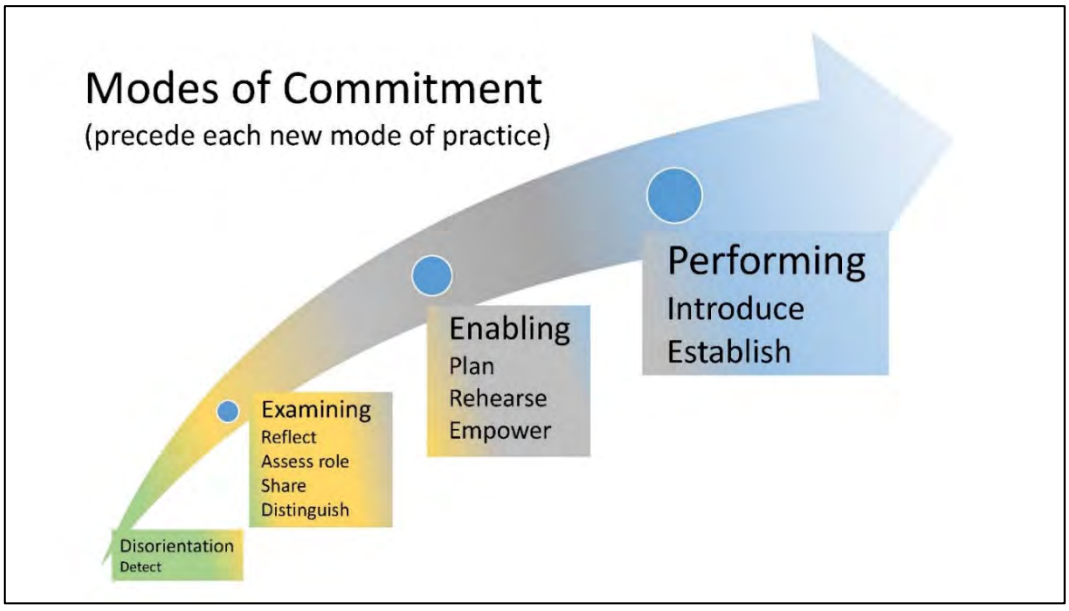

Figure 1. The DEEP modes of commitment with phases of each.

Disorientation

- *Detect*: Experiencing an event that disorients one's sense of self with a familiar role.

Examining

- *Reflect*: Engaging in reflection and self-reflection.
- *Assess*: Critically assessing the personal [epistemic, sociocultural, or psychic] assumptions and feelings that have alienated self from traditional role expectations.
- *Share*: Relating discontent to similar experiences of others; recognizing the shared problems [and that others have negotiated a similar change].
- *Distinguish*: Identifying new ways of acting within the role [relationships, and actions].

Enabling

- *Plan*: Planning a new course of action.
- *Rehearse*: Acquiring the knowledge and skills necessary to implement this new course of action.
- *Empower*: Building personal confidence and competence [in new roles and relationships].

Performing

- *Introduce*: Trying out the planned action and assessing the results.
- *Establish*: Reintegrating into society with new role behaviors, assumptions, and perspectives.

Besides attending to the modes of practice and their intervening modes of commitment, faculty can facilitate learner progress through intentionally designing developmentally accelerated courses. Such courses require students to show behaviors oriented to specific modes of practice within some dimensions of the discipline and some dimensions shared with the division or college. Typically, no course addresses all the dimensions of a program while aiming for a single mode of practice in each. A study of over 500 dimensions provided by faculty from sciences, humanities, and social sciences in a liberal college reported in Dirlam (Forthcoming, 2017) found that eight dimensions were shared by all divisions, while each single divisions had 2 to 5 additional dimensions. A typical course in a five-year graduate professional program addressed roughly half of the dimensions identified for the program.

One great advantage of using the same developmental rubrics for an entire program is that it gives learners the opportunity to commit to ever more complex practices from year to year.[2] Program rubrics are abstract and while not all dimensions apply to every assignment, every assignment should apply to some dimension(s). Matching rubrics to assignments can be useful even when the rubrics are not shared across other courses. Such different levels of abstractness for rubrics exemplify the practical meaning of the scaling principle mentioned above.

Another advantage of program level developmental rubrics is that student progress can be shared across an entire curriculum. This resembles competency-based education in that it identifies what learners have accomplished. The acquisition of modes of practice, however, differs from competencies, because the latter are usually all-or-nothing and exclude predecessor practices. Advanced modes of practice gradually replace predecessors after first appearing as a result of transformative learning. Currently learner progress is recorded only in course titles and grades.

[2] Such program-level developmental rubrics do not preclude teachers from identifying particular examples of rubrics for particular assignments.

Recording the use of modes of practice gives a more accurate picture of learner accomplishments and opportunities for further development.

So how else might teachers help learners to discover transformative learning? Classes might begin with projects that allows teachers to identify the practice that students use when they enter the course. Designs of dilemmas that involve one or more typical practice could be evaluated on the spot by their impact on learner questioning. When learners question their actions related to who, where, or when to use their current mode of practice, this indicates that the dilemma actually did disorient their role within the discipline. Recording such events can be done by either the teacher or the learner, but in the latter case, teacher review improves accuracy. When a sizable portion of a class logs the same new commitment, it could occasion discussion involving reflection, assessment, and sharing of their experience with the mode of practice. The criteria that emerge from such an examination, then, would form the basis for evaluating more complex alternative mode that has been identified by the discipline. This process can be augmented by the well-known scaffolding procedure within Vygotsky's zone of proximal development (see Vygotsky, 1978, Wood, Bruner, and Ross, 1976, Tharp and Gallimore, 1988, and Rogoff, 1990).

When learners commit to the next mode of practice, they should initiate planning that provides many opportunities for rehearsal and receiving the sort of teacher and fellow student feedback, support, and encouragement that ultimately empowers them to take over and make the practice their own. When learners use program-level developmental rubrics and their understanding of the modes of commitment both to evaluate and record their own plans and progress, that is when they greatly accelerate their own learning.

Planning by program faculty for Real-Time Developmental Assessment (RTDA) begins with creating developmental rubrics and then using them to design developmentally accelerated courses. Performance of RTDA occurs when teachers use modes and phases of commitment to help learners transform the modes of practice addressed in their courses. Such performance is facilitated by recording learner commitments so that responsibility can be gradually transferred to them. When development has been made so transparent and carefully planned, it becomes accelerated—potentially doubled or tripled in rate according to some early data. The result, captured in Figure 2, is an accelerated development curriculum (ADC).

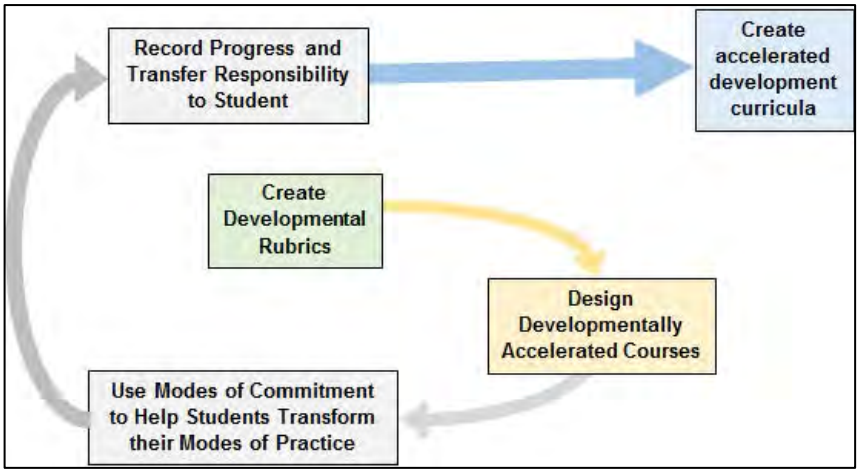

Figure 2. *The spiral from RTDA to Accelerated Development Curriculum (ADC).*

CONCLUSIONS and one more disorienting dilemma

The goal of this paper has been to facilitate the transformation in higher education assessment away from a once-per-year activity patterned after the social science research process of problem identification, data collection, analysis, and application. The proposed alternative was to use Real-Time Developmental Assessments (RTDA) to create Accelerated Development Curricula (ADC). With the latter, all program teachers often remind learners of the major transformations in learning a field by using the same terms and interpreting them in different contexts. With RTDA every class results in students being rewarded with confirmation of what they have accomplished and inspired with opportunities of what they are ready to try next using a memorable number of terms. RTDA produces ADC because teachers improve their ability to identify developmental transformations and find ways to stimulate and scaffold them. Ultimately, the developmental transformations occur faster, reduce educational costs, and improve the experience of the learners and teachers involved.

Real-Time Developmental Assessment fits with the best that we know about learning and developmental transformations. It requires teachers to use accurate description in their classes of developmentally sequenced behaviors along 8-12 dimensions. Medical appointments are coded using 16,000 diagnoses and 76,000 procedures. The coding system improves public health, accurately classify and treat injuries and diseases, helps physicians measure performance against peers, contain costs, and accurately recognizes accomplishments. RTDA can improve higher education, more accurately classify and remediate learner development, help teachers measure performance of their courses against peers, contain costs, and get accurate recognition of accomplishments. A typical RTDA assessment involves less than 50 developmental codes. Another 50 instructional procedure codes might be used once per term per course.

Using RTDA, it is likely that students could learn and develop sufficiently to satisfy Robert Zemsky's (2013) vision of meeting all the requirements of their peers in ¾ or less of the current time. If so, it would save the economy billions and students an average of $10,000 each. To justify reducing undergraduate seat-time from 120 to 90 credits would require three steps. First, determine a baseline by every program in the college evaluating every student using a developmental rubric. Secondly, every faculty member uses RTDA often and designs Accelerated Development Curricula (ADC). Third, after every year compare the student's performance at the end of the junior year with the baseline evaluation. If within a few years the 90-credit-hour juniors fare as well as the 120-hour graduates did a few years earlier, an argument would be made to the college's accrediting agency to allow awarding baccalaureate degrees after 90 credit hours. If any college succeeded in being the first to prove that RTDA and ADC work, the discovery would lead to national change in higher education and national leadership by the college. The "one more disorienting dilemma" of this section is encapsulated in the question, "What college might commit to undertake this experiment?"

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Table 1. Developmental Interviewing Rubrics*

	Beginning	Exploring	Working	Inspiring
Identify Participants	**Protected** Interview friends or family	**Volunteers** Interview interested and willing experts encountered in daily life	**Career** Interview workplace experts needing to identify developmental patterns	**Marketplace** Interview ever expanding varieties of expert groups
Use Succession Graph	**Levels** Mention only the 4 strategy names. (levels). Interviewees apply it to themselves.	**Decision & Time** Focus on the decision and practice time (ignore the graph and needs). Interviewees apply it to a few individuals they know well.	**Dialog** Dialogue about the graph with quick and flexible recall of all details. Use it to generate questions. Interviewees apply the tool broadly.	**Enrichment** Add or modify the table or preface to facilitate interviewee comprehension or incorporate his/her ideas. Interviewees enrich the graph or definitions with new concepts.

Table 1. Developmental Interviewing Rubrics*

	Beginning	Exploring	Working	Inspiring
Collaborate	**Introduce** Introduce selves to interviewees. Explain why they were invited to participate. Expect interviewees to take care of themselves or do not think about protecting them.	**Disclose** Talk about selves, explaining why they are interested in conducting the interview. Explain that the interviews will not be confidential. Explain how they will help the interviewer.	**Take Interest** Explain how the interview will help both participants. Learn major settings of the participants' experience. Create opportunities to make formerly unarticulated voices audible to a small, known group of users. Build rapport by showing interest in interviewees' responses, being sympathetic, affirming.	**Authenticate** Explain how the interview will help people that the interviewee cares about. Authenticate the interviewee's expertise by making constructive use of it for broad audiences. Use developmental principles and interviewee knowledge to create more than either could create alone.
Define Dimensions	**Brainstorm** Ask interviewee to brainstorm the things people need to learn to become expert in their field.	**First Emotional** Ask interviewees to remember frustrating things advanced learners do. Then ask about the development of the first thing they mention.	**Multiple Emotional** Ask interviewees to remember frustrating things advanced learners do, list dimensions as they talk, and work on the list one dimension at a time after they are ready.	**Insightful** Ask interviewees to remember frustrating things advanced learners do, separate out dimensions as they talk, and pick unique insights from other dimensions to expand later.
Discover Commitments	**Grades** Be satisfied with grading analogies that use qualitative adjectives.	**Practice Times** Accept descriptors based on the amount of practice time it takes to achieve each level.	**Commitments** Record notes after discerning how the answer relates to one of the four commitments (try, learn, become proficient, or contribute).	**Innovations** See commitments unique to the expertise being discussed which have the potential to change the expertise.

Table 1. Developmental Interviewing Rubrics*

	Beginning	Exploring	Working	Inspiring
Discover Practices	**Avoidance** Interviewees try to avoid particulars by asking questions or telling what they did or felt.	**Impressionistic** Record impressions of what learners feel, think or have "talent" in.	**Behavioral** Help interviewees focus on what people do. Ask for examples and then ask them to generalize.	**Activity** Help the interviewees recall the typical settings and interactions of experts.
isten and Use Notes	**Recorded** Record the interview	**Sequenced** Record or take notes. Follow persistently the developmental order of questions even when the interviewee goes in a different direction. Ask more than one question at once.	**Interpreted** Use notes to pick up on potentially useful leads. Help interviewees interpret experiences that can be useful to others. Let them speak for themselves, unless they want help finding a word or idea.	**Constructed** Allow interviewees to process at their own pace and participate in constructing the meaning of the interview. Use notes to work together to create a way to express complex ideas, making sure the interviewees contribute more to constructing the narrative than the interviewer.
Improvise	**Closed** Ask questions that can be answered by a single word or phrase.	**Formulaic** Ask for elaborations, using formulaic questions like, "What do you mean by that?" "Can you tell me more about that?" Be satisfied with abstractions or adjectives.	**Development Focused** Help interviewees focus on developmentally relevant information, especially, ask interviewees to describe what people actually do.	**Yes, and…** Help interviewees frame their narrative by affirming their thoughts and feelings, encouraging them to expound, and connecting their ideas with development by affirming interviewee contributions and added something to them.
Produce Flow	**Pushing** Keep the talking going even if they have to do it themselves.	**Pulling** Put words in interviewees' mouths even if it means interrupting them.	**Patient** Wait patiently, realizing that people take time to come up with ideas.	**Open** Provide an atmosphere conducive to open and undistorted communication by being receptive to being changed and describing the change when it happens.

Table 1. Developmental Interviewing Rubrics*

	Beginning	Exploring	Working	Inspiring
Use Results from Others	**Personal** Talk about family, friends, etc.	**Leaders** Talk about researchers or disciplinary leaders.	**Other Interviews** Talk about other interviewees but give the interview back to the interviewee to modify.	**Community Building** Talk about ideas from other interviewees to help guide the interviewee as examples (but avoid implying that the "right answer" is known or providing so many ideas that it overwhelms them). Let the interviewees know that a "collective collage" of the interviews will be returned to the community for editing.
Clarify	**Imitative** Record whatever the interviewee says	**Stock** Use paradigm questions such as "What does that mean?" or "Can you give examples?"	**Lexical** Get definitions of disciplinary jargon and enough examples for non-experts to get an idea of disciplinary concepts.	**Expansive** Use analogies from their developmental expertise to help users connect with both the interviewees and the interviewers discipline

* From Dirlam and Covitz, Unpublished Document (2010)

Appendix: Sample Interview Protocol

The purpose of this interview is to record your memories of the modes of practice learners use -- what they do at different points in developing expertise in your field. We'll use the result to help make developmental rubrics for your program. The modes of practice within each dimension are:

- *Beginning* – Take minutes to try an activity (behavior on introductory course, day 1).
- *Exploring* – Take months to learn the basics (behaviors after the introductory course).
- *Working* – Take years to acquire job-level proficiency (behaviors of graduates; sophomore differs from senior courses by involving fewer dimensions).
- *Inspiring* – Take many years to make discoveries or innovations in a field (undergraduate students will often achieve this level on isolated dimensions).

A common example that helps many people remember how different dimensions develop at different rates is children's drawing. Beginners scribble meaningless lines in the middle of a paper, explorers make stick men and geometric objects on base lines, workers make three dimensional objects with curved outlines on base planes, and inspiring drawers use chiaroscuro for outlines of objects with symbolic meanings, controlled proportions, true perspective or designs that control viewer eye movements. Objects, backgrounds, meanings, and designs are different dimensions of drawing development. For some, meaningful objects in the middle of the paper may precede base lines; for others it is the reverse. But in each dimension there is a dominant mode of practice at any moment in time.

If you have ideas for the dimensions already, I'll write them down. If not, tell me how learners differ with experience and I'll note down possible dimensions that you might like to talk about.

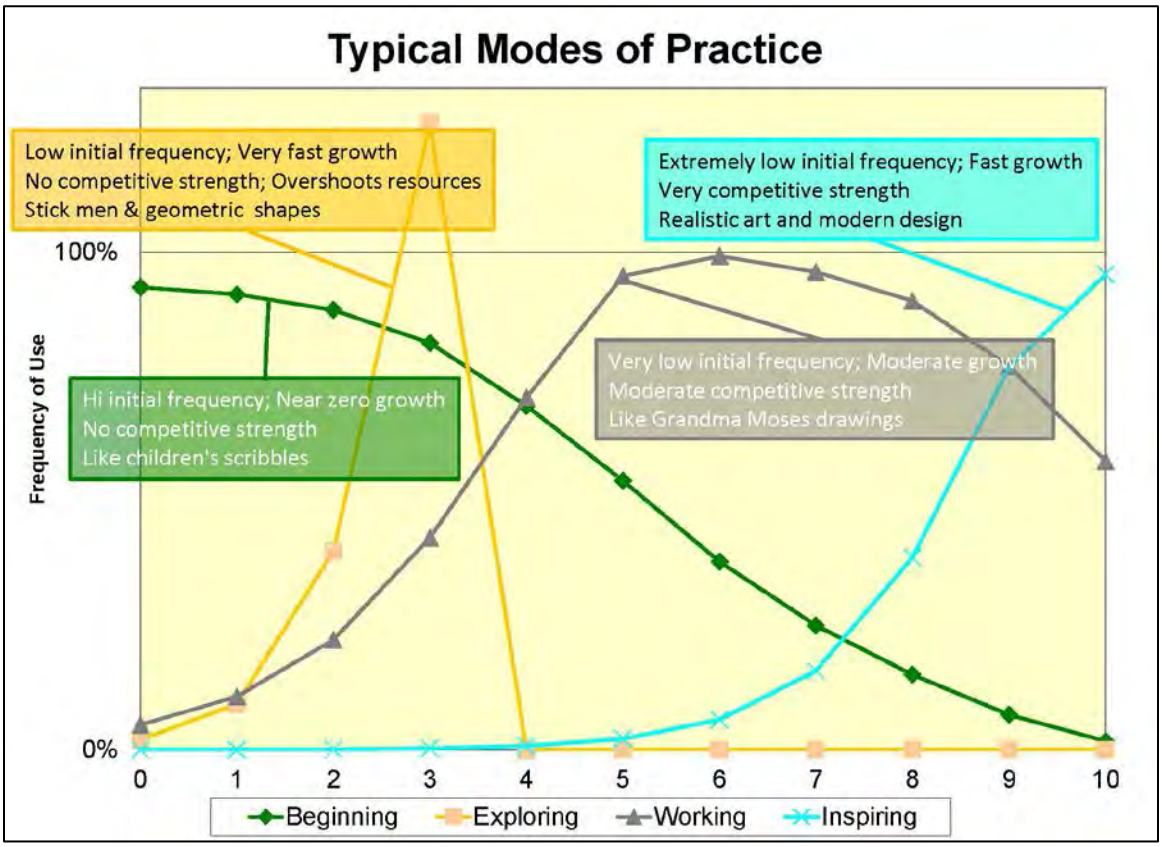

Figure 3. Modes of Practice showing how initial frequency, growth rates, and competitive strengths result in progressively more complex practices.

Contribution to Keston Fulcher Panel for AALHE 2016
Does Assessment Make Colleges Better?

David K. Dirlam[1]

1. **Does assessment make colleges better?**

   If assessment refers to summative, annual, close-the-loop cycles, no. Learning research is hard and results in low replication rates even for published articles. Many programs engage in amateurish learning assessment projects. But even if they consult learning researchers, the settings are different. College classrooms are not controlled labs and much student learning occurs during class preparation, not class time. Standardized tests further muddy the waters. The best they can offer is showing a need for a new course, but tests taken at the end of programs have no effect on students who took the test. That some students still put significant effort into them is more a testament to their good will than the quality of the results obtained.

   On the other hand, two types of formative assessment are essential for knowledge development. The first, feedback from practice, is most effective when frequent and close to the moment of practice. The second type is identification of multiple dimensions of developmental opportunities. If faculty are armed with a collectively constructed and often refined set of progressive knowledge commitments, this type of assessment can have remarkable effects. With it, we can achieve Robert Zemsky's[2] aim of a three-year degree costing less than today but resulting in better performance of graduates.

2. **Often, assessment is said to lead to "improvement". What does improvement mean to you?**

   Improvement is mostly about student needs for faster, more accurate, more effective performance in multiple dimensions of progressively more complex tasks. However, institutions also need to sustainably compete in fulfilling these needs at reasonable costs, with attractive lives for employees.

3. **In terms of evidencing student learning improvement, what are the biggest challenges?**

   There is a local and a societal challenge. The local one is to improve how people identify knowledge development. I recommend a five-step collaborative process:

   1. Assessment experts conduct developmental interviews with program faculty, combine them into developmental rubrics, and create on-line recording tools.
   2. Assessment experts make quick on-line course design surveys.
   3. Faculty frequently identify student progress to individual students, record it on-line, and annually submit course designs plus collaborate to refine the rubrics.
   4. Assessment experts analyze and summarize results for program faculty, who adapt instruction and program designs in response.
   5. Results are disseminated both regularly and nationally.

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[1] ddirlam@changingwisdoms.com Reading times: 1:30, 0:20, 2:30, and 1:35 minutes for each answer respectively.

[2] Zemsky, Robert (2013). *Checklist for Change.* New Brunswick, NJ: Rutgers University Press.

The societal challenge is to grasp and commit to the local challenge, by supporting and disseminating local efforts and disruptively innovating the three impediments to it: standardized tests, closed accreditation results, and trivial government oversight.

Society has explored testing for centuries and it has been a dismal failure. Tests aim to assess expertise development through problems addressed in minutes, hidden from public scrutiny and refinement, and producing no publically useful product or service beyond absurdly aggregated scores. This has not worked. In contrast, medicine, agriculture, ecology, and engineering train experts to identify the effects of long-term activities or projects using national standards, on the fly with external validation. A societal commitment to make such identification work for the acquisition of knowledge is necessary.

The second impediment is that the accreditation process hides results behind the closed door of institutional embarrassment rather than uses them to produce collective progress. Annual conferences help, but are poor substitutes for the collective, international description and scrutiny available through any academic library's on-line search tools.

Finally, simplistic governmental solutions like the College Scorecard and No Child Left Behind do more harm than good. Some check needs to be placed on abusive institutions that funnel government money from student loan guarantees into their proprietors' pockets. But that problem is more like finding and disciplining cheaters in a class than identifying and advancing the learning of conscientious students.

4. **As a network of assessment professionals, how can we best leverage our collective knowledge to answer Question 1 (Does assessment make colleges better)?**

We need to help teachers accurately identify student knowledge development on the fly, and get more societal respect and support for doing so.

We cannot accomplish this goal through isolated efforts of individual colleges. We need a national AALHE database of the Assessment of Learning in Higher Education with three Board-approved surveys of Learning Progressions, Course Designs, and Assessment Practices plus reports. The surveys would solicit input from ASSESS members. The database and reports would be read-accessible to AALHE members. There would be no financial cost to AALHE.

Each survey would include clickable target options of levels, programs, divisions, degrees, with an option to "describe other." Learning progressions would include descriptions of behaviors associated with several short series of progressively more complex developmental commitments. Course designs would include clickable options within each question of who, what, when, where, why, and how, plus "describe other". Assessment practices would include descriptions of problems, measures used, analyses, uses of results, reporting, how long they took to establish, and how many years they have been in place.

AALHE would openly solicit and review articles on interpretations and connections of the survey results plus produce an annual review by one or more Board-appointed contributor. AALHE would work toward getting the reports included in international library search tools.

Help teachers
accurately identify student
knowledge development
on the fly, plus
get more societal respect
and support for doing so.

Create and use an AALHE database with 3 surveys

1. Learning Progressions
2. Course Designs
3. Assessment Practices

Plus Articles Connecting and Interpreting the Results

How to Help Faculty Make Better Rubrics

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Abstract

Five-point scales and Sequences Which Expand Little by Little (SWELL rubrics) do not work. They do not discriminate levels of student experience, scaffold student learning, pinpoint areas for curricular improvement, or measure institutional effectiveness. This session will present four principles for making developmental rubrics that do work in all four ways. First, to create developmental rubrics, describe examples of *behaviors* (not judgements or impressions of quality). Next, choose *multiple dimensions* in order to reveal an enormous variety of patterns of expert behavior. Third, for each dimension use a dynamic *succession of levels* that depends on rates of growth and competition resulting from the combination of behaviors into complex units. Fourth, create developmental rubrics for extremely diverse *time scales* ranging from minutes to millennia. Examples and supporting evidence are described.

Key Words: developmental rubrics, expert behavior, dimensions of learning, succession model, assessment time scales, scaffolding, curriculum design, institutional effectiveness

Compelling evidence presented below reveals that many versions of assessment rubrics fail completely to show value-added for educational programs. This happens when rubrics are based on multi-point (or Likert) scales. Any time the same scale is used across several dimensions or criteria of learning, they are SWELL Rubrics, an acronym for Sequences Which Expand Little by Little. The following sequence is a common SWELL rubric: “needs much improvement, needs improvement, adequate, better than adequate, outstanding.” The well-known Value rubrics differ somewhat from dimension to dimension but still bear much resemblance to SWELL rubrics. Such rubrics resemble grades in that the average value for second year and fourth year students differs very little. Simply put, SWELL rubrics do not show value-added for educational programs.

In contrast, developmental rubrics powerfully discriminate levels of student educational experience. This is true when four basic principles are used within assessment surveys that contain several developmental dimensions, each listed as a multiple-choice question with the developmental levels as the options.

The data in Figure 1 are based on an assessment survey, which showed the difference between SWELL and developmental rubrics with extreme clarity. Sixteen faculty members rated every student in every course using a single form containing both a Likert-type Rating Scale that they had developed and developmental rubrics for which they were one of fifty participating interviewees. Figure 2 illustrates three of the twelve dimensions of developmental rubrics.

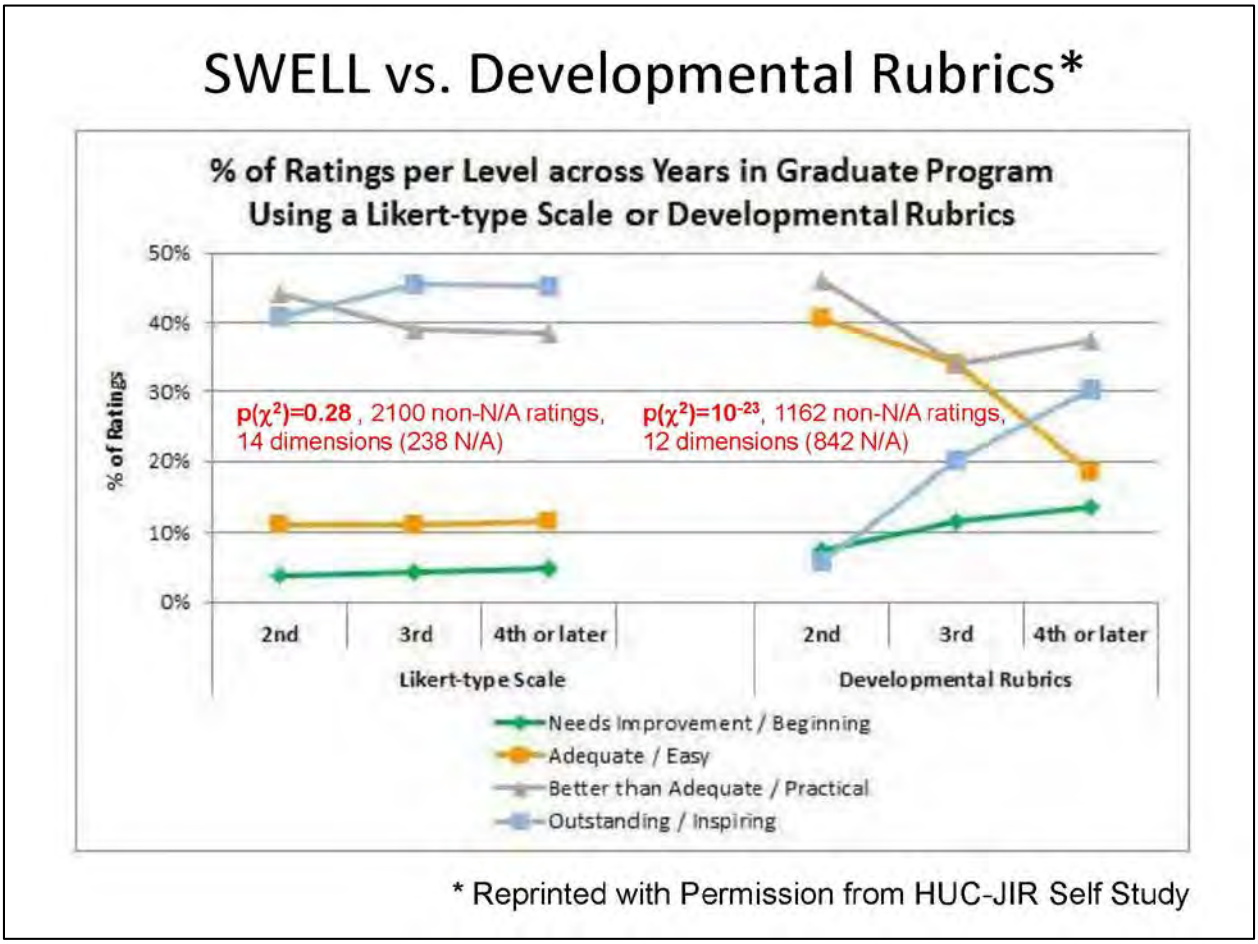

Figure 1. SWELL vs. Developmental Rubrics

	Beginning	Easy	Practical	Inspiring
Interpret Texts	Read at face value.	Seek data fitting their preconceptions.	Read for inspiration and identify important ideas.	Combine lenses, connect texts, expand boundaries, reframe, and apply to new context
Understand Contexts	Disconnected from knowledge of the past.	Read and describe influential surroundings in space and time, ± a few centuries.	Describe the writer's culture including time, place, community, ideology, economic situation, liturgy, and use of Jewish texts.	Connect multiple concepts through the ages simultaneously.
Use Hebrew Language	Know alphabet and try to sound out words.	Understand simple written and spoken texts relying on inter-language dictionaries, practical guides and translations.	Read, comprehend and translate simple unvocalized texts with limited use of lexical aids.	Sight-read multiple forms of ancient and modern Hebrew without multilingual aids.

Figure 2. Three dimensions of developmental rubrics for Rabbinical Studies

The purposes of this report are twofold: (1) to identify the four basic principles for creating developmental rubrics along with their foundational origins and (2) to describe how they can scaffold student learning, pinpoint areas for curricular improvement, and measure institutional effectiveness.

The Four Basic Principles for Creating Developmental Rubrics

To create developmental rubrics, people need to understand the structure and dynamics of development and what these mean for the development of expertise. Expertise develops along multiple dimensions involving a few transformations of behaviors each, whether within individuals, groups, institutions, or even cultures.

The Behavior Principle: *Developmental rubrics contain descriptions of examples of behaviors.*

Many rubrics fail because they focus on rater's judgments of impressions or feelings, rather than descriptions of learner behaviors. Rubrics creators should begin with behaviors that typify learner activities at different levels of expertise (see the Succession Principle below). Rubrics that try to define levels rather than describe typical behaviors also often fail because raters become stymied by borderline dilemmas. When rubrics creators and users understand the Succession Principle, examples of behaviors become more effective than definitions.

The Dimensions Principle: *Developmental rubrics consist of multiple dimensions.*

Most people think of rubrics as multidimensional, so the Dimensions Principle is easy to grasp. Choosing among dimensions, however, is more complex and the fundamental value of multiple dimensions is poorly understood. The criterion for whether two sequences are actually separate dimensions is when every level of one sequence can logically coexist with any level of another sequence. We know that for writing evaluation, audience and time frame are separate dimensions, because of examples like reflective diaries. Such writing is usually done for the writer only (egocentric audience), but can contain careful predictions and hopes for the future (timeless or future time frame). Thus, a developmentally primitive audience accompanies a very advanced time frame.

In general, every expertise develops along multiple dimensions. This is true empirically, because in over 300 one-to-two-hour interviews of experts, I have never had a respondent who could not identify multiple dimensions (though some respondents have not been able to identify a complete developmental sequence in the dimensions they generated). The fundamental value of multiple dimensions, on the other hand, has been obscured by data treatment practices that undermine that value. Assigning scores to levels and then averaging up the scores is a faulty use of statistics, because as the Succession Principle below will show, the distributions of scores within each level are decidedly non-normal. More importantly, combined scores obscure the patterns. Expert behavior is enormously diverse. Ten dimensions of rubrics contain an easy-to-master 40 concepts. But those 40 concepts reveal $5^{\wedge 10}$ (nearly 10 million) patterns of behavior. If the levels for each dimension are analyzed separately rather than muddled into averages, the design of courses and curricula can be informed by the specific impacts of those practices on each dimension of development.

The Succession Principle: *Developmental rubrics show a dynamic succession of levels.*

In his renowned classic on the "Problem of Serial Order in Behavior", Karl Lashley (1951) showed that each level of expertise requires practice before it transforms to the next level. Thus, a beginning typist pecks at letters. After enough practice at finding letters, typists transform their activity to typing words. After extensive more practice, whole phrases or even sentences become the unit of typing. Each transformation is accompanied by a jump in typing speed and accuracy.

A similar sequence occurs in the development of drawing behaviors (Dirlam, 1980 and 1997). Children first scribble lines, later organize lines into geometric shapes, and later still organize the shapes into compositions. In writing (Moffett, 1968, and Dirlam, 1980), learners begin egocentrically writing for themselves, transform their thinking to address other people in correspondence, later address whole groups in presentations or newsletters, and ultimately commit to addressing abstract, general audiences.

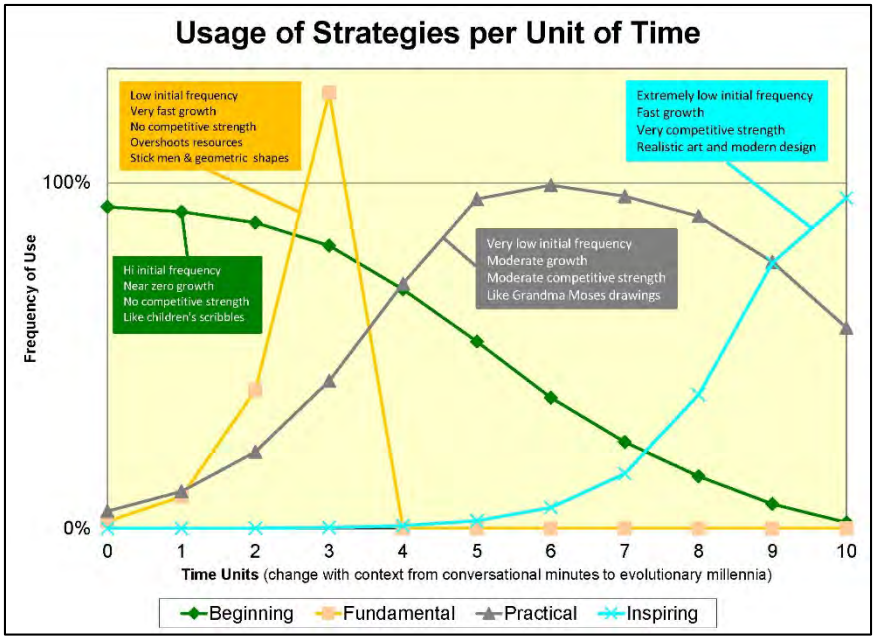

Figure 3. Succession Model for Creating Developmental Rubrics

Developmental transformations also occur historically in whole groups of people. Thus, Dirlam, Gamble, and Lloyd (1999) found that developmental researchers counted events in the early 20th century and sought statistical differences between groups of events beginning in mid-century. Likewise, they first applied their results to other researchers and later to the general public.

Ratings from thousand-sample studies of both drawing and developmental research fit the succession model generalized from ecology's Lotka-Volterra equation by Dirlam et al. (1999). An example is in Figure 3. Beginning approaches (lichens, scribbles, and counts) are at first very common, but do not grow or compete. Simple approaches grow quickly (weeds, stick-people, and difference statistics) but overshoot the resources (for behavior, often acceptance by others) and disappear. Practical approaches (softwoods, folk art, complex statistics) emerge more slowly but are more competitive. Inspiring approaches (climax forest, fine art, advanced mathematical analyses) are most competitive. Hundreds of academic interviews in scores of fields have shown that these levels readily correspond to higher education milestones with progressively longer acquisition times. These milestones are (1) what students do in their first attempts on the first day of an introductory course, (2) what they do by the end of that course, (3) how they differ by the end of a multi-year program, and (4) what their approaches are a decade after graduation. Beginners try the activity; learners acquire the basics; practical approaches contribute to organizations; inspiring approaches contribute to disciplines or the lives of others.

The Scaling Principle: *Developmental rubrics can be created for extremely diverse scales of times and spaces.*

Dynamic successions in such an incredible diversity of individual, institutional, and historical development are not accidental. We can use the insights of Erdos and Rényi (1961) to show that such progressions have a mathematical basis. If we begin with isolated nodes (think random dots on a paper) and then link pairs of nodes at random (lines between the dots), a remarkable

progression appears. The links haphazardly create little tree structures until the average number of links per node approaches one. Then within a relatively small number of new links, a phase shift to a *giant component* occurs that links nearly all nodes together. These giant components contribute to transformations in learners. Beginners have few options (e.g., typewriter keys), so giant components of patterns of behavior (words) emerge quickly. These components then become nodes for the next level (word typing). Since each new node is a unique pattern of elementary nodes, the number of new nodes and links needed for new giant components is exponentially larger than the earlier level (e.g., a few letters form millions of words). It thus, takes much longer for the giant components to emerge at this level. Such transformations to new levels occur only one or two more times, while the sheer complexity limits the completion of a fourth level. It is, therefore, at this fourth level where innovations and discoveries become possible. Because of the mathematics that underlies development, developmental rubrics exist at extremely diverse time scales.

Ideas for Using Developmental Rubrics

Scaffolding Student Learning

Developmental rubrics "scaffold" student learning when instructors have well-practiced familiarity with each level of each dimension. Vygotsky (1935/1978) discriminated a person's independent problem solving from his or her potential solutions under the guidance of a more developmentally advanced person. To scaffold is to instruct in a child's level of potential development. A teacher reading a beginning writer's egocentric story might ask the writer what his or her best friend thought of it. Thus, the teacher "scaffolded" the pupil's "diary" level of audience with a "correspondence" level of audience. For a class accustomed to writing letters to each other, a scaffolded assignment would involve students making presentations to their whole class. In turn, such presentations are important precursors to writing for abstract audiences. In the 1970's, a group of campus-school teachers from the State University of New York at Plattsburgh held 30 one-hour meetings to refine eight dimensions of writing development. In the process, they learned the developmental rubrics so thoroughly that they commonly used them in interactions and lesson plans with their elementary school pupils. A representative of the NY State Education Department on a consulting trip reported that the fifth grade students, which three years earlier had been a year behind grade level, could all pass the regents high school writing exam. The next section shows the potential for higher education curricular design for developmental rubrics even without the deep familiarity shown by the campus-school teachers.

Pinpointing Areas for Curricular Improvement

At last year's AALHE meeting (see the 2014 Proceedings), I reported on a Course Design Survey used by a Communication program. The faculty filled out a survey with several options each to answer basic questions about their courses: who did what, when, where, why, and with what resources. They also rated every student in every course using nine dimensions of developmental rubrics. Analysis revealed that two weeks devoted to presentations in a 200-level course resulted in dramatically more sophisticated performance on the senior research project. Determining the impact of such course design features is much less threatening to academic freedom than determining the impact of courses. Faculty members can choose to modify their syllabi to add approaches shown to be effective for their programs much easier than they can modify whole courses.

	Dimension	Option 1	Option 2	Option 3	Option 4
PREPARATORY ISSUES	**Assessment Problem**	INSTRUMENTAL Comply with college, Federal financial aid, or accreditation requirements.	DEMONSTRATION Show what the program has accomplished.	PROGRAM QUESTIONS Learn things about the program that nobody has the answer to, e.g. what approaches to instruction are most effective.	INNOVATION Find and test new ways to have impact on students that endure for decades and generate emergent effects.
	Program Student Learning Outcomes (PSLOs)	UNMEASURABLE Stated in such a way that no unambiguous measure can be developed.	INCOMPLETE Too few (< 5) or represent only a minor portion of the program's mission.	COMPREHENSIVE Created either by a disciplinary accrediting agency or departmental faculty, the outcomes reflect all aspects of the program's mission and offerings (e.g., faculty create descriptions of levels based on student work samples or developmental interviews).	UNIQUE AND ANALYTICAL Collaboratively adapted rewordings of comprehensive outcomes for greater validity, reliability, program identity, and ease of communication to students and the public.
METHODS	**Level(s) of Students Who Provide Assessed Work**	SUMMATIVE Program raters assess work from only one course (usually at the capstone level).	FORMATIVE Program raters assess work from specified Entry, Midpoint, and Capstone Courses.	PROGRAMMATIC Each student is assessed at least once per course.	INTERACTIVE Assessment details are mentioned during spontaneous interactions of program faculty with students in all courses.
	Kinds of Program Assessment Measure(s) Used	DESCRIPTIONS Grades or narrative descriptions.	GENERIC Generic measures only loosely connected to PSLOs, such as standardized tests or Likert-scale ratings with sequences that expand little by little (SWELL rubrics) and are the same for multiple criteria.	DEVELOPMENTAL At least one faculty member assesses classroom artifacts from representative students using a tool that provides a measure of reliability and discriminates levels of student experience defined by the PSLOs (i.e. developmental rubrics).	MULTIPLE Assessments are compared with student performance on developmental ratings and a second type of assessment measure.
RESULTS	**Number of Assessment Cycles**	1 YEAR	2+ YEARS COMPARED	1 COHORT (4 YEARS)	MULTIPLE COHORTS
	Analysis	PERCENTAGES OR DESCRIPTIONS The % of students at each level who have achieved the PSLOs or a general description of student performance.	RELIABILITY Correlations or percentages of agreement between independent raters or test-retest reliability either from a locally made test or from the standardized test documentation.	DIFFERENCES Tests for statistically significant differences between student experience levels.	NETWORK Networks of mutualistic or competitive activities. Course impact scores from a network of learning outcomes ratings.
CONCLUSIONS	**Program or Assessment Changes**	DEMONSTRATE Show value gained by students from the program.	CRITIQUE Show some areas for potential curricular innovation or assessment improvement.	EXPERIMENT Compare differential effects of curricular approaches.	CONTRIBUTE Help the assessment and accreditation communities improve their practice.
	How would you like to disseminate your results and conclusions?		INSTITUTIONAL PROFESSIONALS Only internally (e.g., members of the program department, academic administration, Academic Effectiveness Committee members, and accrediting agency representatives).	INSTITUTIONAL STAKEHOLDERS Current and prospective VWC students, parents, and staff as well as institutional professionals. (put it on vwc.edu/wiki or add highlights to your program brochure).	THE PUBLIC Would you be interested in working with the OIEA or Communications Office to present your results at conferences or in a professional journal, to prospective employers of our students, magazines, or newspapers?

Figure 4. VWC Student Learning Assessment Report Rubrics for 2015

Measuring Institutional Effectiveness

At the AALHE meeting two years ago and in my Keynote Address at the 2014 New England Educational Assessment Network's Fall Forum, I reported on the use of multidimensional rubrics for the development of institutional learning assessment. The current rubrics are attached here in Figure 4 for ease of access. A similar version was used three years ago to evaluate Student Learning Assessment Reports (SLARs) provided by every program at Virginia Wesleyan College. The next year the rubrics were put into a template for the reports, so that every assessment coordinator became familiar with them. Independent ratings of these reports by the Co-Chairs of the College's Academic Effectiveness Committee revealed no differences between these first two years. In the third year, however, the program assessment coordinators had seen the opportunities afforded by more sophisticated options than they had used the year before. This year, the reports showed very dramatic increases in the sophistication along most of the dimensions of assessment.

The one dimension that did not show such improvement was "Assessment Problem." This result confirmed that identifying a good problem for learning assessment is as difficult as identifying a good research problem. The Course Design Survey mentioned above solves that common problem. The highly significant advances in other SLAR dimensions shows the power of allowing rubrics users to choose their level. The developmental SLAR template, therefore, scaffolds the development of assessment expertise. When faced with demands involving a new area of expertise, everyone progresses through successive levels. Acquisition of expertise in one area may speed up acquisition in other areas, but scaffolding still is the most efficient way to develop.

Conclusions

Developmental rubrics discriminate value added of instruction astronomically better than other sorts of rubrics. In order to create developmental rubrics people need to describe *behaviors* indicative of beginning, learning, practical application, and innovation or discovery. They also need to organize these into multiple dimensions that develop independently. A critical principle in making developmental rubrics that discriminate most effectively is to attend to the succession in which beginning strategies decline; learning strategies overshoot resources and crash; practical strategies endure for years as slower growing but more competitive; but inspiring strategies are the most sustainable due to their very high competitive strengths. Finally, because of the mathematical nature of development, developmental rubrics can apply not only to educational settings but also to extremely diverse time frames ranging from the minutes of conversational development to millennia of historical or ecological development.

When instructors know developmental rubrics well, they can use them to scaffold student learning. If supplemented by a course design survey, analysis can pinpoint areas for curricular improvement. Finally, we can scale developmental rubrics up from individuals to groups in order to measure and scaffold the development of various aspects of institutional culture.

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The Course Design Survey: A critical link in formative program assessment

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Abstract

Program assessment gets exciting when faculty make educationally useful discoveries. There has been much recent interest in a small number of "High Impact Practices." Considering that only a few educational practices have high impacts, however, implies educational usefulness is a "settled" issue. Course Design Survey (CDS) enable assessors to identify learning impacts for an astronomically large number of educational practice patterns using an easily countable number of options checked in a simple survey. This workshop describes how a CDS advances assessment, how to create them, how to identify useful analyses for various formative assessment designs, and includes a sample survey.

Keywords

developmental rubrics, learning outcomes network, course design survey

In an ASSESS Listserv posting last January, Ephraim Schechter offered an elegant solution to the problem of public disclosure impacting assessment bias. He proposed that "real accountability includes also reporting the data's impact on planning…. Closing the loop this way, providing context for data by saying what they told you and what you did or plan to do as a result, makes sense whether or not you're happy with what you found." Programs can be proud when their assessment results help them make discoveries about learning. A Course Design Survey combined with Learning Outcomes Network ratings provides a way to ensure that programs will make discoveries: i.e., given a reasonable sample size (and our college of 1400 is plenty big) the probability of not discovering something reduces nearly to zero.

There were four steps from several different institutions in creating this impossible-to-avoid-discovery design. First, we used developmental interviews to create multidimensional rubrics with four levels for each practice:

1. Beginning involves taking a few minutes to try an activity
2. Fundamental involves taking a few months to learn basics about it
3. Practical involves taking a few years to get good enough to earn a living with the activity
4. Inspiring involves taking decades to contribute to the field

A single set of such rubrics can be used to rate student progress in any course across an entire program. They make it possible to compare student progress to a standard and beyond. They also

result in enormous value-added effects, in contrast to grades which have similar averages for sophomores and for seniors.

The second step is to use such developmental rubrics to rate every student in every course across an entire program. Such a Learning Outcomes Network (LON) was first created at Hebrew Union College several years ago. After the first few terms of use, the bias-in-reporting problem discussed on ASSESS became apparent. With LON data it was possible to calculate both a reliability score and an impact score for all but capstone courses. Both calculations require a comparison across predecessor and successor instructors. If an instructor rates most of his or her students higher on a dimension than all predecessor instructors, then there are two interesting possibilities for successor raters. On the one hand, if the successors rate the students the same as the predecessors (meaning lower than the instructor in question), then either the instructor had too rosy an idea of the student progress or the learning that was used for the rating was not sustained. On the other hand, if the successor instructors agreed with the higher ratings, then the course in question had a high impact on learning within that dimension. The trouble with reporting impacts, however, was what happens when a course has no impact? My solution was to get permission to report the impact results only to the instructor of the course in question. I was granted that permission and carried the problem to my next place of employment, Virginia Wesleyan College (VWC), where I was granted the same permission. Reporting such individual assessment results is basically the same problem for instructors as sharing assessment results on line is for programs.

The remaining steps for creating the impossible-to-discover-nothing design occurred at VWC. One of the things that attracted me to the college was that the faculty had very recently undergone a wholesale curriculum revision from five three-credit courses per term to four four-credit courses. For every course change proposed for this new 4-by-4 curriculum, faculty had to identify which of eleven "enhancements" (plus "other") would account for the additional credit hour. The third step emerged after a year of working toward LON assessment when a faculty committee identified that we could solve the problem of reporting course impacts by focusing instead on educational enhancement practices that were used across courses. We could calculate the impact of practices rather than the impact of courses. When a practice was used multiple times and found to have no impact, instructors would be much less defensive than if their courses were found to have no impact. They could keep the course and change the practice--exactly the kind of outcome Schechter sought.

However, a problem that engendered the final step became immediately apparent. Richard Bond, our Director of General Studies, had helped to create the original list of enhancements and criticized it as being mostly "seat-of-the-pants" and requiring a more careful look. George Kuh's (2008) eleven "high impact practices" were certainly interesting in this regard, but most of them were in the list that the committee found unsatisfactorily abrupt. The solution was prompted by

Robert Zemsky's (2013) sage advice in his *Checklist for Change:* "It is advantageous to disaggregate the traditional instructional format into a set of more or less discrete activities."

We in the assessment community have been disaggregating learning for decades, but few of us have systematically disaggregated instruction. We set about identifying six dimensions with five to nine elements of each: (1) social contexts, (2) locations, (3) instructor roles, (4) preparation strategies, (5) evaluations used, and (6) resources needed. Our faculty committee came up with a term "Course Design Survey" and helped to streamline the form for easy entry. The first set of figures at the end of this document show the three pages of the draft of our current Course Design Survey. Instructors identify which of 2 levels of emphasis (major or important) for each course design strategy. The result is millions of possible patterns of strategies – certainly better than eleven. We can look for high probability patterns of the elements across any or all of the programs in the college. Given the rich data that we get from our LONs, the odds of us discovering some approaches that work better than others are astronomically good.

The Couse Design Survey leaves faculty free to design courses as they see fit and to change course designs from one term to the next. Given the power of the novelty effect in educational research, we should not expect that our solutions would often be permanent or universal. But the survey takes a minor fraction of an hour, and the LON ratings only one or two minutes per student. Both are small fractions of the time it takes to write a syllabus or to compile final grades. And the solutions should be useful not only to us, but to other institutions.

The key to public disclosure, as Schechter implied, is discovery. It needs to happen and we need to share it. Combining LONs with Course Design Surveys provides a powerful method for enhancing both.

Faculty members from programs, which had done especially complete work on their LON ratings this academic year, were asked to pilot the CDS. The Communication program faculty provided over 400 ratings this year, so analysis began with their data. Clustering of course design elements was based on 77 design submissions.

Analysis began with determining the similarity between two courses. This was done by assigning numbers to each of the affirmative answers and deciding whether to discriminate extent of usage. If not, a binary distribution results (0 for not checked and 1 for checked). If so, you will have a time-weighted distribution (0 for no mention, 0.25 for “Important”, and 1 for “Major”). For most of us, the most familiar clustering methods involve the Pearson correlation which can be used with either distribution (with binary distributions it becomes the phi coefficient). Researchers will need to choose whether to include items that were not used in either course. Including them will tend to increase the correlation and since the list is not exhaustive, the increase is likely to be exaggerated.

Another clustering method is Keyword Network Deconstruction (KND) that I have written about in the AALHE Methodology Blog (http://aalhe.org/blogs/methodology/text-analysis-tools). This involves counting the number of co-occurring links[1], averaging that number for all of the items, and then "deconstructing" the network by subtracting the same number from all the co-occurrences until the average is approximately one (co-occurrence per link). The final number of the subtraction is the "deconstruct number." Then, sort the remaining practices by the maximum number of co-occurrences for each and then the first group becomes all the practices that co-occur with the one with the most links. Remove this group and reset the deconstruct number to a value that sets remaining average near one. Redo the process above for each group.

Using either way of clustering the course design practices (correlations or KND), meaningful names for each cluster need to be created. The final analysis step, then, begins with identifying the experience with the cluster of practices that each student has had in the courses taken within the program. This is absolutely essential to making sense of the data.

No educational practice exists in isolation. This truism often gets buried in the typical methodological approach of isolating a factor for study. But it is impossible to calculate the impact of a practice on learning in isolation from other practices. Experience with a cluster of educational practices can contribute to the acquisition of one LON level in each learning dimension in only 3 ways: advancing its appearance, delaying its appearance, or having no effect. This means that the general rate of progression becomes the expected value for the emergence of any learning outcome.

The last figure at the end of the paper shows the effects of one course design cluster on the nine learning outcomes dimensions of the Communication program at Virginia Wesleyan College. The Presentation cluster included Evaluation Basis – Presentation, Social Context – Other Group, Social Context – Small Student Group, Instructor Role – Facilitate Collaboration, and Preparation – Collaborate or Discuss. The charts on the left side of the figure show the influence of progressively greater use of the Presentation cluster while the right side is the progress of the students overall. Significance levels of the chi-squares comparing the left with the right data are shown in the chart titles (*-0.05, **-0.01, ***-0.001, etc.). The conclusion for the nine dimensions of learning is that "partial course use of the presentation cluster had large positive effects on Program Level performance for Research, Historical Context. That one course (in Public Speaking) produced program level performance in research and historical context suggests that early use of the presentation cluster could motivate development in other dimensions. The department's prior requests for enough staffing to make this a requirement is supported by this data. Possibly the significant effects on Public Communication and Film Style & Narration for partial course use of presentations could be connected to differences in

[1] The co-occurrences can be readily modified to address the time-weighted approach simply by using counts of 0.25 instead of one for the courses that only have the practice used an "Important" amount of time.

interpretation involving beginning and easy definitions." Thus, the Presentation cluster might effectively be used earlier as a small but important part of more courses at the early level and even to scaffold effects of other practice clusters like writing essays or reports and searching for information, analyzing data and integrating or synthesizing. The five other clusters had equally interesting results.

The writing cluster produced a contrasting outcome. In this case "the cluster mirrored the whole program well, reflecting the fact that Communication is a 'Writing intensive department.' The large number of Beginning ratings for Partial use in Public Communication is due to the assignment to write an outline for personal use during the presentation. Personal use is part of the definition of Beginning Public Communication." The other four clusters produced equally distinct outcomes.

In general, the CDS shows that disaggregating course designs using a CDS generates an enormous number of possible relations between design elements and learning outcomes. Clustering the design elements makes it possible to identify practices that have unusual impacts on learning. But no practice exists in isolation. So called High Impact Practices only have high impacts relative to a rich background of other practices. It would take a truly radical and probably unnecessary educational experiment to determine if a particular high impact practice (like the one found here of using Presentations as parts of courses) would work in isolation. The CDS does for higher education assessment research what biodiversity methods do for ecology (c.f. Dornelas, et al., 2014): it provides a holistic overview of how the units of analysis co-occur.

Finally, the analysis of Course Design Survey and LON data can also identify low impact practices without posing a personnel evaluation threat to anyone using them. Armed with distinctions between what is working and what is not in a program, the faculty can use the results to propose changes designed to improve the program. These become inspiring assessment problems.

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EMERGENT DIALOGUES IN ASSESSMENT, AALHE, 2014

Course Design Survey-AALHE

Data from this Course Design Survey will greatly improve the "use of assessment results." Coupled with results from the Learning Outcome Network (LON), it will show what practices are having the most impact and it can do so without identifying individual faculty members.

Questions 3-5 on the next page refer to how you spent the instructional hours on the registration schedule. Question 6 and 7 on Page 3 refer to any time resources and preparation. The survey typically takes a few minutes per course. When you have finished each course that you taught in the last term, click "Done" and the screen will be ready for you to enter the next course. Please use the "Other" boxes to suggest options that should be added.

***1. Instructor email address prefix**

***2. Course Identifier (use Rubric Number as in ART 105)**

In items 3 through 7 below, please indicate whether the characteristic was a major or important part of of the time the hours assigned to the course by the Registrar. Leave blank for activities that are minor or not on the syllabus. MAJOR is 4 or more weeks (normally 16 class periods). IMPORTANT is 1 to 4 weeks (4 to 15 class periods).

Next

+

Course Design Survey-AALHE

Page 2. Questions about Scheduled Class Time

3. Social Contexts (Who will they interact with during class periods?)

	MAJOR (4+ wks)	IMPORTANT (1-4 wks)
No one	○	○
Instructor	○	○
Small student group	○	○
Whole class	○	○
Other college group	○	○
Other non-college group	○	○
Other (rate here; describe below)	○	○

Description of other

4. Locations for each instructional session (Where will classes be held?)

	MAJOR (4+ wks)	IMPORTANT (1-4 wks)
Classroom, lab, or studio	○	○
Librray	○	○
Other on campus	○	○
Off-campus (field or cultural event)	○	○
Off-campus (internship or service)	○	○
Travel inside USA	○	○
Travel outside USA	○	○
Other (rate here; describe below)	○	○

Description of other

5. Instructor Roles for each instructional session (How do you plan to spend class periods?)

	MAJOR (4+ wks)	IMPORTANT (1-4 wks)
Present or lecture	○	○
Describe & critique methods use	○	○
Facilitate collaborative learning	○	○
Research advisor	○	○
Event or Travel Guide	○	○
Internship or service advisor	○	○
Other (rate here; describe below)	○	○

Description of other

Prev Next

EMERGENT DIALOGUES IN ASSESSMENT, AALHE, 2014

Course Design Survey-AALHE

Page 3. Any time activities

Rough estimates are OK. Over 30 hours or 1/4 of the time is MAJOR and over 12 hours or 1/10 of the time is IMPORTANT.

6. Preparation (How are students supposed to spend their time preparing for class?)

	MAJOR	IMPORTANT
Read and analyze text	○	○
Write	○	○
Analyze data	○	○
Synthesize and integrate	○	○
Search for information	○	○
Compose or design	○	○
Practice skills	○	○
Collaborate or discuss	○	○
Other (rate here; describe below)	○	○

Description of other

7. Evaluation Basis

	MAJOR	IMPORTANT
Tests	○	○
Essays	○	○
Presentations or performances	○	○
Artworks or products	○	○
Multiple observations	○	○
Research or project report	○	○
Class participation	○	○
Other (rate here; describe below)	○	○

Description of other

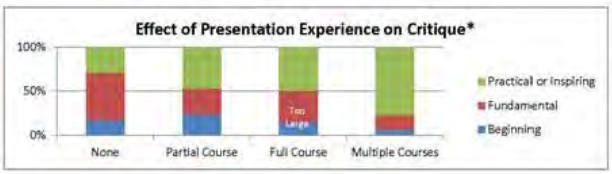
8. Resources (What resources must students use to be successful in the course?)

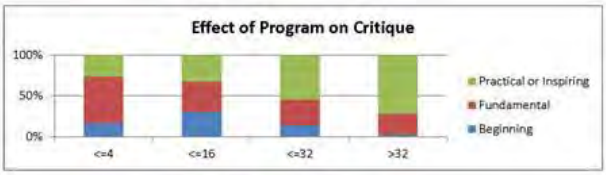
	MAJOR	IMPORTANT
Assigned books	○	○
Library research materials or databases	○	○
Objects or materials	○	○
Computers (incl internet)	○	○
Equipment or instruments	○	○
Other (rate here; describe below)	○	○

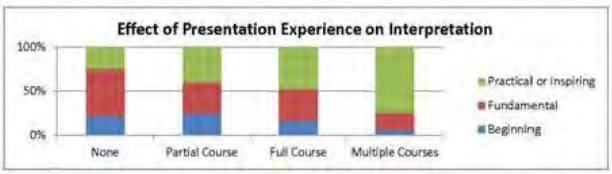
Description of other

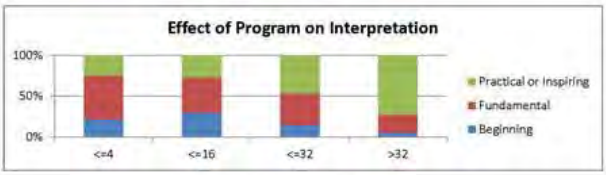
9. Comments

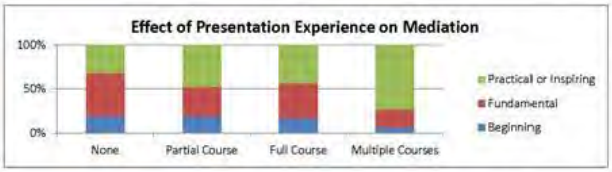
Effects of Amount of Use of the Presentation Cluster on Nine Developmental Dimensions of Communication

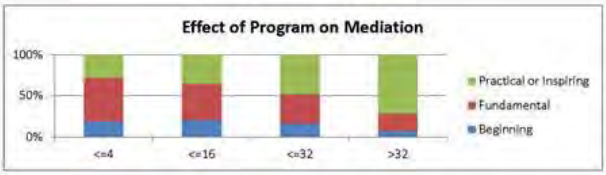


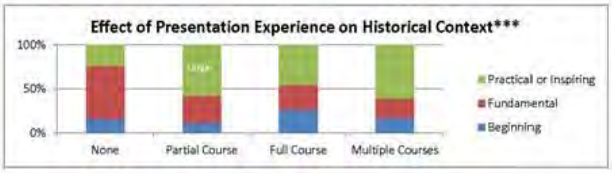


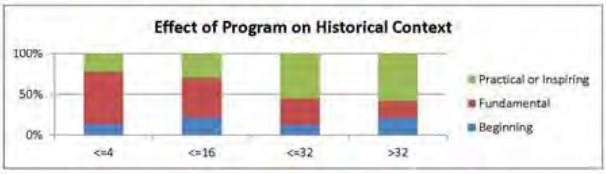


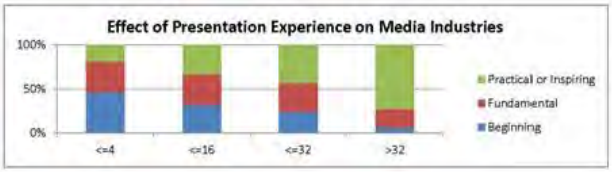


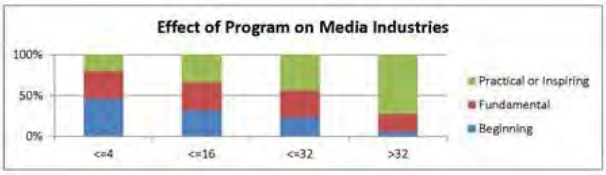


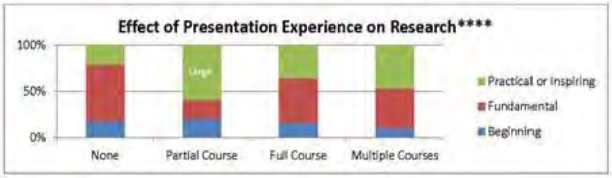


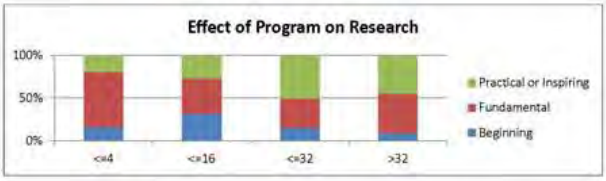


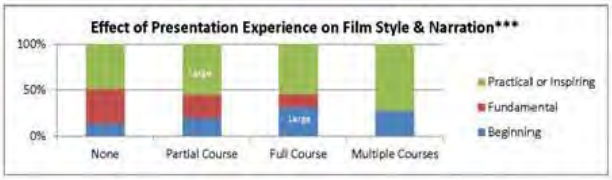


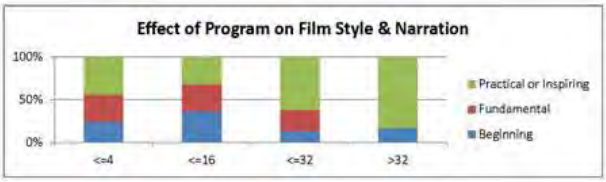


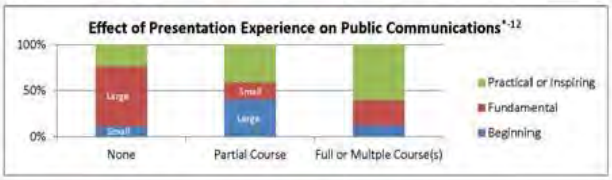


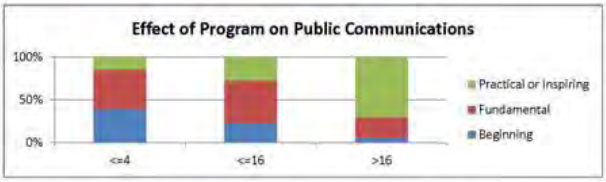


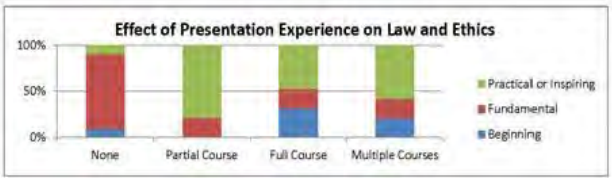


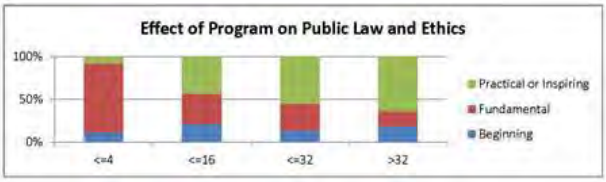












The Course Design Matrix: A critical link in formative program assessment

David K. Dirlam
(and full time faculty in any program(s) completing their CDS and LON ratings for this year).

Virginia Wesleyan College

Abstract

Program assessment gets exciting when faculty make educationally useful discoveries. Considering that few educational practices have high impacts, however, implies educational usefulness is a "settled" issue. Course Design Matrices (CDMs) enable assessors to identify learning impacts for an astronomically large number of educational practice patterns using an easily countable number of options checked in a simple survey. Participants in this workshop will learn how CDMs advance assessment, create CDMs, identify useful analyses for various formative assessment designs, and receive a sample survey.

Keywords

developmental rubrics, learning outcomes network, course design survey

In an ASSESS Listserv posting last January, Ephraim Schechter proposed an elegant solution to the problem of public disclosure impacting assessment bias. Programs can be proud when their assessment results help them make discoveries about learning. A Course Design Survey combined with Learning Outcomes Network ratings provides a way to ensure that programs will make discoveries: i.e., given a reasonable sample size (and our college of 1400 is plenty big) the probability of not discovering something reduces nearly to zero.

There were four steps from several different institutions in creating this impossible-to-avoid-discovery design. First, we used developmental interviews to create multidimensional rubrics with four levels for each practice:

1. Beginning involves taking a few minutes to try an activity
2. Fundamental involves taking a few months to learn basics about it
3. Practical involves taking a few years to get good enough to earn a living with the activity
4. Inspiring involves taking decades to contribute to the field

A single set of such rubrics can be used to rate student progress in any course across an entire program. They make it possible to compare student progress to a standard and beyond. They also result in enormous value-added effects in contrast to grades which have similar averages for sophomores and for seniors.

The second step is to use such developmental rubrics to rate every student in every course across an entire program. Such a Learning Outcomes Network (LON) was first created at Hebrew Union College several years ago. After the first few terms of use, the bias-in-reporting problem discussed on ASSESS became apparent. With LON data it was possible to calculate both a reliability score and an impact score for all but capstone courses. Both calculations require a comparison across predecessor and successor instructors. If an instructor rates most of his or her students higher on a dimension than all predecessor instructors, then there are two interesting possibilities for successor raters. On the one hand, if the successors rate the students the same as the predecessors (meaning lower than the instructor in question), then either the instructor had too rosy an idea of the student progress or the learning that was used for the rating was not sustained. On the other hand, if the successor instructors agreed with the higher ratings, then the course in question had a high impact on learning within that dimension. The trouble with reporting impacts, however, was what happens when a course has no impact? My solution was to get permission to report the impact results only to the instructor of the course in question. I was granted that permission and carried the problem to my next place of employment, Virginia Wesleyan College, where I was granted the same permission. This is the same problem, on an individual level as sharing assessment results, on line.

The third and fourth steps for creating the impossible-to-discover-nothing design occurred at VWC. One of the things that attracted me to the college was that the faculty had very recently undergone a wholesale curriculum revision from five three-credit courses to four four-credit courses and for every course change they had identified which of eleven "enhancements" (plus "other") would account for the additional credit hour. After a year of working toward LON assessment a faculty committee identified that we could solve the problem of reporting course impacts by focusing instead on educational enhancement practices that were used across courses. We could calculate the impact of practices rather than the impact of courses. When a practice was used multiple times and found to have no impact, instructors would be much less defensive than if their courses were found to have no impact. They could keep the course and change the practice--exactly the kind of outcome Schechter sought.

However, a fourth problem became immediately apparent. Richard Bond, our Director of General Studies, had helped to create the original list of enhancements and criticized it as being mostly "seat-of-the-pants" and requiring a more careful look. George Kuh's (2008) "high impact practices" were certainly interesting in this regard, but most of them were in the list that the committee found unsatisfactorily abrupt. The solution was prompted by Robert Zemsky's (2013) sage advice in his *Checklist for Change:* "It is advantageous to disaggregate the traditional instructional format into a set of more or less discrete activities."

We in the assessment community have been disaggregating learning for decades, but few of us have systematically disaggregated instruction. We set about identifying six dimensions with a five to nine levels of each: (1) social contexts, (2) locations, (3) instructor roles, (4) preparation

strategies, (5) evaluations used, and (6) resources needed. Our faculty committee came up with a name "The Course Design Survey" and helped to streamline the form for easy entry. When instructors identify which of 2 levels of emphasis (major or important) for each course design strategy, there millions of possible patterns of strategies--certainly better than 11. We can look for high probability patterns of the 36 components across any or all of the programs in the college. Given the rich data that we get from our LONs, the odds of us discovering some approaches that work better than others are astronomically good.

The Couse Design Survey leaves faculty free to design courses as they see fit and to change course designs from one term to the next. Given the power of the novelty effect in educational research, we should not expect that our solutions would often be permanent or universal. But the survey takes a minor fraction of an hour, and the LON ratings only one or two minutes per student. Both are small fractions of the time it takes to write a syllabus or to compile final grades. And the solutions should be useful not only to us, but to other institutions.

The key to public disclosure, as Schechter pointed out, is discovery. It needs to happen and we need to share it. Combining LONs with Course Design Surveys provides a powerful method for enhancing both.

Analysis begins with determining the similarity between two courses. This can be done by assigning numbers to each of the affirmative answers and deciding whether to discriminate extent of usage. If not a binary distribution results (0 for not checked and 1 for checked). If so you will have a time-weighted distribution (0 for no mention, 0.25 for “Important”, and 1 for “Major”).

For most of us the Pearson correlation is the most familiar and can be used with either distribution (with binary distributions it becomes the phi coefficient). Researchers will need to choose whether to include items where that were not used in either course. Including them will tend to increase the correlation and since the list is not exhaustive, the increase is likely to be exaggerated.

A more direct measure is to use the Jaccard index, a measure of similarity developed at the turn of the last century to compare biomes, which is still in use today (see Dornelas, et al. 2014). This relatively simple calculation is basically the number of co-occurrences divided by the total number of occurrences of two items and excludes the cases where neither course uses a strategy. This number can be readily modified to address the time-weighted approach simply by only adding 0.25 when one of the courses uses a strategy a “Major” amount of time and the other only an “Important” amount of time.

Armed with either index courses can be sorted into groups that have high similarity. If a program has developed a Learning Outcomes Network, it is then a straightforward to task to determine for each dimension in the program’s LON whether courses taken after any or several

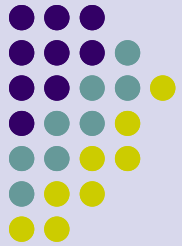
of those in the group result in ratings of a developmentally higher value than those taken before the group in question. The percentage of sustained increases is the impact of the approach on that dimension. The analysis of Course Design Survey and LON data can also identified low impact practices without posing a personnel evaluation threat to anyone using them. Armed with distinctions between what is working and what is not in a program, the faculty can use the results to propose changes designed to improve the program. These become inspiring assessment problems.

Dornelas, M., Gotelli, N.J., McGill, B. Shimadzu, H. Moyes,F, Sievers, C, and Magurra, A. E. (2014). Assemblage Time Series Reveal Biodiversity Change but Not Systematic Loss, Science, **344**, 296-299.

Kuh, George D. (2008). *High-Impact Educational Practices: What They Are, Who Has Access to Them, and Why They Matter*. Washington, D.C.: Association of American Colleges and Universities.

Zemsky, Robert. (2013). *Checklist for Change: Making American Higher Education a Sustainable Enterprise.* New Brunswick, NJ: Rutgers University Press.

AALHE Webinar: Creating and Using Developmental Rubrics



Presented by

Monica Geist, Ph.D. monica.geist@frontrange.edu
David Dirlam, Ph.D. ddirlam@vwc.edu

Overview

- Introductions
- Difference between judgmental and developmental rubrics
- Creating developmental rubrics using developmental interviews
- Collecting the data
- Analyzing the data

Introductions

- David - How it all began: 10 minutes-9.5 steps

Stimulus	New Concept	Published	Source	Slides
1. Lack of organizing unit of behavior	Efficient chunk sizes	1972	max- min theory	
2. Memory overload	Matrix of labels	1976	Cartesian product; L^d patterns	3-5
3. Labeling difficulty	Developmental dimensions	1980	Piaget, Erikson; Lowenfeld	
4. Collecting data	standardized developmental ratings; now Developmental Rubrics	1978/1997		6-10
5. Distribution of drawing, writing, developmental research ratings	Succession Model	1997, 1999	Lotka-Volterra	11-13
6. Lack of developmental theorists	Developmental Interviews	2003-present	300+ Experts	14-27
7. Ease of data collection	Developmental Rubrics Survey	AALHE 2010+	Survey Monkey	28-30
8. Analysis	Expected values	31-33	Frequency distributions	31-33
9. Relationship to educational practices	Course Design Survey (CDS)	2014	Impact problem and input-out-put analysis	34-35
10. Integrated theory	Actor-Network Analysis	??	Erdos Evolution of Random Networks	

- Monica - How she learned about Developmental Rubrics

DIFFERENCE BETWEEN JUDGMENTAL RUBRICS AND DEVELOPMENTAL RUBRICS

Judgmental Rubric (excerpt)

- VALUE Rubric – Written Communication

	Capstone	Milestone		Benchmark
	4	3	2	1
Context of and Purpose for Writing Includes considerations of audience, purpose, and the circumstances surrounding the writing task(s).	Demonstrates a thorough understanding of context, audience, and purpose that is responsive to the assigned task(s) and focuses all elements of the work.	Demonstrates adequate consideration of context, audience, and purpose and a clear focus on the assigned task(s) (e.g., the task aligns with audience, purpose, and context).	Demonstrates awareness of context, audience, purpose, and to the assigned tasks(s) (e.g., begins to show awareness of audience's perceptions and assumptions).	Demonstrates minimal attention to context, audience, purpose, and to the assigned tasks(s) (e.g., expectation of instructor or self as audience).

Developmental Rubrics

- Rubrics should describe BEHAVIORS (not try to define cognitions or match emotional responses of raters)
  - Judgmental (SWELL) rubrics don't discriminate
    - SWELL
      - S = Sequences
      - W = Which
      - E = Expand
      - L = Little by
      - L = Little

Developmental Rubric (excerpt)

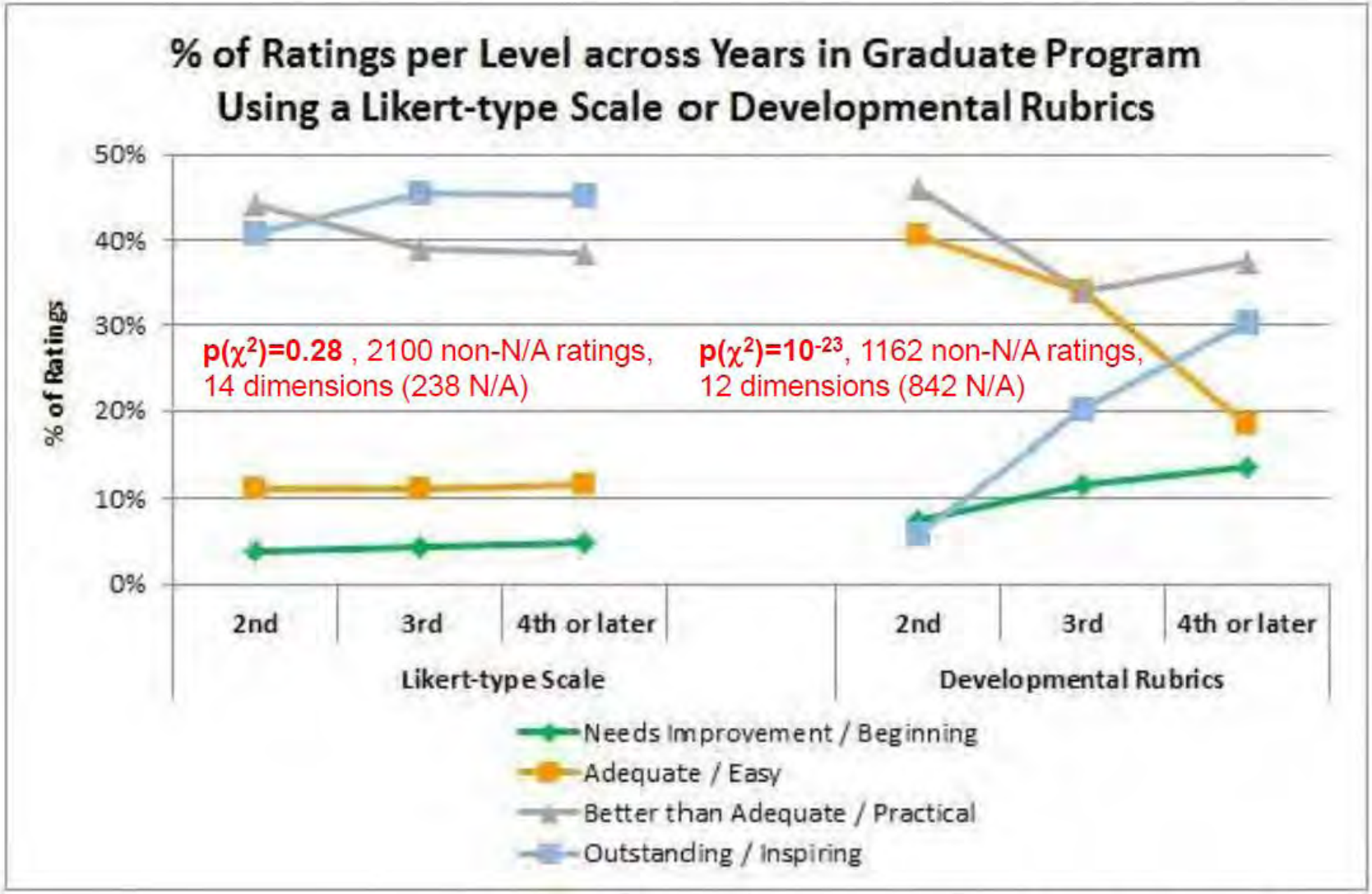
Writing Rubric	Beginning	Easy	Practical	Inspiring
Perspective The attitude(s) described or espoused by the author: the perceptions, thoughts or feelings of the writers or character(s).	**Unitary**. Writing from one person's experience (oneself or a single other person) without attempting to corroborate any statement with another person's or with more than one character's point of view. A whole group may have a unitary perspective if the writers did not attempt to describe differences between the attitudes or points of view of the group's members.	**Multiple.** Discussing or comparing the perceptions, thoughts or feelings of more than one person or character.	**Common.** Describing an experience in such a way that anyone in the same situation would have had the same perceptions, thoughts, or feelings. Examples include objective reporting, scientific descriptions, and writing which expresses the common perspective of a race, class, or creed.	**Universal.** Describing experiences that humans must have because of their nature.
Continuity The retention and elaboration of key ideas in discourse.	**Inconsistent.** Contains abrupt, unintended displacements of topic or time frame *without* a later return to the original topic or time frame.	**Digress and Return.** Contains abrupt, unintended displacements of topic or time frame *with* a later return to the original topic or time frame.	**Structured memory.** Contains complete divisions each with a topic statement and a conclusion, as well as on overall topic statement and conclusion for the entire discourse.	**Inference-based.** Each division is not only complete but a logical precursor to the next.

Developmental Rubrics

- Developmental Rubrics describe multiple dimensions of behaviors that signify transformations occurring in particular time frames.

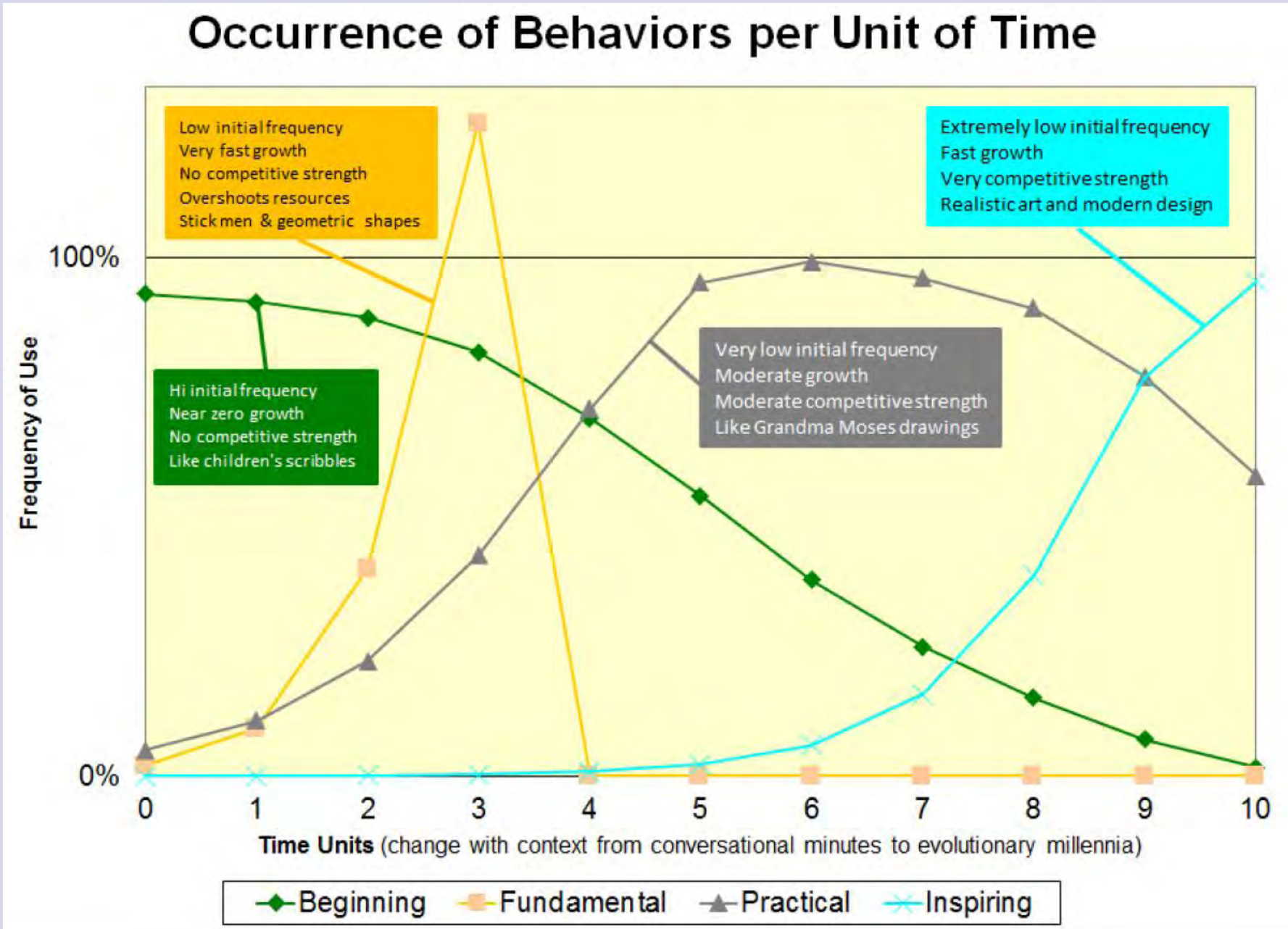
http://www.vwc.edu/wiki//images//1/18/Swell_vs_Model_Rubrics.pdf

SWELL vs. MODEL Rubrics*



* Reprinted with Permission from HUC-JIR Self Study

http://www.vwc.edu/wiki//images//b/b1/Succession_Model_of_Behavior.pdf



NOT APPLICABLE To	Ignore—No behavior linked to the dimension appears.
BEGINNING behaviors should decline (first day of program; scribbles; journals) To	Try—Most people begin here.
FUNDAMENTAL behaviors should grow extremely fast but also quickly fail (first successful course completion; stick people and geometric shapes on baselines; correspondence) To	Learn a little—Overshoot resource level and crash.
PRACTICAL behaviors should replace fundamental behaviors, endure, but gradually become boring over years of use (successful program completion; curvy and 3-D objects on base planes; presentations) To	Earn a living—Contribute to an organization.
INSPIRING behaviors lead to discoveries, innovations, or other transformative experiences (like saving a life; accurate proportions and perspectives or compelling designs; reports)	Create—Add to the discipline, industry, or lives of others in a way ultimately accepted by them.

Development Rubrics

- Each dimension should consist of a few authentic TRANFORMATIONS (typing example)
  - Development is gradual within levels but includes transformations to new modes of practice with different purposes, strategies, and typical behaviors.
  - Four transformations are common (example contexts are for higher education coursework; el-hi drawing; elementary to higher education writing)

Development Rubrics

- Developmental Rubrics should be MULTIDIMENSIONAL
  - All 300+ expert interviews generated multiple dimensions
- Example – drawing dimensions
  - Meaning
  - Shape control
  - Organization
  - Chiaroscuro
  - Design

Development Rubrics

- Rubrics can be made for other TIME FRAMES (minutes to millennia) and broader contexts (here to worldwide)
  - Conversations
  - Education
  - History
  - Ecosystems

Time Frame Example

Disability Awareness

Not Evident	Limited	Developing	Hopeful Outcomes
Unreflective. Unaware of what their disability is. No idea how it impacts them as learners. Unable to identify what they can do independently as a learner. No idea what has worked for them in the past (in K-12). Haven't even scratched the surface of learning. May feel defeated, but might not be able to say that. They don't know why "everyone else gets it and they don't". Can't even visualize it. Don't even know what's involved with, say, being a nurse. No technology.	**Memory based**. Can tell you their diagnosis. Can tell you what they have trouble doing when they learn; when the read; when they attempt to process new information. Able to tell you what they've tried in the past or at another college. Can say what has worked and what hasn't. Needs scaffolding on learning strategies. "Low technology".	**Anticipating their needs**. Aware of what technology is needed for him/her to access all his/her materials in school and to work independently. Can register for his classes. Knows how to ask for the high technology (e.g. Jaws) that he/she needs to see the board. Knows what books to ask for. Knows what to ask for in technology. Smoother, fluid process. Catches on quickly to new technology. Asks the right questions. Use analytical skills to figure out how to use the technology at home to assess it. He/she is coming up with ideas – "Hey if you do this, then I can easily access this from home." Ownership. Can work with "Medium Technology".	**Analysis based**. Know what their strengths are as students. They know what their barriers are. These are accurate. When students get excited, they feel more independent. They have control over their environment. I know what I need. They know how to ask for it. Are read to be able to do this on the job: 1. analyze the job/task, 2. examine their own learning barriers, 3. Ask for what they need. Can work with "High Technology"

CREATING DEVELOPMENTAL RUBRICS USING DEVELOPMENTAL INTERVIEWS

Interviews

- Who
  - Experts, ideally those at the inspiring level
- What
  - Ask what behaviors they did when they were first learning it; then when they were doing it a while
  - Ask questions like:
    - “What do students do in this dimension that frustrate you?”
    - “What does that mean?”
    - “Can you give examples?”
- Fascinating process!

Interviewing Rubric

- Developmental Rubric on Developmental Interviewing
  - http://www.vwc.edu/wiki/index.php?title=AEC#Developmental_Interviews_for_Rubrics_in_Design.2C_Text.2C_and_STEM_Fields

- Identify participants
- Use Interview Tool
- Collaborate
- Define Dimensions
- Discover Commitments
- Discover Practices
- Listen and Use Notes
- Improvise
- Produce Flow
- Use Results from Others
- Clarify

From that rubric…

- Dimension: Use Interview Tool
  - Example: Therapist interview
    - Easy
      - Supervisor
- Dimension: Define Dimensions
  - Example: Clergy working with suicidal people
    - Beginning
      - “Quivering mass of availability”

From Dev Interview rubric…

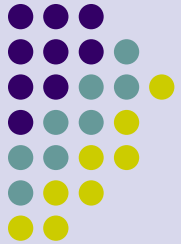
- Dimension: Collaboration
  - Example: Singer
  - http://changingwisdoms.org/?s=Wisdom%20Profiles&sid=5&ss=Singer&ssid=27

	Beginner	Novice	Worker	Master
Ensemble relationship	Feels not worthy	Cat fight	Delight in exchange; comfortable competition	Union into a whole ensemble; no ego

Creating the Rubric

- Qualitative Research Perspective
  - Participatory research
    - Co-creating the rubric
    - Member checking

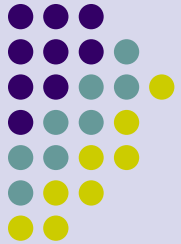
Introducing the concept/ process to interviewees



- **Developmental/Progression Interview Guideline**
  - (based on the work of David K. Dirlam, Ph.D., Virginia Wesleyan College, Director of Institutional Effectiveness and Accreditation)

- We want to create a developmental theory of your field. The result will be a rubric, or matrix, describing the progression of growth on a variety of dimensions.

Introducing the concept/ process to interviewees



- There are four types of commitments learners make…

To try	To learn a little	To earn a living in the field	To contribute to or make discoveries within a field

- We call these commitments…

Beginning	Easy	Practical	Inspiring

Introducing the concept/ process to interviewees

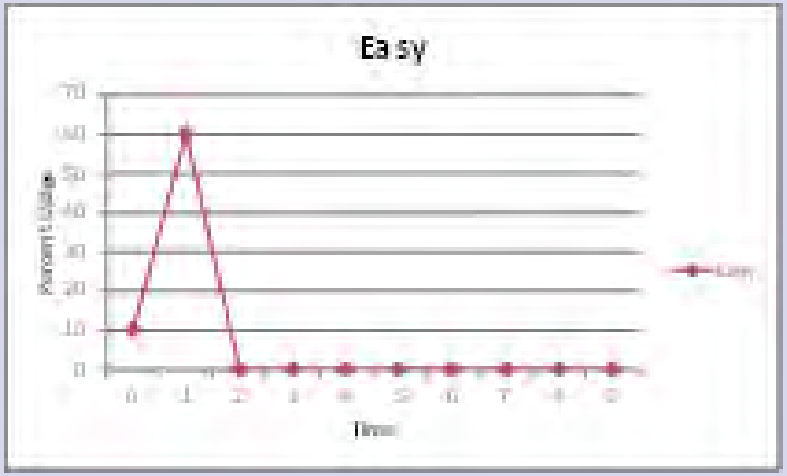
Each commitment is realized within a different time frame…

- No time to begin
  - BEGINNING: These strategies are what people in your field do with no training or experience. For example, what a person does the very first time he/she is learning a new skill.
  - What do beginners do and how does this differ from the easy strategy learners?

Introducing the concept/ process to interviewees

A few months to learn easy strategies

- EASY: These strategies are fast growing, but resources cannot hold these strategies up. For example, an employee learning a new job might ask his/her supervisor how to do everything. The supervisor won't be able to continue to answer every question. Therefore, this strategy will not last very long.



Introducing the concept/ process to interviewees

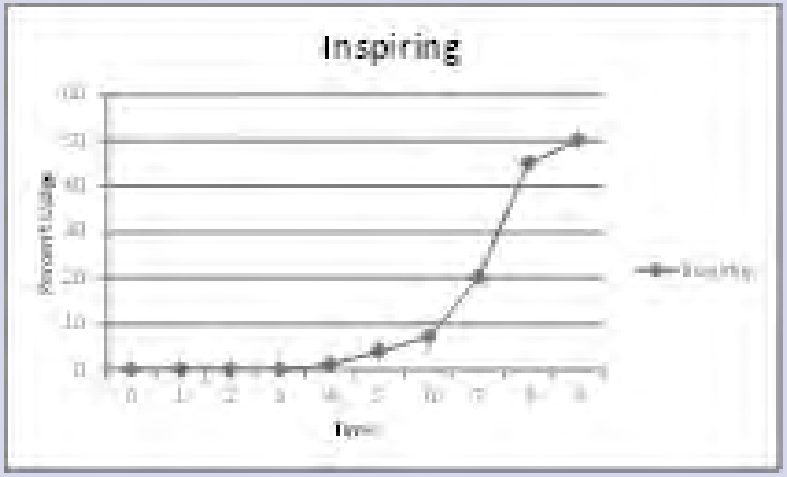
A few years to learn practical strategies

- PRACTICAL: These strategies are what people do who make a living in your field.
  - What do people need to do to earn a living in your field? How does this differ from what experts or masters to make discoveries?

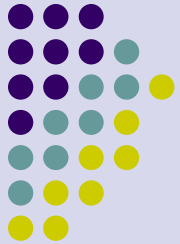
Introducing the concept/ process to interviewees

To contribute to or make discoveries within a field

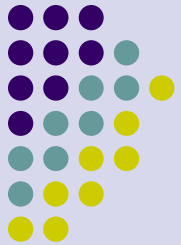
- INSPIRING: A decade to make regular contributions to the field
  - These innovative strategies are used by experts/masters in the field. These experts/masters are now creating new ways to approach the field. They are contributing to the field by creating new, innovative strategies that improve the field.



Combine the Interviews



- Add all the interviews into a single table
- Sort them into 5-12 groups and label the groups, which will become dimensions
- Write abstracts of each level of each group and label the levels
- If you have too many dimensions (60 seems like a lot) contact Monica Geist for a collaborative method or David Dirlam for an Excel-based tool.



COLLECTING THE DATA

Two Methods

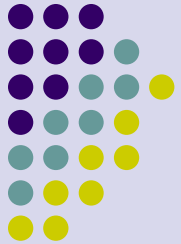
- By hand
  - Each faculty/advisor keep track of ratings on paper.
- Using technology
  - Survey Monkey
    - Art example
      - http://www.vwc.edu/wiki/images/d/dd/Art_Rubrics_2014-15.pdf

Survey Monkey

5. Awareness

- ○ Not applicable
- ○ FULFILL REQUIREMENTS (Beginning): View the study of art as a mere school requirement without relating to it.
- ○ EXPAND PERCEPTION (Fundamentals): See the past or other cultures as different. Impose the progress model on history and art. Assert they know what they like but avoid engaging the unfamiliar.
- ○ SITUATE SELVES (Practical): Make a personal connection to art of past or other cultures. Imagine themselves in another time, as members of another culture. Apply their own experience to other contexts.
- ○ IMPROVE DECISIONS (Inspiring): Use history to solve problems. Critique art to make better decisions in the present community. As a result of imagining an alien perspective, re-evaluate themselves/ society. Sustain and preserve art.

Comment (especially optional ideas for improving the Awareness rubrics)



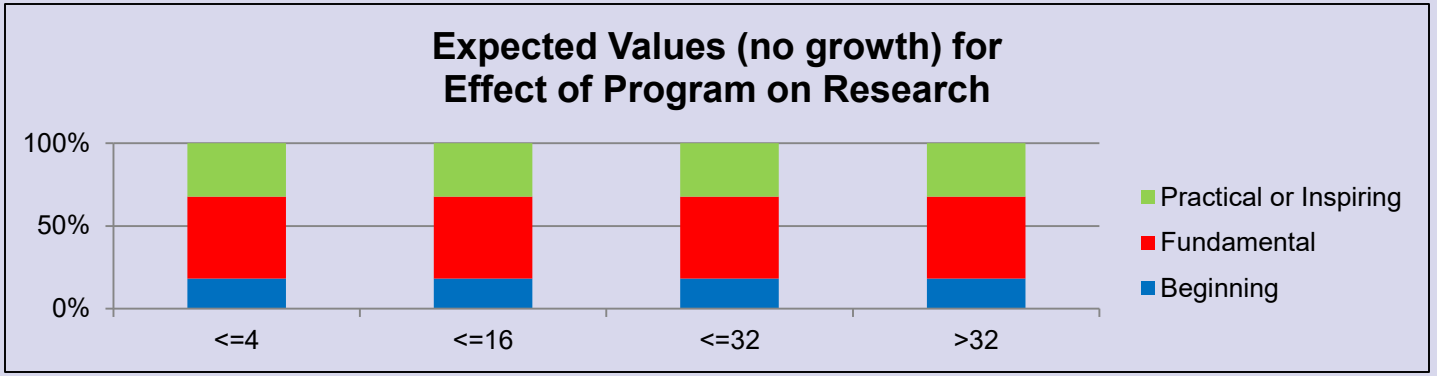
ANALYZING THE DATA

Analyzing the Data

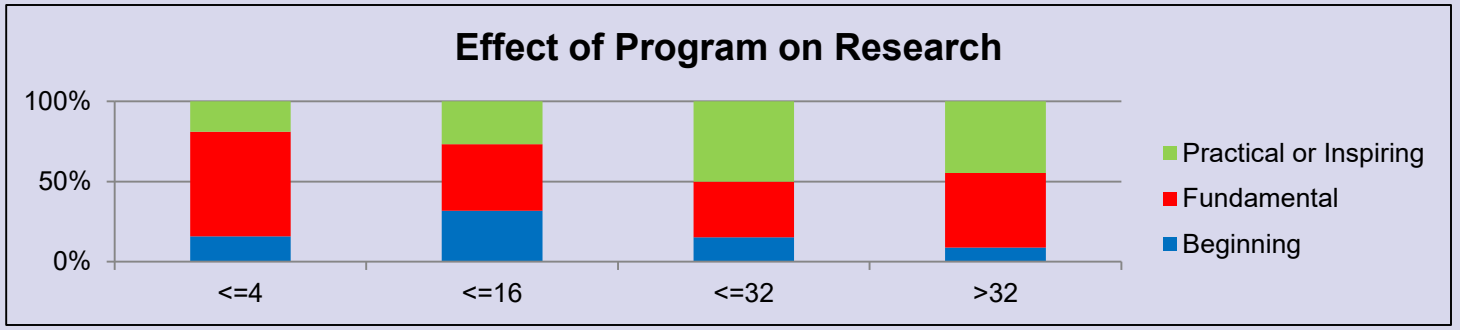
- Descriptive Statistics
  - Bar Graphs
  - Side-to-side bar graphs
  - Stacked bar graphs
- Chi-Squared
- Impact Scores
  - **High Impact Course**: Prior ratings are lower; later ratings do not revert to the lower level.
  - **High Impact Practice**: Small amounts of experience results in large gains in development

Communication Example

- All dimensions should show large differences using no growth as the expected values (rows times columns divided by the grand total gives no growth).



- To see which dimensions a program should focus on, use the average frequencies for all dimensions as the expected values.

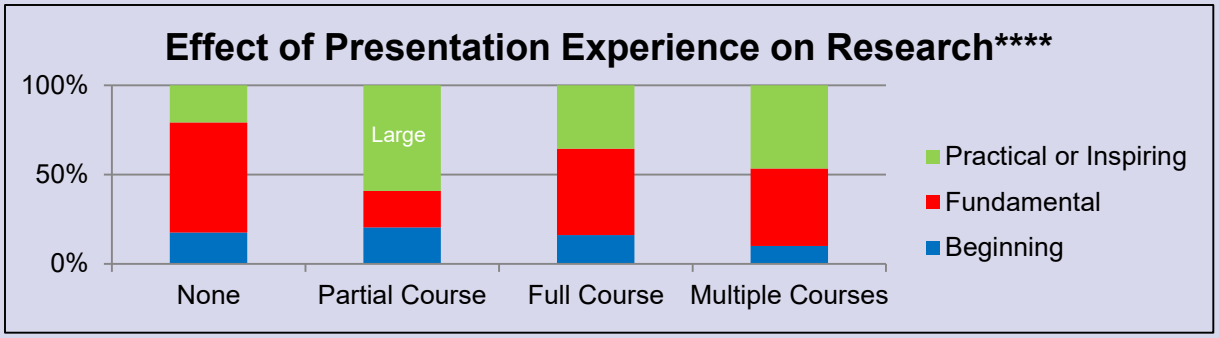


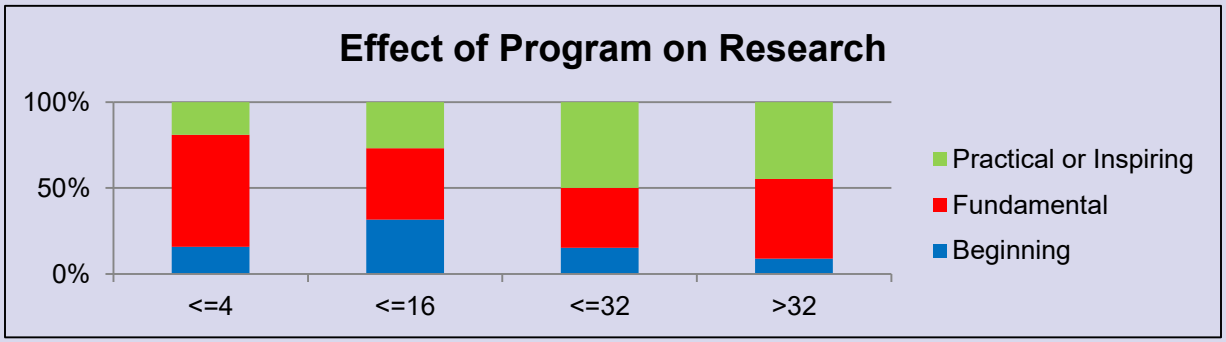
Discovering Practices

- Create a Course Design Survey
  - Faculty check off what they did according to how much time each student spent with who, doing what, where, why, how, and with what resources.
  - The responses are clustered into a few types of activities such as a presentation given to the class in the classroom during the last week of the course.

Communication Example

Fall 2013 connection between students giving presentations early in their course work and their research skills.





Websites and Emails

- www.changingwisdoms.org
  - Before you start interviewing, click on “Wisdom Profiles” on the left. Then click on the professions along the top. Read as many as you can.
- http://www.vwc.edu/wiki//index.php/Main_Page

- David Dirlam, ddirlam@vwc.edu

- Monica Geist, monica.geist@frontrange.edu


Q
A

The Intricate Unfolding of Assessment Systems

David K. Dirlam, Ph.D.

Director of Institutional Effectiveness and Accreditation

Virginia Wesleyan College

and

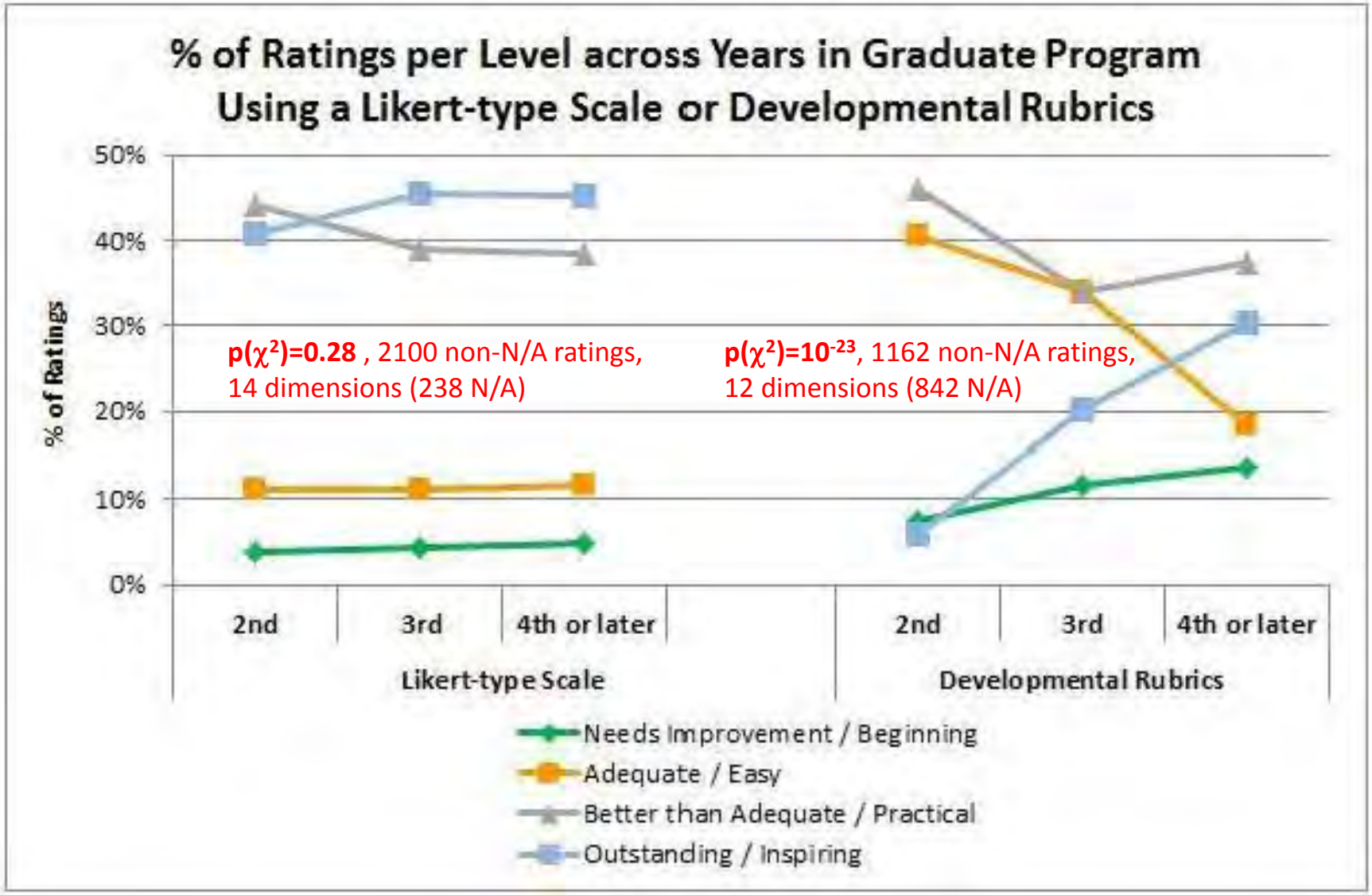
Facilitator of AALHE Methodology Community of Practice

HOW DO ASSESSMENT SYSTEMS GROW?

Essential Resources

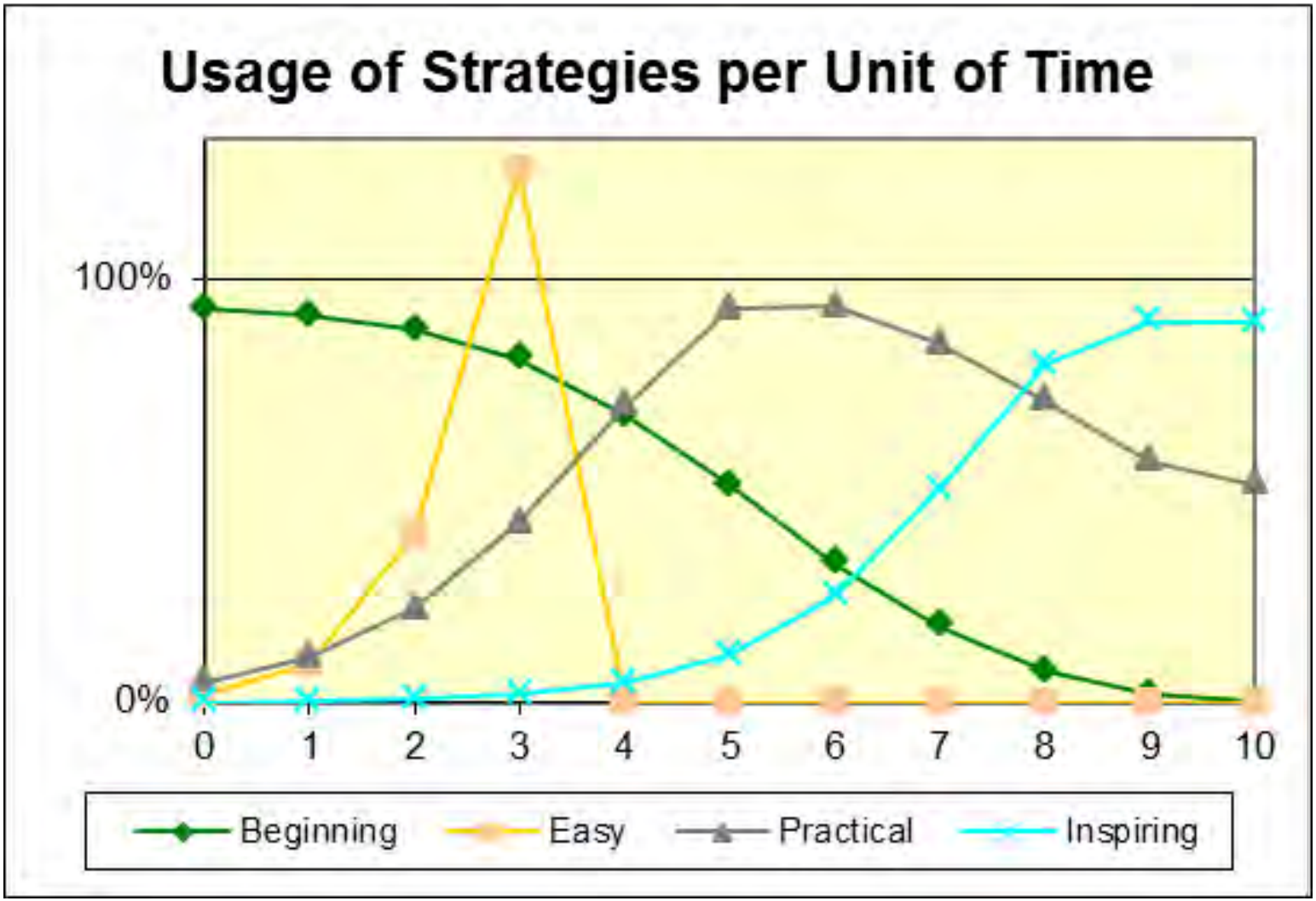
- Assessment Professionals
- Multiple developmental progressions
- Social Science Research

Impact of Professional Methods*



* Reprinted with Permission from HUC-JIR Self Study

One Developmental Progression*



* Best fitting data model for multidimensional ratings of over 1,200 drawings and 2,000 writing samples (ages 5-19), 900 developmental research articles published from 1930-1992

Social Science Research

- Introduction
- Methods
- Results
- Discussion
- Dissemination

PROGRAMS NEED ASSESSMENT PROFESSIONALS

Typical Unguided Program Assessment

Question	Typical Unguided Action
Why do assessment?	
Who creates the definitions?	
How many developmental levels are identified?	
What level(s) of students provide work to be assessed?	
What kinds of assessment measure(s) are used?	
How many assessment cycles have been compared?	
How are the results summarized for further use?	
What changes did the program make as a result of assessment findings?	
What approach was used to write the report?	
Who reads the report?	

For novices these questions produce overwhelming complexity

- With 4 levels for each progression there are more than a million possible patterns.
- Non-expert knowledge is
  - inefficient,
  - unproductive,
  - idiosyncratic, and
  - undiscriminating.

Key Findings about Multidimensional* Developmental Ratings

Efficient		40 developmental concepts → 10 dimensions
Productive		10 progressions → $4^{\wedge 10} \approx$ 1 million patterns.
Prevalent		300 experts → 5-15 dimensions in roughly 90 minutes each.
Predictive		Non-experts ↓ discrimination above their level.

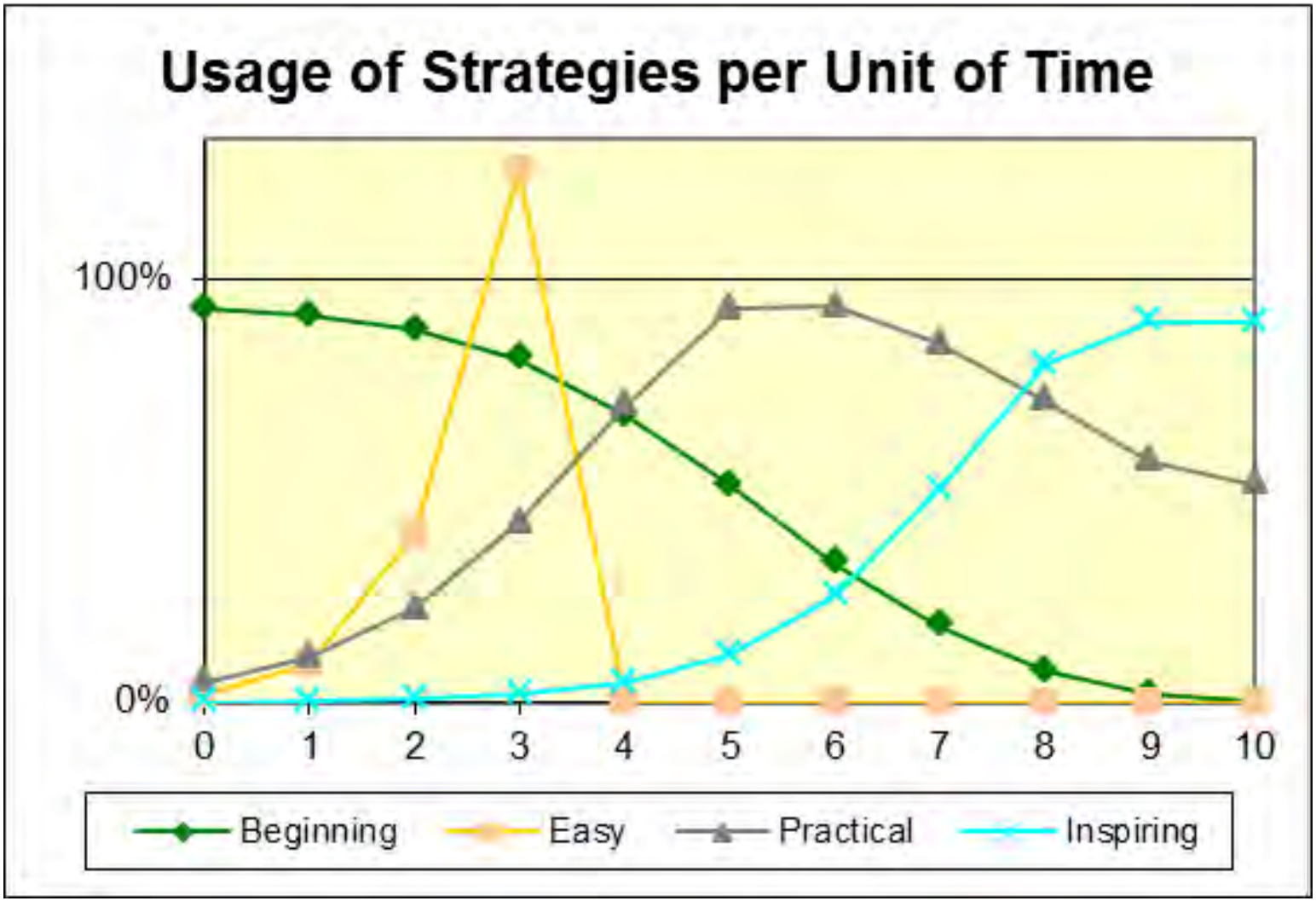
* Because they are independent each progression is a dimension

Use Developmental Ratings to Simplify your Programs' Assessment Work

- Identify a program's (almost unique) assessment pattern in seconds.
- Use only 40 concepts to do so.
  - Embedded in a ten-item multiple choice test
  - That you practice often and probably already know most of the options.
- Stimulate the development of their assessment system.

DEVELOPMENTAL PROGRESSIONS

Succession Model for Each Developmental Progression*



* Best fitting data model for multidimensional ratings of over 1,200 drawings and 2,000 writing samples (ages 5-19), 900 developmental research articles published from 1930-1992

Multiple choice surveys also work…

SLAR Rubrics

Print | Cancel | Go Back to My Form

1 **Program**

2 **Term (use 2 numbers for year and FA, SP, SU for term)**

3 **Rater (email prefix)**

4 **What type of assessment problems were identified?**

- ☐ Beginning: INSTRUMENTAL - Comply with federal financial aid and accreditation requirements.
- ☐ Easy: DEMONSTRATION - Show what the program has accomplished.
- ☐ Practical: PROGRAM QUESTIONS - Learn things about the program that nobody has the answer to.
- ☐ Inspiring: INNOVATION - Find and test new ways to have impact on students that endure for decades and generate emergent effects.
- ☐ Not Applicable

5 **How were the program's Student Learning Outcomes defined?**

- ☐ Beginning: SOLE AUTHOR OR INTERNET - A representative of the faculty creates definitions or adapts them from the internet or another generic source.
- ☐ Easy: COMMITTEE - A committee creates definitions informed by the institutional culture through discussion.
- ☐ Practical : SUMMARIZED INDIVIDUAL CONTRIBUTIONS - Several disciplinary experts individually contribute developmental insights (using either examples of student work or collaborative interviews with a developmentalist) that are combined into definitions of levels.
- ☐ Inspiring: CONSENSUAL REWORDING - Experienced raters reach a collaborative consensus on rewordings of summarized individual contributions for greater validity, reliability and easier communication to students and the public.
- ☐ Not Applicable

6 **How many developmental levels are identified?**

- ☐ Beginning: INCOMPLETE -Insufficient number of program completion outcomes are described (<5).
- ☐ Easy: SINGULAR - Described only one level of each SLO (usually the program completion level).
- ☐ Practical: PREFERENTIAL - Program completion and inadequate performance levels are described
- ☐ Inspiring: DEVELOPMENTAL - Beginning, introductory, program completion, and later career levels are described.
- ☐ Not Applicable

SSDM Developmental Rubrics

Print | Cancel | Go Back to My Form

1 **Rater Name**

2 **Student Name**

3 **Course**
(if an essay, enter essay in this field and declaration or reflection in the next)

4 **Document Being Rated**
(Title of Assignment)

5 **Posing Problems**
What type of social problems inspired you to undertake a broad study of social sciences?

- ◯ Not applicable
- ◯ CONVENTIONAL (Beginning): Unaware of social science theories or findings to applicable to problems they identify. Ask irrelevant questions to keep talking. Interact with individuals without attending to their organizations.
- ◯ PRAGMATIC (Easy): Ask specific textbook questions that may not be answerable by research involving the target audience. Gather some information about client needs but do not know how to address discrepant answers.
- ◯ INFORMED (Practical): Generate questions informed by social science. Create clear hypotheses. Seek relevant data. Understand what approaches worked and why. Consider ethical issues. Avoid resistance through creative, collaboration-enhancing questions.
- ◯ INNOVATIVE (Inspiring): Help develop organizations by examining constraints, efficiency, funding, audiences, ethical dilemmas, and resource revisioning Produce social improvements through research and theory. Help clients penetrate complex issues while respecting their autonomy.

6 **Comments on Posing Problems**
(optional clarifications of rubrics level rating)

7 **Choosing Methods**
What approaches do people need to learn to make a difference with these problems?

- ◯ Not applicable
- ◯ IDIOSYNCRATIC (Beginning): Collect the first facts they find on the internet or newspapers and accept them at face value. Only exposure to social science basics is through everyday experience.
- ◯ COLLECTING (Easy): Collect facts or memorize dates dealing literally with everyday life, but overlook research problems. Find wildly divergent data abo the same phenomenon, so ask how evidence was collected.
- ◯ OPERATIONAL (Practical): Operationalize problems, knowing good data is needed to solve problems, but can be used for competing agendas. Create and use databases. Analyze results. Understand constraints on conclusions.
- ◯ INTEGRATIVE (Inspiring): Apply multiple social science methodologies and data to everyday problems and social science advancement. See data sets everywhere with quality, availability, and usefulness dependent on sources and uses.

8 **Comments on Choosing Methods**
(optional clarifications of rubrics level rating)

Developmental Progressions of Assessment Systems

David Dirlam, Ph.D., Director of Institutional Effectiveness and Accreditation, Virginia Wesleyan College, ddirlam@vwc.edu

Dimensions	*Related Question*	Beginning	Easy	Practical	Inspiring
Problem Identification	*Why do assessment?*	**Instrumental** Comply with federal financial aid and accreditation requirements.	**Demonstration** Show what the program has accomplished	**Program Questions** Learn things about the program that nobody has the answer to.	**Innovation** Find and test new ways to have impact on students that endure for decades and generate emergent effects.
PSLO* Definitions	*Who creates the definitions?*	**Sole author or internet** A representative of the faculty creates definitions or adapts them from the internet or another generic source.	**Committee** A committee creates definitions informed by the institutional culture through discussion.	**Summarized individual contributions** Several disciplinary experts individually contribute developmental insights (using either examples of student work or collaborative interviews with a developmentalist) that are combined into definitions of levels.	**Consensual rewording** Experienced raters reach a collaborative consensus on rewordings of summarized individual contributions for greater validity, reliability and easier communication to students and the public.
PSLO* Levels	*How many developmental levels are identified?*	**Incomplete** Insufficient number of program completion outcomes are described (<5)	**Singular** Described only one level of each SLO (usually the program completion level).	**Preferential** Program completion and inadequate performance levels are described	**Developmental** Beginning, introductory, program completion, and later career levels are described
Student Selection	*What level(s) of students provide work to be assessed?*	**Summative** Program raters assess work from only one course (usually at the capstone level)	**Formative** Program raters assess work from specified Entry, Midpoint, and Capstone Courses	**Programmatic** Each student is assessed at least once per course.	**Interactive** Assessment details are mentioned during spontaneous interactions of program faculty with students in all courses.
Measure Selection	*What kinds of assessment measure(s) are used?*	**Descriptions** Ad hoc or narrative descriptions.	**Generic** Generic measures only loosely connected to PSLOs, such as standardized tests or Likert-scale ratings with sequences that expand little by little and are the same for multiple criteria).	**Developmental** Classroom artifacts from representative Individual students are assessed by at least one faculty member using a tool that provides a measure of reliability and discriminates levels of student experience defined by the PSLOs.	**Multiple** Assessments are compared with student performance on developmental ratings and a second type of assessment measure
Duration of Approach	*How many assessment cycles were compared?*	**1 Term**	**1 year**	**Cohort**	**Multiple Cohorts**
Analysis	*How are the results summarized for further use?*	**Percentages or Descriptions** The % of students at each level who have achieved the SLOs or a general description of student performance.	**Reliability** Correlations or percentages of agreement between independent raters.	**Differences** Test for statistically significant differences between student experience levels.	**Network** Networks of mutualistic or competitive activities. Course impact scores from a network of learning outcomes ratings.
Application	*What changes did the program make as a result of assessment findings?*	**Demonstrate** Show value gained by students from the program	**Critique** Show some areas for potential curricular innovation or assessment improvement.	**Experiment** Compare differential effects of curricular approaches.	**Contribute** Help the assessment and accreditation communities improve their practice
Report Format	*What approach was used to write the report?*	**Descriptions** Describe what was done and found in a story format	**Standard** Use separate sections for methods, results and conclusions, but miss connections between them	**Problem Solving** Identify questions about curriculum that assessment could elucidate, describe changes in assessment and program from prior year, compare new with prior results, and relate conclusions about program changes to them.	**Assessment Research** Relate all aspects of a problem oriented report to literature in the discipline, educational research, or assessment.
Dissemination	*Who reads the report?*	**Internal** Program faculty and accreditation officials.	**Institutional Professionals** Faculty in any institutional department as well as board members administrators concerned with assessment.	**Institutional Stakeholders** Current and prospective VWC students, parents, and staff as well as institutional professionals	**The Public** Conferences, journals, magazines, newspapers.

ASSESSMENT ⊂ SOCIAL SCIENCE RESEARCH

Introduction

- Problem Identification
- Definitions of Program Student Learning Outcomes
- Levels of Program Student Learning Outcomes

Methods

- Student Selection
- Measure Selection
- Duration of Approach

Results

- Analysis

Discussion

- Application

Publication

- Report Format
- Dissemination

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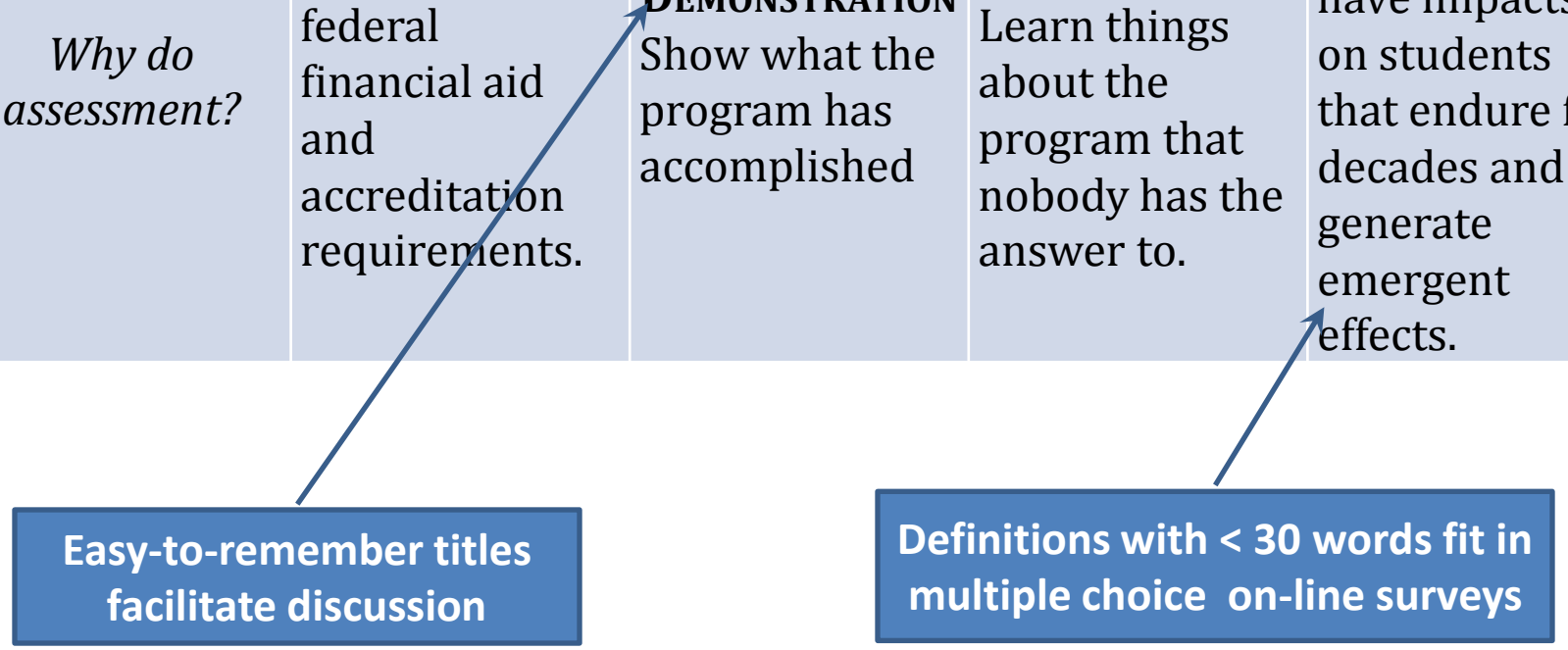
- Dissemination

Problem Identification

Related Question *(time to learn)*	**Beginning** *(a few minutes)*	**Easy** *(a few months)*	**Practical** *(a few years)*	**Inspiring** *(a decade+)*
Why do assessment?	**INSTRUMENTAL** Comply with federal financial aid and accreditation requirements.	**DEMONSTRATION** Show what the program has accomplished	**PROGRAM QUESTIONS** Learn things about the program that nobody has the answer to.	**INNOVATION** Find and test new ways to have impacts on students that endure for decades and generate emergent effects.

Problem Identification

Related Question (time to Learn)	Beginning (a few minutes)	Easy (a few months)	Practical (a few years)	Inspiring (a decade+)
Why do assessment?	**INSTRUMENTAL** Comply with federal financial aid and accreditation requirements.	**DEMONSTRATION** Show what the program has accomplished	**PROGRAM QUESTIONS** Learn things about the program that nobody has the answer to.	**INNOVATION** Find and test new ways to have impacts on students that endure for decades and generate emergent effects.



Definitions of Program Student Learning Outcomes

Related Question	Beginning	Easy	Practical	Inspiring
Who creates the definitions?	**Sole author or internet** A faculty representative creates definitions or adapts them from the internet or another generic source.	**Committee** A committee creates definitions informed by the institutional culture through discussion.	**Summarized individual contributions** Several disciplinary experts individually contribute developmental insights (using either examples of student work or collaborative interviews with an assessment specialist) that are combined into definitions of levels.	**Consensual rewording** Experienced raters reach a collaborative consensus on rewordings of summarized individual contributions for greater validity, reliability and easier communication to students and the public.

Definitions of Program Student Learning Outcomes

Every level of every dimension has a unique definition

Related Question	Beginning	Easy	Practical	Inspiring
Who creates the definitions?	**SOLE AUTHOR OR INTERNET** A faculty representative creates definitions or adapts them from the internet or another generic source.	**COMMITTEE** A committee creates definitions informed by the institutional culture through discussion.	**SUMMARIZED INDIVIDUAL CONTRIBUTIONS** Several disciplinary experts individually contribute developmental insights (using either examples of student work or collaborative interviews with an assessment specialist) that are combined into definitions of levels.	**CONSENSUAL REWORDING** Experienced raters reach a collaborative consensus on rewordings of summarized individual contributions for greater validity, reliability and easier communication to students and the public.

Levels of Program Student Learning Outcomes

Related Question	Beginning	Easy	Practical	Inspiring
How many developmental levels are identified?	**INCOMPLETE** Insufficient number of program completion outcomes are described (<5)	**SINGULAR** Described only one level of each SLO (usually the program completion level).	**PREFERENTIAL** Program completion and inadequate performance levels are described	**DEVELOPMENTAL** Beginning, introductory, program completion, and later career levels are described

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- Measure Selection
- Duration of Approach

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Student Selection

Related Question	Beginning	Easy	Practical	Inspiring
What level(s) of students provide work to be assessed?	**SUMMATIVE** Program raters assess work from only one course (usually at the capstone level)	**FORMATIVE** Program raters assess work from specified Entry, Midpoint, and Capstone Courses	**PROGRAMMATIC** Each student is assessed at least once per course.	**INTERACTIVE** Assessment details are mentioned during spontaneous interactions of program faculty with students in all courses.

Measure Selection

Related Question	Beginning	Easy	Practical	Inspiring
What kinds of assessment measure(s) are used?	**DESCRIPTIONS** Ad hoc or narrative descriptions.	**GENERIC** Generic measures only loosely connected to PSLOs, such as standardized tests or Likert-scale ratings with sequences that expand little by little and are the same for multiple criteria).	**DEVELOPMENTAL** Classroom artifacts from representative Individual students are assessed by at least one faculty member using a tool that provides a measure of reliability and discriminates levels of student experience defined by the PSLOs.	**MULTIPLE** Assessments are compared with student performance on developmental ratings and a second type of assessment measure

Duration of Approach

Related Question	Beginning	Easy	Practical	Inspiring
How many assessment cycles have been compared?	**1 Term**	**1 year**	**Cohort**	**Multiple Cohorts**

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How are the results summarized for further use?	**Percentages or Descriptions** The % of students at each level who have achieved the SLOs or a general description of student performance.	**Reliability** Correlations or percentages of agreement between independent raters.	**Differences** Test for statistically significant differences between student experience levels.	**Network** Networks of mutualistic or competitive activities. Course impact scores from a network of learning outcomes ratings.

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Application

Related Question	Beginning	Easy	Practical	Inspiring
What changes did the program make as a result of assessment findings?	**DEMONSTRATE** Show value gained by students from the program	**CRITIQUE** Show some areas for potential curricular innovation or assessment improvement.	**EXPERIMENT** Compare differential effects of curricular approaches.	**CONTRIBUTE** Help the assessment and accreditation communities improve their practice

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Report Format

Related Question	Beginning	Easy	Practical	Inspiring
What approach was used to write the report?	**Descriptions** Describe what was done and found in a story format	**Standard** Use separate sections for methods, results and conclusions, but miss connections between them	**Problem Solving** Identify questions about curriculum that assessment could elucidate, describe changes in assessment and program from prior year, compare new with prior results, and relate conclusions about program changes to them.	**Assessment Research** Relate all aspects of a problem oriented report to literature in the discipline, educational research, or assessment.

Dissemination

Related Question	Beginning	Easy	Practical	Inspiring
Who reads the report?	**INTERNAL** Program faculty and accreditation officials.	**INSTITUTIONAL PROFESSIONALS** Faculty in any institutional department as well as board members administrators concerned with assessment.	**INSTITUTIONAL STAKEHOLDERS** Current and prospective VWC students, parents, and staff as well as institutional professionals	**THE PUBLIC** Conferences, journals, magazines, newspapers.

The Intricate Development of Assessment Systems

Social Science Research			Developmental Progressions			
	Responsibilities	**Related Question**	**Beginning**	**Easy**	**Practical**	**Inspiring**
Introduction	**Problem Identification**	Why do assessment?	Instrumental	Demonstration	Program Questions	Innovation
	PSLO Definitions	Who creates the definitions?	Sole author or internet	Committee	Summarized Developmental Interviews	Consensual rewording
	PSLO Levels	How many developmental levels are identified?	Incomplete	Singular	Preferential	Developmental
Methods	**Student Selection**	What level(s) of students provide work to be assessed?	Summative	Formative	Programmatic	Interactive
	Measure Selection	What kinds of assessment measure(s) are used?	Descriptions	Generic	Developmental	Multiple
	Duration of Approach	How many assessment cycles have been compared?	1 Term	1 year	Cohort	Multiple Cohorts
Results & Discussion	**Analysis**	How are the results summarized for further use?	Percentages or Descriptions	Reliability	Differences	Network
	Application	What changes did the program make as a result of assessment findings?	Demonstrate	Critique	Experiment	Contribute
Publication	**Report Format**	What approach was used to write the report?	Descriptions	Standard	Problem Solving	Assessment Research
	Dissemination	Who reads the report?	Internal	Institutional Professionals	Institutional Stakeholders	The Public

Next Steps in Assessment System Development

Responsibilities	Related Question	Where should they go next?
Problem Identification	Why do assessment?	
PSLO Definitions	Who creates the definitions?	
PSLO Levels	How many developmental levels are identified?	
Student Selection	What level(s) of students provide work to be assessed?	
Measure Selection	What kinds of assessment measure(s) are used?	
Duration of Approach	How many assessment cycles have been compared?	
Analysis	How are the results summarized for further use?	
Application	What changes did the program make as a result of assessment findings?	
Report Format	What approach was used to write the report?	
Dissemination	Who reads the report?	

Be Professional by being active in AALHE

AALHE is the premier national organization dedicated to improving the assessment of learning in higher education.

Use Developmental Progressions to Help Programs

- See the handout table
- Use the progressions chart

Do Research

- Help to make progress within our culture by replacing assessment as compliance with assessment as research.

Other Activities to Facilitate Development

- Discuss program questions that can be addressed by assessment.
- Conduct developmental interviews.
- Conduct workshops to collect likes and dislikes about student work.
- Organize interview or preference responses into rubrics dimensions using text analysis.
- Organize responses into rubrics dimensions using group discussion.
- Write abstracts of grouped responses.
- Create Livetext or Survey Monkey forms to collect rubrics ratings.
- Analyze data using statistics, text analysis, or network theory.
- Discuss possible educational innovations with program faculty.
- Coauthor conference presentations or articles.

AALHE Essay on Assessment

Analyzing Developmental Rubrics Ratings

David K. Dirlam[1]
Virginia Wesleyan College

Over the four decades of their use, developmental rubrics have grown to be widely recognized as the practical way to assess creative work of students ranging across the arts and sciences. Assessment practitioners are well aware that analyses of rubrics data vary widely in effectiveness. This essay is written for those who have seen or tried a number of different approaches and are seeking some guidance for how to quickly narrow down the options to those that are most effective.

Readers will learn how to use two key concepts to analyze rubrics data. The first is resolving the *developmental ordering dilemma,* which distinguishes abuses from uses of the ordinal data that forms the basis of all developmental rubrics. The second is evaluating with *developmental expectancies,* which separates general ordering across multiple dimensions of development from unique findings within a single dimension.

The quality of rubrics varies as widely as their uses. An extremely powerful way of enhancing quality is to ensure that the rubrics are developmental. Though the analytical methods described below were constructed in the context of developmental rubrics, they apply to other types of rubrics as well (e.g., the Value Rubrics of AAC&U are only quasi-developmental, but the analytical methods will work with them as well). Developmental rubrics show distinctions as well as general commonalities between dimensions. In extremely diverse disciplines within higher education, all faculty members can distinguish performance at the ends of the first day, first course, first degree, or first innovative contribution to the discipline. Such beginning, fundamental, practical, and inspiring performances are general commonalities between dimensions. Every discipline also has distinct dimensions. Among other qualities, artists distinguish developmental levels of shape, organization, depth, and design while writers distinguish professionalism, fluency, cogency, and disciplinary knowledge. The developmental modes within each dimension differ so that any level of organization (e.g., floating objects, baselines, and base planes) can co-exist with any level of shapes (e.g., geometric objects, organic outlines, or proportioned with shaded edges). Co-existence across levels is the essential idea underlying the concept of dimension.

Resolving the Developmental Ordering Dilemma

Ordinal data turns up in many places in psychology, in surveys and tests, as well as rubrics. This generality, however, has been the cause of difficult-to-break bad habits of analysis. Survey analysts far and wide turn five-point scales into 1, 2, 3, 4, and 5 and find the average score among many questions. First and third place, however, are no more the same as two ties for second place than a pea and a watermelon are the same as two bananas. We can put things in rank order, but the average of ranks only has meaning in a truck-driver sense. Truck drivers need to know their truck weight capacities, as well as routes, traffic and laws, but those who make it or farm it or order or use it, need to know much more about their loads. If

[1] David Dirlam is also author of AALHE's methodology blog

we want to know anything about the value or purpose of the items we need to get past weighing them and start counting each individual type.

More than a century ago, William James (1890) pointed out that the best way to break a bad habit is to replace it with a better one. Rather than summing ranks, the first step with ordered data should be to indicate the answers, not with numbers, but letters: a, b, c, d, and e. That simple substitution removes the temptation to sum the answers, retains their ordering, and increases the chance that researchers will start counting. It also sets up a whole new approach to the data. If one has counts, the tendency is to begin asking whether there is anything that distinguishes the counts. Are there differences in the respondents or in the items that lead to different groupings? Once we have such differences, meaning comes alive. Differences are like the deer in the woods that remain all but invisible when motionless, but become immediately apparent when they move.

A good place to look for differences in respondents is to look at their experience. One of the first places assessment researchers should seek differences in frequencies of answers is to divide respondents according to how many courses or years of instruction they have had in an activity related to the survey. Do counts differ between respondents with more than a median amount of experience from those with less? Using this approach, it is quite possible to get highly significant results with fairly small groups of respondents.

The analyses below use MS Excel. Each analyst has his or her preferred medium. Excel is the most widely used and accessible analysis software. It also allows researchers to stay close to the formulas and data; it is versatile (containing engineering as well as text functions and being programmable); and results and graphs are easy to transfer to other MS Office products. In the following examples, grey backgrounds show where formulas given near the table were entered. It also lacks the most complex statistical models such as ANOVAs with more than three dimensions or factor analysis. Nevertheless, the simple models described here can often result in clearer conclusions with fewer assumptions.

Data used in this section will be minor modifications of actual data obtained from multiple sources that have used ratings based on developmental rubrics. Usually these ratings are done in a survey tool, like Survey Monkey where respondents can fill in a few fields to identify themselves and the student performance rated and then click one of a few answers to multiple-choice questions.

The number of questions is very relevant to the analysis. If developmental ratings are used—where every level of one dimension can logically co-exist with any level of any other dimension—the number of possible patterns grows geometrically with the number of questions. Five alternatives for each question results in 25 patterns for two dimensions, 625 patterns for three questions, and over 10 million patterns for ten questions. From a developmental perspective, summing “correct” answers from 100 questions provides an overwhelming and therefore useless variety of patterns.

A Learning Outcomes Network (LON) provides ratings on 5 to 15 items, for at least one project per term for all students in a program, where each question is a dimension name, the optional answers are the levels or modes, and descriptions follow unique names for each mode. The underlined spaces in the outline below indicate that usually names are a single

word. Since multiple-choice items are also used for 5-point scale data, the methods below can be generalized to a wide variety of settings.

1. Dimension I
    a. Not Applicable
    b. Dimension_I_Mode_1_Name (BEGINNING): Mode 1 description for Dimension I.
    c. Dimension_I_Mode_2_Name (FUNDAMENTAL): Mode 2 description for Dimension I.
    d. Dimension_I_Mode_3_Name (PRACTICAL): Mode 3 description for Dimension I.
    e. Dimension_I_Mode_4_Name (INSPIRING): Mode 4 description for Dimension I.
2. Dimension II
    a. Not Applicable
    b. Dimension_II_Mode_1_Name (BEGINNING): Mode 1 description for Dimension II.
    c. Dimension_II_Mode_2_Name (FUNDAMENTAL): Mode 2 description for Dimension II.
    d. Dimension_II_Mode_3_Name (PRACTICAL): Mode 3 description for Dimension II.
    e. Dimension_II_Mode_4_Name (INSPIRING): Mode 4 description for Dimension II.

The first set of examples include counts of instructor ratings on one dimension of practice within 23 students at one level of experience, 45 students at the second level, and 27 students at the third level. The row and column totals are given by the Excel formula

=SUM(Level_1_values),[2]

Where Level_1_values are obtained by highlighting the cells with 17, 6, and 0 right after inputting the characters, "=SUM(" and ending with ")[Enter]"[3]

Observed Counts for One Dimension of Ratings (o_i)				
Experience Level	BEGINNING	FUNDAMENTAL	PRACTICAL	Total Students
Level 1	17	6	0	23
Level 2	7	28	10	45
Level 3	0	20	7	27
Total Ratings	24	52	19	95

The traditional statistical test for analyzing this data is based on the Chi-squared distribution. The typical approach is to create expected values using the row total times the column total divided by the grand total as in the following table.

Expected Values for One Dimension of Ratings (e_i)			
	BEGINNING	FUNDAMENTAL	PRACTICAL
Level 1	5.8	13.1	4.1
Level 2	11.4	25.6	8.1
Level 3	6.8	15.3	4.8

[2] In this appendix, when mathematical and Excel formulae are contained in the same section, the Excel formulae will be centered on the line after the relevant text.

[3] Key names with more than one character are included in brackets and strings of keystrokes are put in quote marks.

The Chi-square value is then obtained by squaring the difference between each observed score and its corresponding expected score, dividing the result by the expected score and then summing all the ratios. The textbook formula is $X^2 = \Sigma\ (o-e)^2/e$ or in Excel

=SUM(component_values),

where component_values are those in the table below. In Excel the probability that the Chi-squared value could be obtained with random numbers is calculated in either of two ways. The easiest does not even require calculating the component values, since it uses the formula

=CHITEST(o_values,e_values).

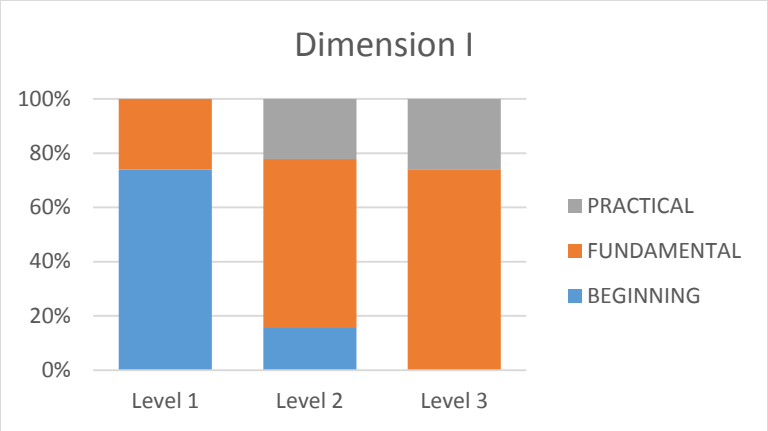
Since the probability of getting the Chi-Squared value in the table below using random numbers is considerably less than one chance in a million, we conclude that there was a strong effect of the program on development.

Chi-Squared Components for One Dimension of Ratings			
	BEGINNING	FUNDAMENTAL	PRACTICAL
Level 1	21.55	3.83	4.12
Level 2	1.68	0.23	0.47
Level 3	6.82	1.41	0.97
		$X^2 = 41.07$	p = 3E-8

Despite having a clear overall answer, there are two advantages of calculating the components separately, summing them, and then using the formula

=CHISQ.DIST.RT(SUM(component_values,4).

In the formula, 4 is the degrees of freedom. Because we used row and column sums to calculate expected values, where knowing the first two values determines the third, the degrees of freedom for rows (r) and columns (c) is (r-1)*(c-1)=4. The first advantage of calculating the components is that it highlights where the differences are. For 4 degrees of freedom, a Chi-squared value of 9.5 or more is statistically significant. The obvious finding is that at Level 1 the observed value for BEGINNING is very much higher than expected and secondarily, both FUNDAMENTAL with the PRACTICAL ratings are lower at this level and BEGINNING ratings are lower than expected at Levels 2 and 3. So, though we still conclude that the program is having a pronounced developmental effect on performance, the effect involves mainly a change from the BEGINNING Level 1 mode of practice. A look at the chart below might lead most observers to the same conclusion, but the statistical results determine the conclusion beyond individual interpretations and biases.



The second advantage of calculating the components is that it facilitates the use of corrections when necessary. The primary circumstance for using corrections in calculating Chi-squared values is for small expected values. If any expected value equals zero, then the category involved must be combined in the most meaningful way possible with another category. Thus, if the expected value for Level 1 PRACTICAL had been 0 instead of 4.1, we would sum the counts for Level 1 and Level 2 together into a "Lower Level" category. Since all expected values are more than zero but at least 20% of them are less than 5 (Level 1 and 3 PRACTICAL), Yates' correction should be used. This involves subtracting 0.5 from the absolute value of each difference between observed and expected value before squaring it. Each Chi-squared component is then calculated in Excel using

=(ABS(o_cell-e_cell)-0.5)^2/e_cell

Notice in the table below that Yate's correction produced a small increase in the probability level, but in this case it did not produce a substantial change in the conclusions.

Corrected Chi-Squared Components for One Dimension of Ratings			
	BEGINNING	FUNDAMENTAL	PRACTICAL
Level 1	19.67	3.31	3.18
Level 2	1.32	0.14	0.26
Level 3	5.86	1.12	0.58
		X^2 = 35.43	p = 4E-07

Evaluating with Developmental Expectancies

The preceding example involved only a single dimension that can be coded in one multiple-choice item. Modes of practices, however, are fractal. Like ferns or coastlines they show similar complexity at every scale. Thousand-sample studies (e.g., Dirlam, 1997, Dirlam, Gamble, and Lloyd, 1999) revealed that a single succession model works (fits the data) on time scales of 62 years of archived historical data and of 14 years of individual development. Casual observations suggests that it also works on the scale of conversations: BEGINNING with greetings, proceeding to FUNDAMENTAL jokes or comments on the weather, getting down to the PRACTICAL purposes of the conversation, and occasionally resulting in INSPIRING collaborations that produces innovations.

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Because modes of practices are fractal, it is useful to analyze them across more than one scale. The individual raters' general impressions across multiple dimensions can be important sources of information for understanding ratings within any one dimension. For the preceding study, there were actually nine dimensions with the total counts below.

Observed Counts for Combined Data				
Experience Level	BEGINNING	FUNDAMENTAL	PRACTICAL	Total Students
Level 1	54	145	8	207
Level 2	38	202	165	405
Level 3	2	83	156	243
Total Ratings	94	439	322	855

Expected Values for Combined Data		
22.8	106.3	78.0
44.5	207.9	152.5
26.7	124.8	91.5

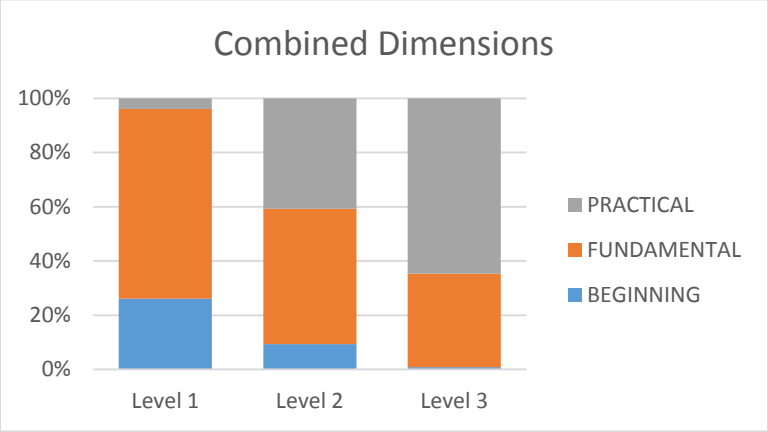
Chi-squared Components for Combined Data		
42.89	14.10	62.78
0.96	0.17	1.02
22.87	13.98	45.44
	X^2=204.20	p=5E-43

The combined data have produced an astronomically large developmental effect, which strongly suggest that if we just continue to analyze the other eight dimensions in the same way as we did the first, we would just keep finding very large developmental effects. This is a nice "summative" finding, proving that the program had an effect on student performance, but it gives us no "formative" information that we can use to improve practice in some way. However, if we divide each one of our combined scores by 9 (the number of ratings for each record), we get expected development values (E_d). These are averages, but the averages of frequencies of the same level (e.g. the average of all the fundamental ratings), is meaningful because unlike developmental levels, the underlying distributions are uniform. Comparing the observed counts for each dimension with these expected development values as in the next two tables will show us how each dimension differs from the combined developmental effect. That information is formative.

Expected Values for Single Dimensions Based on Combined Data (E_d)		
6.0	16.1	0.9
4.2	22.4	18.3
0.2	9.2	17.3

Chi-squared Components for Dimension I Based on Combined Expected Values = $(o_i-E_d)^2/E_d$		
18.38	5.73	0.17
1.23	1.14	3.35
0.35	11.45	5.58
	X^2=43.37	p=1E-9

Again the components table shows that for Dimension I, there was an unusually large number of BEGINNING ratings at Level 1. Now, however, it is clear that the expected developmental values of FUNDAMENTAL ratings at Level 3 is significantly fewer than that observed in the combined dimensions (9.2 compared to 20 resulting in the component value of 11.45). The components table based on creating expected developmental values from the combined ratings of all dimensions, revealed an important problem. There is not as much movement toward the PRACTICAL mode for Dimension I as there is in general for all the dimensions combined. Comparing the figure below with the one for Dimension I could result in the same conclusion, but the statistical approach of combining ratings to create expected developmental values helps to pinpoint how development in one dimension differs from the others. Therefore, an issue was made clear and the calculation showed whether it is worth taking further action. In general, it is as wasteful to take action based on statistically non-significant results as it would be to decide where to focus program design efforts based on a coin toss. The significantly larger than developmentally expected number of FUNDAMENTAL ratings at Level 3 pointed where program designers should look for improvements.



Takeaway Principles

The analyses described above are based on a few fundamental steps. First, immediately change records of order in an analysis program from numbers to letters in order to resist the temptation to add the ordering or calculate means. Next, divide individual performances between students with more or less of a particular type of experience. At the most basic level it can be the number of courses in the field taken prior to the work being assessed. At a more sophisticated level, some other data on experience can be gathered (e.g., like how many class presentations have they made). The result is a table with experience levels in rows and rating levels in columns. Formative results for a single dimension then are calculated by showing that the rating levels are statistically different for different levels of experience.

Secondly, if several developmental dimensions have been rated, the average frequencies of all dimensions can be used as expected values for the Chi-square (note that averages work because frequency distributions are more uniform than developmental ratings distributions). This makes it possible to tell how development in one dimension differs from the typical development in all the dimensions rated. For example, if having just one presentation early in a program results in higher than average ratings of practical level performance or better on several other dimensions (as was found by Dirlam and Minnis, 2014), then introducing presentations in more lower level courses could result in major improvements in student learning outcomes.

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Assessment Rubrics to Advance Assessment Research

AALHE Second Annual Conference, Albuquerque, NM, 2012
David Dirlam
Part of a Roundtable on "Establishing Research Progress in Assessment" with additional presentations
by David Eubanks and Douglas Eder plus a recap and discussion led by Susan Perry

Design

The mission of the assessment profession is to promote student achievement by helping others identify and sometimes learn what experts know that they do not. To do so, we need to help...

1. Students to learn, practice, create, and discover more effectively.
2. Instructors to design and deliver more effective programs.
3. Administrators and institutional governors to improve their decisions concerning educational programs.
4. Public officials and accreditation agencies to support more effective institutions and practices.
5. The public to choose educational experiences wisely.
6. Ourselves to improve the services identified above.

In order to advance this mission, we need to develop both Scientific and Design Research.

Process

The assessment community needs broad-based commitments to advance its methods. Being able to identify next steps leads to new commitments. Developmental rubrics identify steps. The following are MOSHE Rubrics (Matrices Organized Sequentially through Historical Examination) to assess our progress. Beginners take a few minutes to try an activity. Easy strategies require a few months to learn. Practical learners need a few years to acquire enough skill to earn a living. Inspiring strategies appear regularly after a decade of commitment and lead to innovations in a field. Historical progress often takes longer than individual progress and involves a movement of strategies to lower levels. Thus, inspiring strategies become Practical, Practical strategies Easy; etc. For example, reviews that once required a lifetime of study can now be done by students using journal indexes. Assessment should seek such progress.

Conclusions are in the Communication section after the rubrics.

Products

Table 1. Developmental/Historical Sequences of SCIENTIFIC Research

Dimension	Beginning	Easy	Practical	Inspiring
I. Background				
Practically or theoretically needed by society	**Questioning** Aware of need for field, often have specific research or policy questions in mind, but unaware of how to answer them.	**Mandated** Receive mandates to do research, but no funding. Mechanically apply methods of the field while often forgetting the questions that motivated their interest as beginners.	**Problem-Oriented** Become immersed in problems of a narrow specialty and lose perspective on how much of society's resources should be devoted to it.	**Policy Leading** Seek solutions to societal needs with awareness of the costs and benefits.
Public, indexed, specialized and peer-reviewed documentation	**Newsletters** Have newsletters.	**Practical Journals** Have a few specialized, regional, national and international journals focused on particular areas of expertise but also on social practicality rather than scientific advancement.	**Scientific Journals** Have a wide variety of publicly indexed, peer reviewed documentation accessible to field scientists and focused on methodology, results and interpretation.	**Scientific Reviews** Add diverse review journals to specialized science-focused journals.
Tradition of critique	**Isolated** Unaware of the massiveness of the literature related to their data.	**Sporadic** Read widely but sporadically. Do a mechanical or ritualistic search through a topic, but don't think through the implications.	**Accumulative** Read within their specialty and know a variety of tools for dealing with it, but fail to see repeated mistakes and thus, often confuse the existence of many papers with substantial knowledge.	**Methodological** Seek to improve the imperfect tools of the field by reading for methodology rather than content. Read in various disciplines and problem areas to find methods that apply to analogous problems.
Identifying methods, units of analysis, and interpretations	**Unsystematic** Unaware of a need to systematize approaches to problems.	**Practice Identifying** Use categories of "best practices" that lack scientific testing.	**Paradigmatic** Have a paradigm that identifies methods, intersubjectively reliable units of analysis and interpretations.	**Multiple Paradigms** Compare results from more than one paradigm.
Based on falsifiable and predictive hypotheses	**Biased** Based on biases.	**Applicability** Based on a consensus of social usefulness.	**Falsifiable and Predictive** Based on falsifiable hypotheses that generate predictions within a research paradigm.	**Converging Operations** Use converging operations to substantiate generalizations

Table 1. Developmental/Historical Sequences of SCIENTIFIC Research

Dimension	Beginning	Easy	Practical	Inspiring
II. Methods				
Observable, inter-subjective units	**Idiosyncratic** Use idiosyncratic, local observations (e.g., "program doting" or protecting group interests at the expense of common knowledge).	**Cumbersome and Private** Use units based on cumbersome techniques available only privately (e.g., standardized tests and general ledgers).	**Countable** Use units that can be identified and counted by trained observers with a high degree of speed and accuracy due to having been observed and publicly tested under very diverse circumstances by diverse practitioners.	**Automatic** Use units that are automatically determined (e.g., procedures can be described within a computer or mechanical procedure list).
Measurable	**Non-scalable** Indiscriminately confuse nominal, ordinal, interval and ratio data.	**Scalable** Distinguish nominal, ordinal, interval and ratio data but confuse independent and dependent variables (e.g., group by age rather than measure time alive).	**Standardized** Measure time and position plus other ratio measures that use internationally standardized units while accounting for error magnitude.	**Derived** Develop new measures that can be validated through previously standardized units.
Field based and Experimental	**Experiential** Apply methods from life experience or basic learning that are critically unconvincing.	**Field or Experimental** Focus on either field based or experimental methods.	**Field and Experimental** Combine or account for both field based and experimental data.	**International Databases** Create massive, international databases for analysis by the international community of scientists.
III. Analysis				
Aggregated	**Unrelated** Count items with untested relationships (e.g., accounting and test items).	**Pseudo-related** Count items that show pseudo relationships (e.g., two test items that are answered by a particular mean age in a particular environment at a particular time).	**Distinguished** Treat unique patterns as unique.	**Powerful** Find "powerful" ways to identify and compare unique patterns (using a small number of descriptors to uniquely identify a very large number of patterns).
Mathematical	**Non-mathematical** Unaware of the mathematical bases or use pseudo mathematical analyses.	**Transformed** Transform scores so that data look normally distributed or like ratio data (e.g. standardized scores or market values). Use analytical packages that obscure underlying data and mathematical assumptions.	**Model** Apply appropriate data models (e.g., Poisson probability is the number of items randomly distributed in an underlying continuum while item succession is likely to be nonlinear dynamic rather than random).	**Innovative Models** Create new data models (e.g., maximal information-based nonparametric exploration, *Science, 12/16/11*).
IV. Interpretation				
Reproducible	**Undocumented** Fail to document methods, results or analysis.	**Personal** Document only our own use of methods, results or analysis.	**Methodically Reproducible** Identify and compare the results of many others who are using our same methods and analyses.	**Convergingly Reproducible** Compare results from others using different approaches.
Simply explainable	**Descriptive** Endless description of detail.	**Organized Descriptions** Substitute organized descriptions for explanations.	**Inferential** A framework for organizing descriptions that results in reproducible findings and inferences using many fewer concepts than the descriptions do, but producing similar complexity.	**Progressive** A framework that showing that previously considered simple explanations are actually more complex than they appear or are falsifiable.
Generalizable	**Contextualized** Discussion is limited to the context of the study.	**Self-Help Style** Usefulness is asserted for multiple contexts in a self-help style.	**Comparative** Examples of observations and tests in contexts other than that being studied are compared.	**Comprehensive** Diverse groups use the finding in widely diverse circumstances.
Multiply delimited	**Expansive** Arguments are made simply for the diversity of uses of the findings.	**Vague Limits** Limits on generalizability are vaguely described along with predictions of usefulness.	**Differentiated** Differences between multiple tests of generality from independent groups are identified.	**Transcended** Attempts to overcome limitations of prior methods are tested.
Convergent	**Haphazard** Study is haphazardly related to other studies.	**Parametric** New studies copy old ones with restricted changes.	**Intersected** Two independent approaches to a problem are used in such a way that they create more possible findings than either could alone.	**Convergent** Previously independent fields are used to study a single phenomenon.
Socially practical	**Self interested** Justify studies based on their own interests.	**Diffuse Audience** Fail to distinguish audiences of studies.	**Policy Directed** Write to policy makers.	**Science Directed** Write to present and future scientists.

See discussions on AALHE.org Methodology CoP at **Establishing Assessment Science**, **Why Assessment is Prescientific**, **Engaging Assessment Science**, and **MOSHE Rubrics Elucidate Paradigmatic Changes**

Table 2. Developmental/Historical Sequences of DESIGN Research

Dimension	Beginning	Easy	Practical	Inspiring
OVERVIEW	**Stereotypes** Actualize personal preferences. Test what the assessment person deems important in a format that he or she likes (multiple choice, short answer, narrative) would be an example).	**Fulfillments** Make lists of user requirements and "*fulfill*" the items in it. Incorporate user thinking and develop hierarchies of use (e.g., assess using Bloom's taxonomy to create learning outcomes exemplifies an easy strategy).	**Specifications** "*Specify*" relations among uses, programs, and diverse human experiences in enough detail to be producible (e.g., work with practitioners in a field to identify learning outcomes and use authentic assessments to determine their achievement.	**Discoveries** Create "*discoveries*" by expanding people's attention and stimulating unexpected experiences (e.g. good capstone projects contribute to a field of expertise by providing the student's prospective community of practice experiences with their expertise that they have not had before).
PROCESS	**Start** Follow instructions seeking validation after each effort. Start project and describe its development as if preparation is not part of the process. Do not know basic classifications and questions or who or even whether to ask. Choose any idea whether useful or not, using only the history they have personally experienced.	**Sequence** Follow directions but fail to assess each step so miss destructive errors. Try several alternatives using a memorized process but selected options are often too obvious and pragmatic. Learn the competition between ideas by describing rejected ideas. Choose problems they can solve but use techniques not practiced enough or avoid ones they should know.	**Combine** Respond to situational: needs. Assess, correct errors, and record what happened for use on next project. Describe process stages using basic story structure of setup, problem-creating event, rising conflict, decisive event and resolution. Use multiple sources to design workable relationships between needs, resources and stakeholders, accounting for skill constraints of self and collaborators.	**Transform** Make the unexpected seem inevitable. Connect processes in different times and cultures. Invent techniques, tools, materials or shapes. Incorporate project development in life development. Help others make discoveries or develop skills. Go beyond facts to reinterpret, creating designs that transform historical into inspired human experience. Understand how designs “learn”.
Research	**Assuming** Presume their first ideas, points of view and problem understandings to be sufficient. View design history and nature as closed books with names, dates, and places. Consider internet and popular media as information. Resist ordering their thoughts. Omit citations, research techniques and comparisons.	**Confirming** Recite how research inspires design but begin without it. Haphazardly collect references, interview experts, and engage in hands-on learning, without identifying goals or applying information to process. Note elements and principles of design in everyday world and art history. Seek and use rules, procedures, and measures but allow no conflict with previous opinions.	**Comparing** Do visual and verbal research of local environment, historical or cultural designs to create a mood or technique. Compare multiple sources. Measure ideas against criteria. Feel conflict between changing the uncontrollable world and doing unimportant things. Use qualitative and ethnographic research to identify subcultures and understand people’s thinking and behavior. Base research on long-term interests.	**Integrating** Integrate visual, verbal, natural, interdisciplinary and user research into life choices, unifying art history and nature with self. Collect experiences from projects and art around the world and put into historical and future contexts. Participate in users’ lives. Choose methodological issues and topics drawn to since childhood. Design for all viewpoints they discover.
See detailed dimensions of Users, Precedents, and Economics on AALHE.org Methodology CoP at **How Designers’ Dimensions of Research Can Change Assessment**				
Creativity	**Fixating** Come up with only one idea to solve a problem and think it their best. Think development equals inspiration. Listen to every detail but misunderstand key problems. Mimic without realizing it. Know too little of existing products or designs to know what is new.	**Guessing at** Try several ideas and variations but let preconceptions interfere or take too long to record ideas to avoid losing many more. Miss basic process steps if not told. Haphazardly use techniques like analogies, metaphors, humor, reframing, role playing, stream of consciousness, breadth of thought, verbalizing and visualizing.	**Iterating** Provide many resourceful, informed and fresh solutions. Use processes automatically including research, ideation and finalization. Draw for speed in order not to lose ideas that will be selected later. Continue using creativity tools and heuristics until they fail. Fit new ideas into given genres.	**Situating** Integrate problems into their lives influencing their ways of seeing and choices of focus. Continually extend understanding through metaphor, code, deconstruction and reframing the design problem by bringing in new bodies of knowledge, experience or understanding. Empathize with, notate, analyze and integrate other people's understandings and perspectives.
See detailed dimensions of Vision, Critique, Design Principles and Elements, and Drawings on AALHE.org Methodology CoP at Envisioning Beautiful Research				

Table 2. Developmental/Historical Sequences of DESIGN Research

Dimension	Beginning	Easy	Practical	Inspiring
CONCEPT	**Endemic** Use popular concepts stated in common ways. Can't see beyond themselves. Think design and life are not related. Cannot integrate others pain or joy in their designs.	**Procedural** Simplify the concept by relating new to known skills, equating design with technical skill, and incorporating material with vague justification. Look to content from own experience without research. Connect with what they already know with guidance.	**Multi-dimensional** Base conception on a multidimensional matrix including types and interface opportunities. Make a series of designs that richly explore complexity through applying design principles. Do research and immerse themselves in topic enough to narrow it down to an aspect that interests them.	**Insightful** Give insight to user or audience. Base conception on the life enrichment potential of the spaces or objects over time. Follow a flow of investigation. Use visual thinking as part of life and develop new applications or ways to visually represent their thoughts. Know the appropriateness of related disciplines, current events, and social influences. Identify new opportunities for human communication and life enhancement.
Product	**Puttering at** Unaware of product cycle and overwhelmed by the artistic process. Fail to finish design. Crudely made prototype or model that is heavily derivative and made with multiple errors, unresolved craftsmanship, and unnatural or basic forms leaving the audience painfully aware of the medium. Do not think about production.	**Assembling** Articulate components of product cycle. Create novelty by making obscure, useless items or items experts often see. Derivative items have accurate symmetry, proportion and scale. Complex products are incomplete, inconsistent and show little evidence of being tested enough to avoid disrupting the user experience. Focus more on skill development and process than production.	**Refining** Know basics of marketing, sales, finances, manufacturing, and distribution. Beautifully interpret even simple objects with a high level of craft and materials, but still ordinary and less satisfying than drawings. Use mockups to test design and user experience. Products are of average difficulty to produce. Give in to production demands, rarely revisiting failures.	**Diversifying** Know how each product cycle step informs the design solution. Build several models to test proportions, functions, user experience and production in efficient and knowledge-producing ways. All elements have meaningful complexity and qualities. Resist quantity demands to increase quality. In long projects, resurrect failures and sometimes succeed with them.
See detailed dimensions of Materials, Technology, Practice, and Skills on AALHE.org Methodology CoP at Learned with Delight, Remembered Right				
Communication	**Suppressing** Wish or want to communicate but don't know where to start and wait for someone to open the door. Frozen into unreflective group processes. Restricted to their habitual ways of holding or expressing themselves.	**Reacting** Recognize standard vocabulary and others' potential but do not spontaneously use either when obvious opportunities occur. Deconstruct lifelong habits. Resolve conflicts by seeking an authority or dividing the labor and working separately. Try to pitch a design without discussing issues relevant to one major category of the audience.	**Engaging** Discover the human resources of the group, each being a unique equal. Adapt language to those involved. Address concerns of all major aspects of the audience. Talk out differences without attacking those who disagree with them. Able to express viewpoints of others accurately.	**Stimulating** Invite ideas from other disciplines and cultures in hopes that the final ideas will be greater than those of any single participant. Adapt language and expressive movement to audience and situation. Help group members find ways to learn from each other while doing their own part.
See detailed dimensions of Presentation, Collaboration, and Marketing on AALHE.org Methodology CoP at Analyzing Communication				

Communication

Depending on whether we use just the main or also the detailed dimensions of design, we have 23 to 37 places to choose our next steps in advancing assessment research. Doug, David and Susan will provide additional perspectives on the question that brought us together: what should be our next steps in advancing assessment research? AALHE is a prime source for improving the rubrics above, applying them to real world situations, and disseminating results on what worked and what didn't work in such applications.

Using Developmental Interviews to Create Learning Outcomes Networks

David Dirlam*, Nancy Roszell+, Laura Ng^, Robert Covitz*, Marta Wilkinson+

**Hebrew Union College, Cincinnati, OH, +Wilmington College, Wilmington, OH*
^Gainesville State College, Gainesville, GA

Participants will learn how to produce reliable, valid MODEL rubrics using developmental interviewing. The presenters will (1) introduce a developmental model that has succeeded in producing theories of expertise development in nearly 200 distinct interviews, (2) describe easy, practical and inspiring approaches for conducting such interviews, (3) demonstrate an interview, (4) help participants conduct and reflectively critique their own interview, (5) learn techniques for combining the results from independent experts in the same field, and (6) learn how to turn rubrics results from a single program into a Learning Outcomes Network.

Learning Outcomes Networks based on MODEL rubrics (Matrices Organized Developmentally through Expertise and Labeling) have received national recognition for their ability to discriminate what works from what does not work in programs. For advanced, creative or unusual programs where standardized tests are lacking or inappropriate, MODEL rubrics are powerful tools for improving program and student performance.

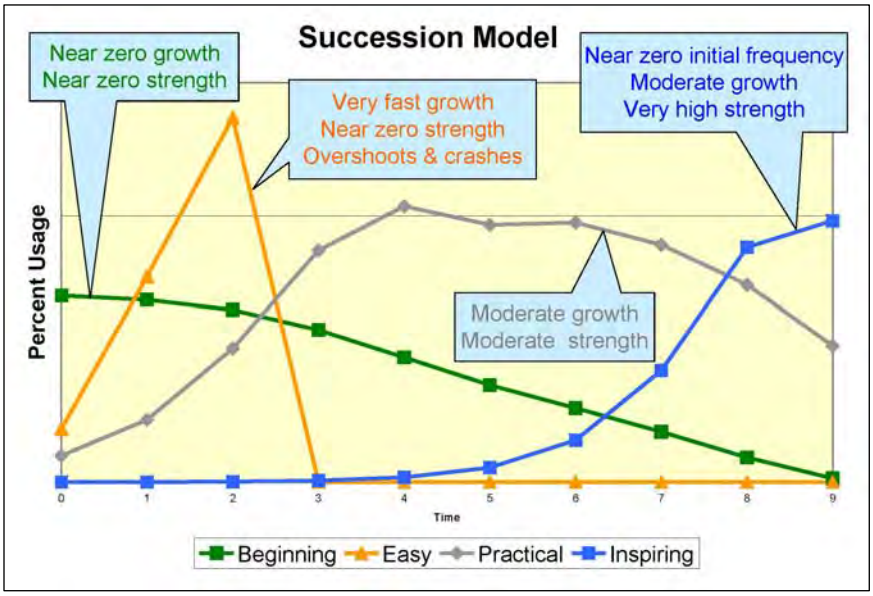
1. **Why did we get started with this?** – Nancy Roszell (5 min.)
2. **A model that enables experts to create a developmental theory for their expertise** – David Dirlam / *Interview Tool* (10 min.)
    - Stage is a *commitment* followed by *practice*
    - But development is *multidimensional* (not all stages move together)
    - The commitments are *try, learn, earn, contribute*
    - Practice times are *minutes, months, years, decades*
    - Stage names are *Beginning, Easy, Practical* and *Inspiring*
3. **Conducting Interviews and Helping Others Interview** – Bobby Covitz and Marta Wilkinson / *Useful Developmental Interviewing Skills* (15 min.)
    - Handout discussion
    - Getting started
4. **Interview Demonstration** – Laura Ng will be interviewed on writing development by David Dirlam with Bobby Covitz taking notes (30 min.)
5. **Workshop Participant Discussion** (20 min.)
    - What's your name? Where are you from? What's your expertise? What do you teach? How would you use this?
6. **Presenters Help Participants Conduct and Reflective Critique Their Interviews** (40 min.)
7. **Combining Results from Independent Experts in a Single Field** – Marta Wilkinson and Bobby Covitz / *Evidence Dimension from Wilmington College Interviews* (10 min.)
8. **Analyzing the Ratings Results** – Nancy Roszell (10 min.)
    - Use nonparametric statistics
    - Do separate analyses for each dimension
9. **Creating Learning Outcomes Networks** (LONs)– David Dirlam / *Creating Learning Outcomes Networks* (10 min.)
10. **What questions do you have and where else would you use this?** – Nancy Roszell (20 min.)

If you would you like to become a LON collaborator, please contact David Dirlam (ddirlam@huc.edu) or Bobby Covitz (rcovitz@huc.edu)

Learning Outcome Network Interview Tool

This tool is intended for to help you and a developmentalist create a development theory of your field. The result will be a learning outcome network for the program where you have your primary appointment. We seek to discover several dimensions of four types of commitments learners make: (1) to try, (2) to learn a little, (3) to earn a living in the field and (4) to contribute to or make discoveries within a field. We call these commitments (1) Beginning, (2) Easy, (3) Practical and (4) Inspiring. Each commitment is realized within a different time frame: no time to begin, a few months to learn easy strategies, a few years to learn practical strategies and a decade to make regular contributions to a field. Fast growing, easy strategies often overshoot resources and cause the activity to be abandoned.

We focus on what students do. What do beginners do and how does this differ from the easy strategy learners? What do people need to do to earn a living in your field? How does this differ from what experts or masters to make discoveries? We take notes and you will have a chance to edit our notes. The edited notes from all the experts in your program will be combined to make a single set of abstract rubrics for the program. These will be edited for reliability and validity in use.



Based on studies of over 1,200 drawings (age 5-19),
2,200 discourse samples (age 5-18), and 900 research articles (published 1930-1992)

Strategy Name	Beginning	Easy	Practical	Inspiring
Drawings Examples	Scribbles	Stick people	Sketches	Fine art
Research Variables	One Dimensional Choices	Summed Multi-dimensional Choices	Counts of Multidimensional Choice Patterns	Categorized Free Behavior
Beginner Use	Common	Rare	Rarer	Extremely rare
Growth Rate	Almost none	Extremely fast	Moderate	Slow
Competitive Strength	Almost none	Very low	Moderate	Very high
Commitment	Try	Learn	Become proficient	Make contributions
Learning Times	Immediate	Weeks to months	A few years	Decade +
Effects	Peripheral Participation	Take little practice; get some reward	Enable living wages but no excitement	Enable Discoveries
Helpful Prompts	What do people do before any instruction?	If a student overuses these at work when about to graduate, you feel discouraged.	Save this “sandwich filling” for last.	What did students do that surprised you with its appropriateness?

A Summary of Useful Developmental Interviewing Skills

(based off of the Developmental Interviewing Profile, © 2010 Dirlam and Covitz)

- **Use Interview Tool:** the ability to dialogue about the tool with quick and flexible recall of all details (strategy names, practice time, graphs) is essential to interviewee comprehension.

- **Collaborate:** build rapport by affirming and showing interest in the interviewee's responses. Use developmental principles and interviewee knowledge to create more than either could create alone.

- **Define Dimensions:** ask interviewees to remember frustrating things advanced learners do, separate out dimensions as they talk, and pick unique insights from other dimensions to expand later.

- **Discover Commitments:** record notes after discerning how the answer relates to one of the four commitments (try, learn, become proficient, or contribute). Identify commitments unique to the expertise being discussed.

- **Emphasize Learner Behavior:** describe student behaviors emphasizing action words while seeking alternatives to adjectives and especially to interviewees focusing on what they did to help the learner rather than on what the learner did.

- **Listen and Use Notes:** help interviewees interpret experiences that can be useful to others. Let them speak for themselves, unless they want help finding a word or idea. Use notes to work together to create a way to express complex ideas, making sure the interviewees contribute more to constructing the narrative than the interviewer.

- **Produce Flow:** wait patiently, realizing that people take time to come up with ideas. Provide an atmosphere conducive to open and undistorted communication by being receptive to being changed and describing the change when it happens.

- **Clarify:** get definitions of disciplinary jargon and enough examples for non-experts to get an idea of disciplinary concepts.

Name: **Program**: **Expertise:** **Date**:

	Beginning	Easy	Practical	Inspiring

Evidence Dimension from Wilmington College Interviews

MODEL Rubric Dimension

Element of Writing	Beginner	Easy	Practical	Inspiring
Use of Evidence (What do you do with information and materials that make the cut?)	Use Google search or class materials, may not know a valid source when they see it or understand the various possible sources of evidence. React with personal experiences or subjective opinions. Misuse terms, or does not apply discipline-specific terminology at all.	Support their opinion with primary and secondary sources, but interaction is shallow. Has some knowledge of research methods (library, databases) – but isolate searches to directly topically related materials. Limited-evaluation of sources based on title or abstract. Better usage of terms; comfortable use of terms in proper context.	Will look at related texts and various other sources of evidence, evaluate effectively, interpret, and apply in a practical way. Understand what evidence means and why certain evidence is appropriate; can generate own evidence, and place their evidence within context of others. Clear understanding of terminology; better fluency.	Communicate own unique insight. Make the reader want to apply new techniques or move the reader to new actions/comments.

Interview Text

	Beginner	Easy	Practical	Inspiring
Evidence	Don't know how to find it; may not know it when they see it. Google search or class materials	Has some knowledge of research methods (library, databases) – but isolate searches to directly topically related materials; still unsure of purpose of research; limited-evaluation based on title or abstract	Uses intuition to navigate thru various sources of evidence; will look at related texts; will vary keyword search on their own initiative; can evaluate more efficiently; can navigate a database.	
Use of Evidence	React with personal experiences or subjective opinions.	Support their opinion with primary sources.	Synthesize the literature of the field and find appropriate secondary sources and apply them in a practical way.	Communicate own unique insight. Make the reader want to apply new techniques or move the reader to new actions/commitment.
Evidence	Often don't know what it is, or the various possible sources of evidence	Use evidence to formulate new ideas; can gather evidence	Understand what evidence means and why certain evidence is appropriate; can generate own evidence and interpret.	
Evidence	Little to none beyond personal experience, or repetition of course materials.	Quotes and primary source examples included, but only minimally explained.	Examples and sources clearly explained, all materials directly relevant to central thesis.	Evidence supports central thesis and expands to encompass questions beyond those raised in the primary literature.

M. Wilkinson and R. Covitz. AALHE 2011
Wilmington College and Hebrew Union College – Jewish Institute of Religion

Creating Learning Outcomes Networks

David Dirlam
Hebrew Union College – Jewish Institute of Religion

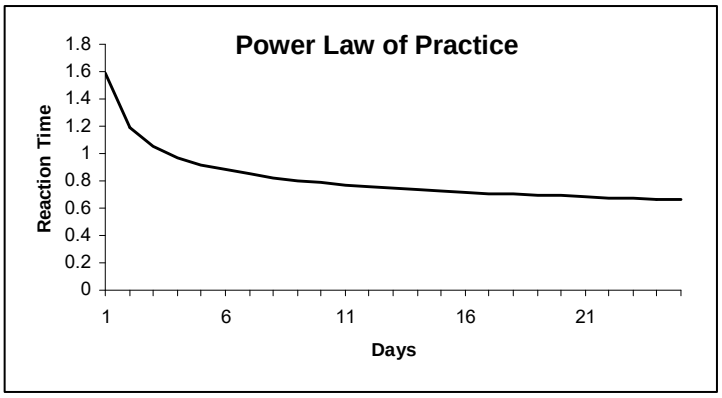
- Beginning
  - A few people use rubrics for a small diverse sample (10-30 projects from beginning and end of program)
  - Allow program participants to revise rubrics especially focusing on areas of low reliability
- Roll out
  - Apply revision to one project per student per course for every course
  - Nobody is leaving the program assessment task to somebody else.
  - Every faculty member will be a knowledgeable contributor when it comes time to use the assessments to suggest innovations that should improve the program.
  - Every faculty member will have enough individual experience with the strengths and weaknesses of the assessment approach to contribute to improving it.
- Use of results
  - Program innovations
  - Reassessment cycle
  - Student interaction

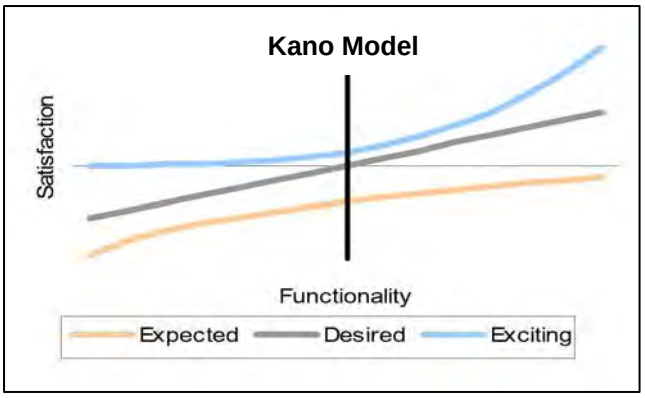
Part of a Workshop Presented at the Annual Conference of the Association for the Assessment of Learning in Higher Education, Lexington, KY, June, 2011

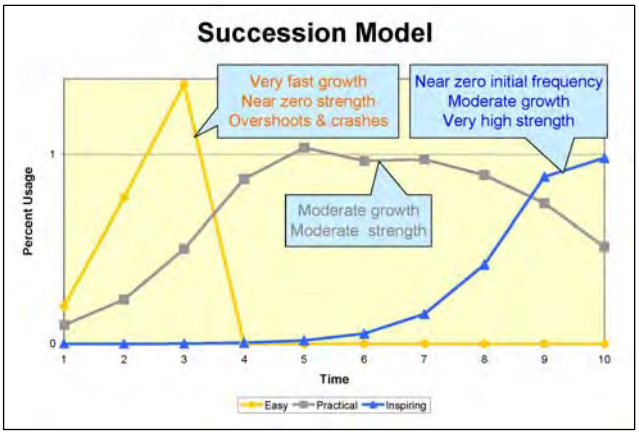
Using Cognitive Science Models to Create Reliable and Valid Rubrics

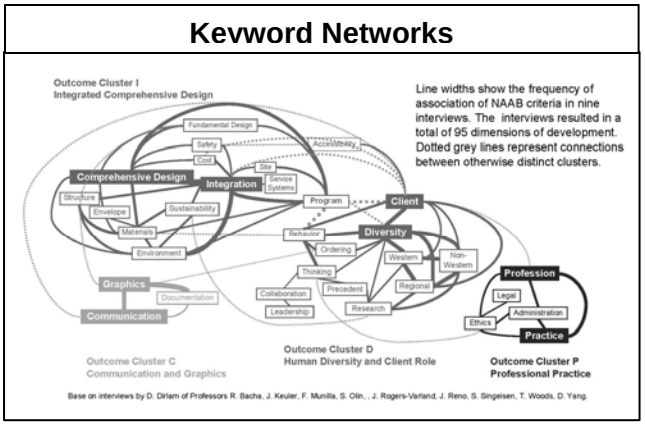
David Dirlam, *Hebrew Union College – Jewish Institute of Religion* & Laura Ng, *Gainesville State College*

Rubrics Rubrics				
	Beginning	**Easy**	**Practical**	**Inspiring**
Type	**Categories** Dimension names only so that those being evaluated only know what categories to work on (e.g., the teacher could respond to a student's first research attempt by saying "Work on spelling, grammar and point of view").	**PAGE** (Poor-Average-Good-Excellent) so that those being evaluated only know how they made the evaluator feel (e.g., a teacher could respond to a student's first research attempt by saying "I'm so glad you wrote it, but it's Poor, so try to be Average next time).	**SWELL** (Sequences Which Expand Little by Little) so that those being evaluated know what areas they should try harder in (e.g., the teacher responds that the student needs more practice in several areas).	**MODEL** (Matrices Organized Developmentally by Expertise and Labeling) so that those being evaluated know what kinds of commitment the evaluator recognized and what kinds of commitment (e.g., try, learn, get job, contribute to field) they need to make in order to advance in the field.
Source	**Internet** Assessor copies it from the net.	**Sole Author** A sole author writes it for a group.	**Committee** A committee gets together and creates them.	**Summarized Interviews** Developmental interviews of each group member are combined into definitions of levels that are unique to how the local group culture envisions the discipline.
Use	**Summative** Capstone only	**Formative** Specific Entry-Midpoint-Capstone Courses	**Programmatic** All courses	**Interactive** Spontaneous interactions of faculty with students in all courses.
Analysis	**Totals** Counts	**Differences** Significant Differences between course levels.	**Reliability** Reliability correlations between independent raters.	**Network** Networks of mutualistic or competitive activities.
Application	**Critique** Critique a program.	**Accreditation** Write an accreditation report.	**Local Experimentation** Experiment with new approaches to educating students.	**Contribution** Help the assessment community improve their practices.









Gainesville State Program Mission Statement

- Enhancing students' understanding of the diversities of literatures, languages, artistic expressions and perspectives of humanity;
- Fostering life-long learners who think critically and creatively; and
- Providing interdisciplinary learning opportunities through which students acquire an understanding of diverse modes and techniques of communication.

Common Complaints	Takeaway
1. Bundling	Rubrics are fractal
2. Left out criteria	
a. Writing process	Rubrics creation is a collaborative process
b. Audience (languages)	The audiences are the faculty, students, and public
c. Research (diversities of literatures)	Rubrics are disciplinary.
d. Ownership	Rubrics creation should involve ownership by the group responsible for setting the standards
3. Left out ties to the Mission	Read mission statement before an interview
a. critical thinking	No description of the differences in teaching approaches
b. creativity	
c. lifelong learning	
d. artistic expressions	
e. perspectives of humanity	
f. diverse modes and techniques of communication	
g. interdisciplinary learning	Coordinated courses taught as co-requisites
4. Debate in regard to whether or not the student should be assessed on how well s/he meets the parameters of the assignment	Analyzing Learning Outcomes Networks can point to answers to such debates
a. Pro side says it needs to be addressed	
b. Con side says it is implicitly addressed in content.	
c. A committee over the summer came up with it	Groupthink versus individual interviews
5. Another question is in regard to whether the terms like "unique" is whether or not we are all using the same definition for it—consistency	Answered by reliability analysis
6. Is tool accessible to the student? Can a student read it and fully understand why the category of emerging was marked instead of mastery?	Tool goes to the inspiring level
7. Should we use summary scores?	Adding apples and oranges vs. using patterns
8. Where are the results?	If not analyzed, what good are they? Reliability and Implications for what is working
9. How are we to use the results?	To suggest foci for program innovations and help students define learning commitments

Apply rubrics meaningfully

Types of rubrics

Ownership of rubrics (students commit when they write about something they care about)

Analysis and use of them

Take an interest in the theory

Commitment followed by practice within writing process, lifelong learning process and history (Peer responses and comparing the development of their own other drafts are a microcosm of lifelong development)

What are the singular experiences that help to move learners commit to moving from one level to the next?

Appendix

Gainesville State Institutional General Education Goals

1. Communicate effectively through speaking, writing, reading, and listening;
2. Perform basic arithmetic and algebraic operations and use mathematical concepts to comprehend, interpret, and communicate quantitative information;
3. Demonstrate critical thinking skills and a basic understanding of systematic methods of inquiry and apply those principles and procedures;
4. Demonstrate knowledge of history and political systems and their implications in local, national, and international contexts;
5. Demonstrate an awareness of cultures different from their own;
6. Demonstrate the knowledge necessary to plan and execute a personal wellness program;
7. Use computers and other forms of technology to perform a variety of tasks;
8. Develop an appreciation of a broad range of artistic experiences;
9. Work effectively in groups;
10. Further education and professional areas of their lives; and
11. Gain enrichment in the personal areas of their lives.

How to Make Local Culture Discoveries by Mining Documents using MS Office

David K. Dirlam and Robert Covitz
Hebrew Union College – Jewish Institute of Religion

Ohio Association for Institutional Research and Planning, Spring 2011

Topics

I. Introduction

II. Culturomics Analysis
- Text*
- 1-grams
- Counts
- Keywords

III. Keyword Network Deconstruction

A. Key Ideas from Network Theory
- Nodes
- Edges
- Giant Components

B. Application
- Keyword Roots
- Edges
- Deconstruct
- Groups
- TextGroups
- SortGrouops

IV. Using Grouped Text for Analysis
- Use Keyword Groups to Group Text
- Further Analyses we have done
- Discussion

*purple indicates an MS Excel sheet title

Culturomics

Science recently published (14 January, 2011) a research article on a “culturomics” study of a half-trillion-word corpus from over 15 million books.

The study was done by 14 authors including the Google Books Team (see http://www.culturomics.org/).

The basic method involved tracking word-frequency changes over time.

Some of their fascinating findings include

1. the acceleration of adoption speed for new inventions,
2. the shortened cycle of fame, and
3. the temporary effects of censorship.

Culturomics and Network Theory

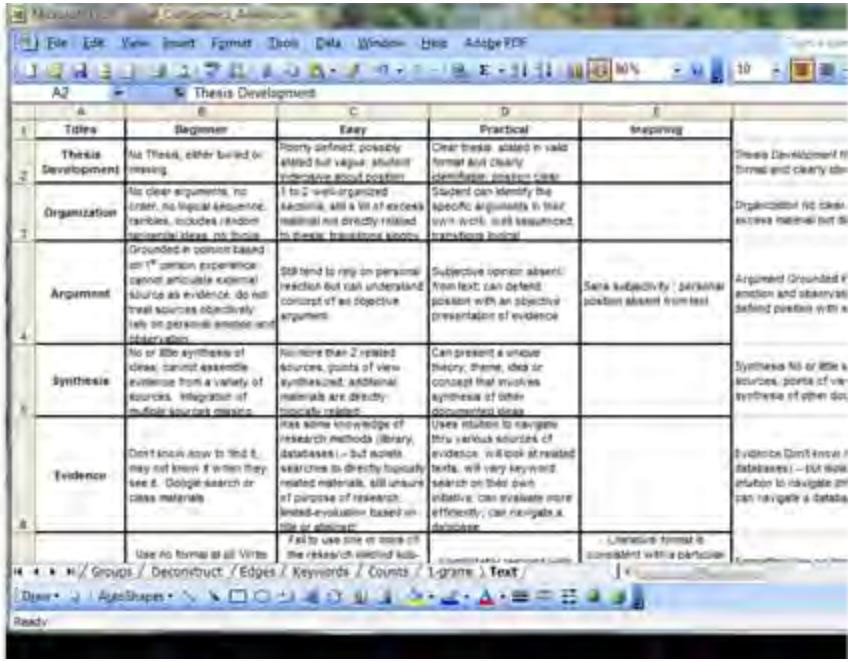
Using basic principles of network theory with corpuses of a few thousand words, assessors can make similarly fascinating discoveries of their local cultures.

Kinds of Data

- Student Papers
  - Half million word corpus of student journals of an after school program with computerized educational games
- Developmental Interviews
  - 40-600 dimensions from 4 to 60 experts in single or diverse programs
- Accreditation Reports
  - A study of evaluating team reports from three regional accrediting agencies
- Any data that is segmented into 30+ units that you want to group or otherwise analyze.
  - Program Descriptions, Course Descriptions, Syllabi, Committee Minutes, etc.

Segment the Text

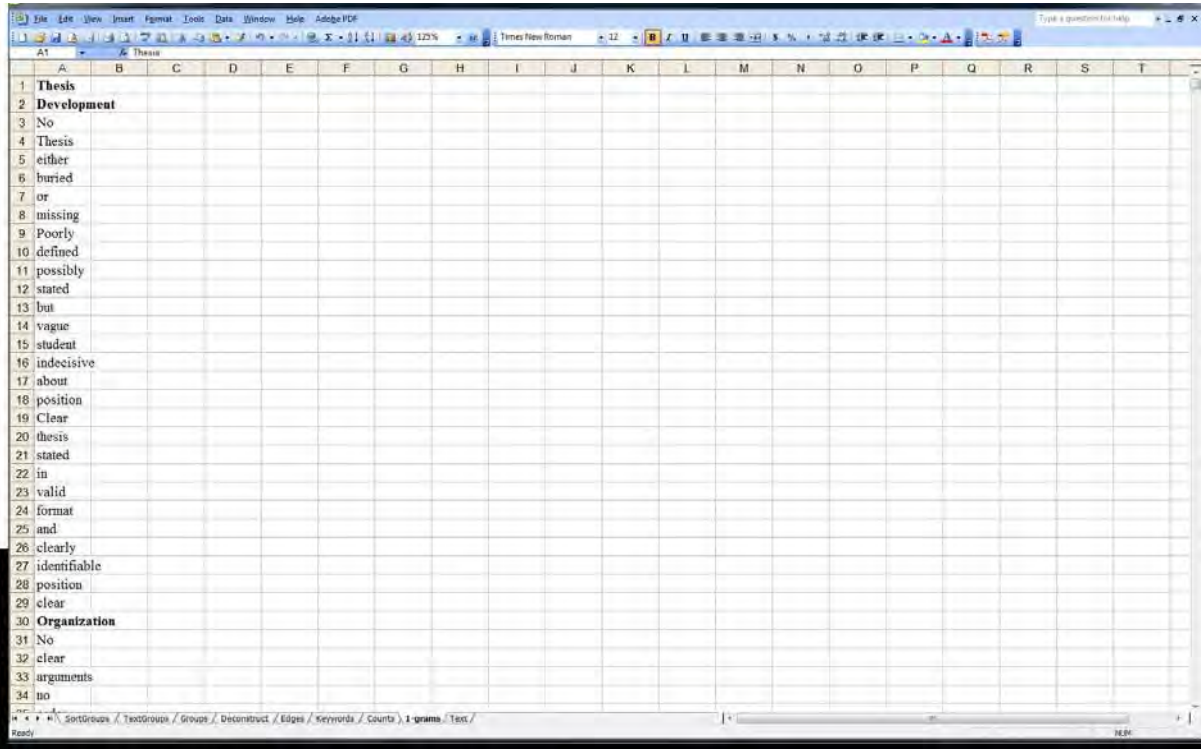
- If you have less than 30 text units with less than 2,000 words, you could probably analyze it as fast by careful reading.
- Copy the segmented text to the Text sheet of MS Excel and to MS Word.
- This sheet is set up for titles and 4 columns.
  - If you don't have titles, clear that column.
  - If you just have titles and paragraphs, delete the text in columns C, D and E (don't delete the columns; just leave them blank).



Note Well. Use Local_Culturomics_Analysis.xls.
Replace only cells that do not have formulas in them.

Find 1-grams

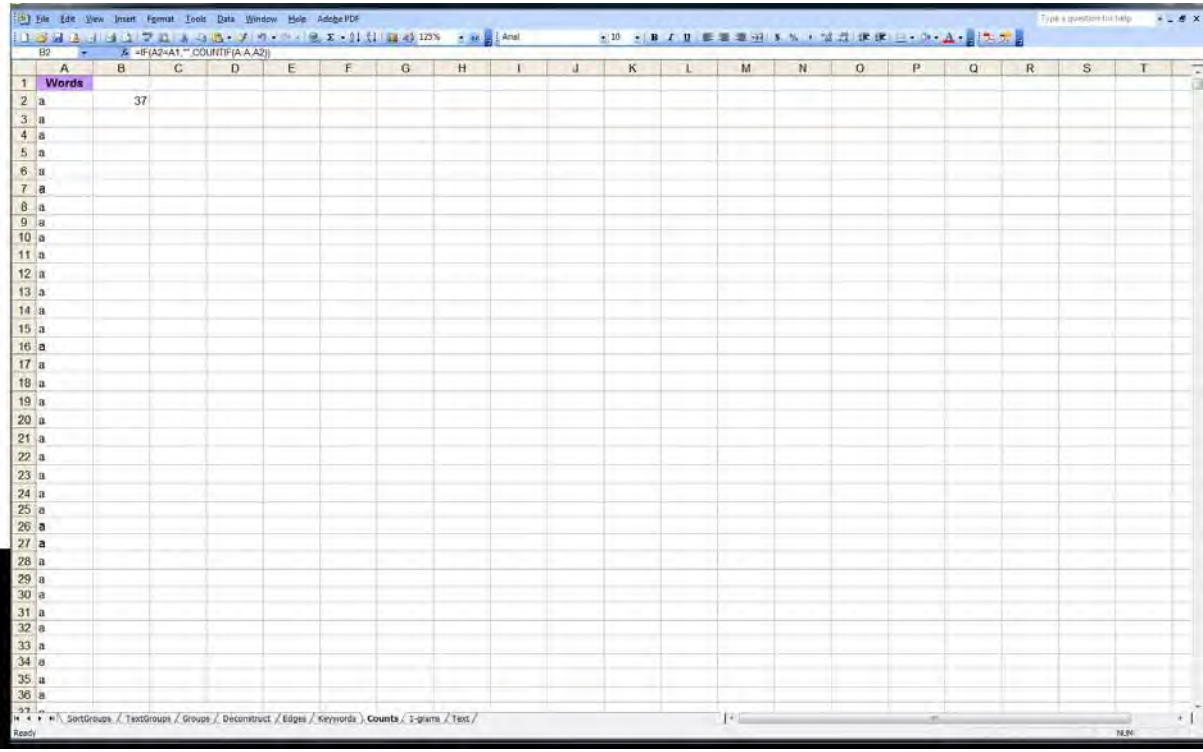
- Copy the text to MS Word
- Replace all spaces ( ), dashes (-) and slashes (/) with Enter (^p)
- Replace all punctuation (.,”;:’!?#$ one at a time) with nothing
- Copy all (Ctrl-a) to the Excel sheet labeled 1-grams



	A
1	**Thesis**
2	**Development**
3	No
4	Thesis
5	either
6	buried
7	or
8	missing
9	Poorly
10	defined
11	possibly
12	stated
13	but
14	vague
15	student
16	indecisive
17	about
18	position
19	Clear
20	thesis
21	stated
22	in
23	valid
24	format
25	and
26	clearly
27	identifiable
28	position
29	clear
30	**Organization**
31	No
32	clear
33	arguments
34	no

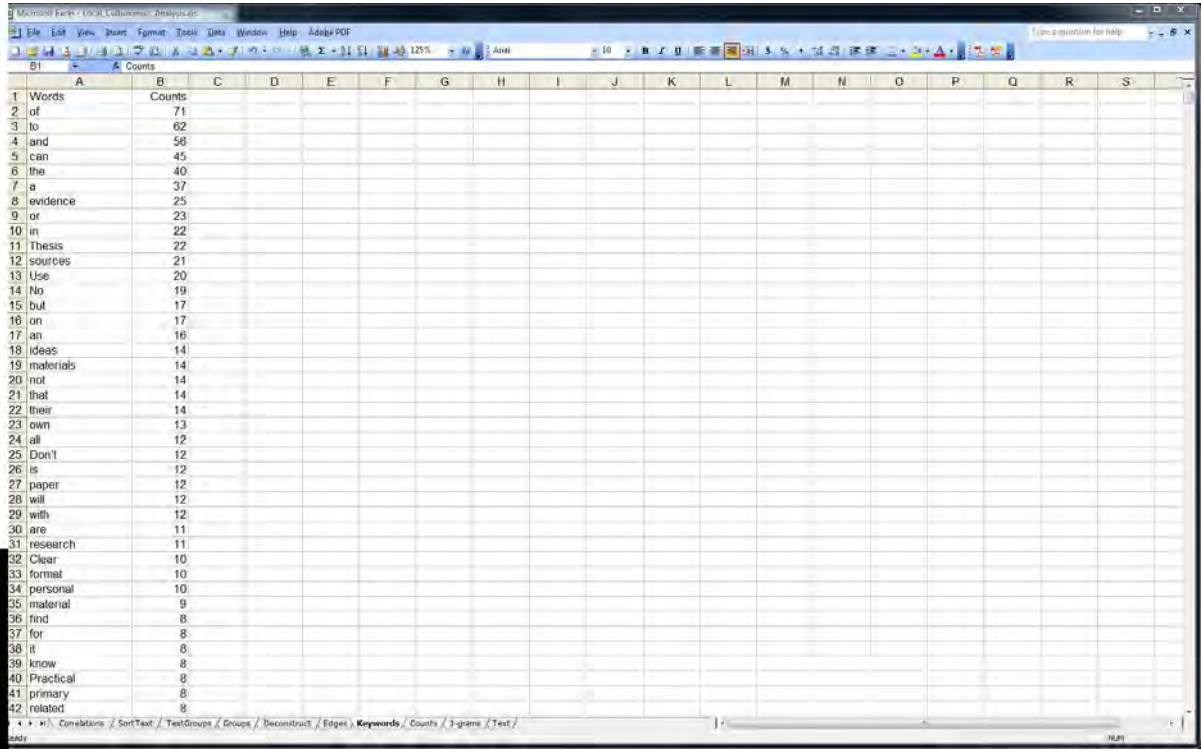
Counts of 1-grams

- Copy the 1-grams to the sheet labeled Counts
- Sort the 1-grams and count them with =IF(A2=A1,"",COUNTIF(A:A,A2))



Find Keywords

- Eliminate duplicates
  - Copy the Counts sheet data using paste values only to the sheet labeled Keywords
  - Filter on the number column to get only the spaces and delete all the empty rows
  - Sort descending by frequency (count column B)
- Eliminate function words
  - Many will be at the top of the frequency list
  - For each word, decide by whether it has much meaning when combined with another 1-gram
    e.g., [analysis] and [style] might tell you something, [analysis] and [make] probably not
  - Delete function words and any others in your list that appear more than 2 times.



	A	B
1	Words	Counts
2	of	71
3	to	62
4	and	58
5	can	45
6	the	40
7	a	37
8	evidence	25
9	or	23
10	in	22
11	Thesis	22
12	sources	21
13	Use	20
14	No	19
15	but	17
16	on	17
17	an	16
18	ideas	14
19	materials	14
20	not	14
21	that	14
22	their	14
23	own	13
24	all	12
25	Don't	12
26	is	12
27	paper	12
28	will	12
29	with	12
30	are	11
31	research	11
32	Clear	10
33	format	10
34	personal	10
35	material	9
36	find	8
37	for	8
38	it	8
39	know	8
40	Practical	8
41	primary	8
42	related	8

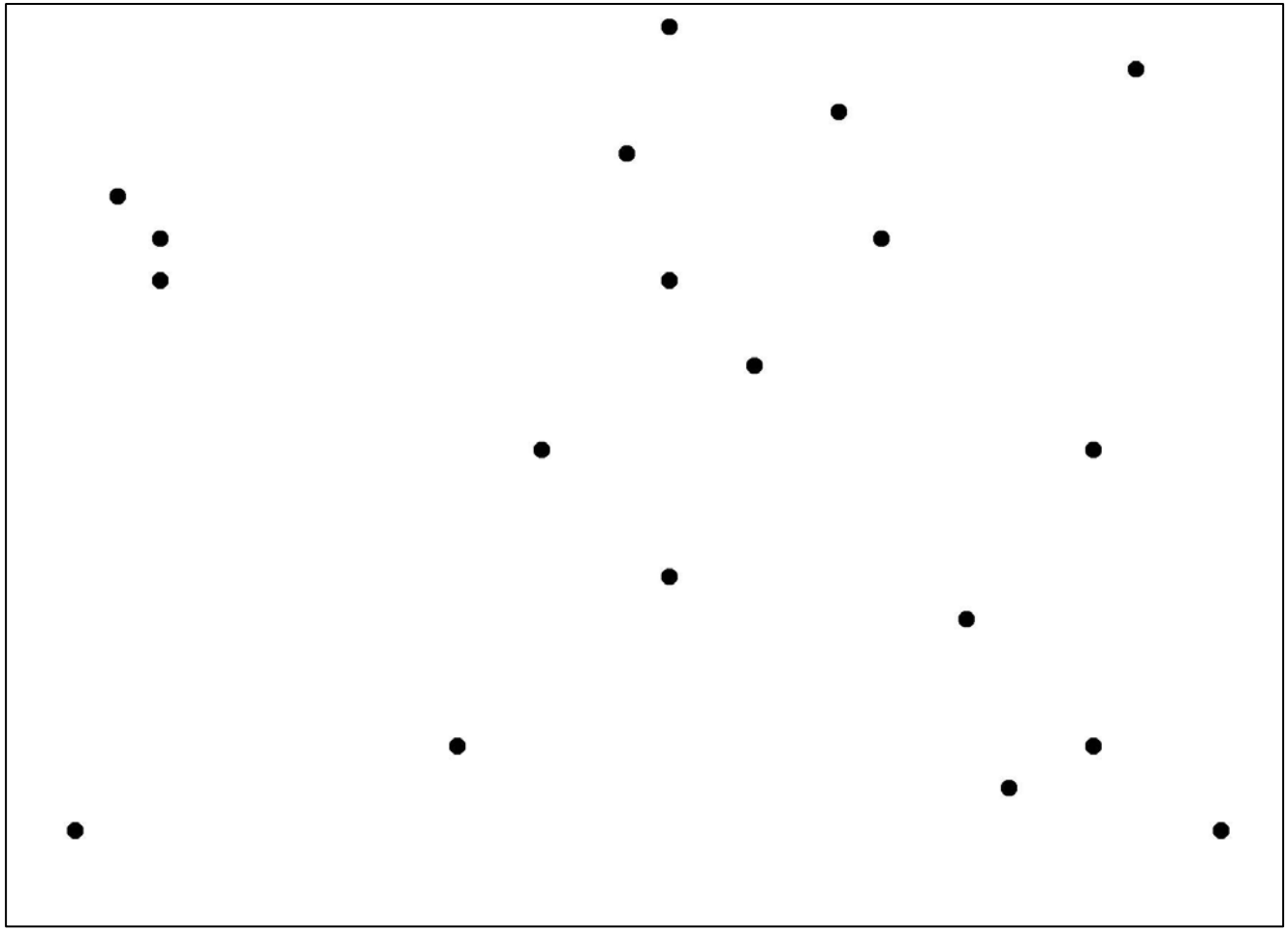
Culturomics

- Analyze for frequency changes over time or activities.
- This was the analytical extent of the culturomics paper in *Science*.
- It requires a minimum of thousands of segments within documents and hundreds of thousands of words.

Keyword Network Deconstruction

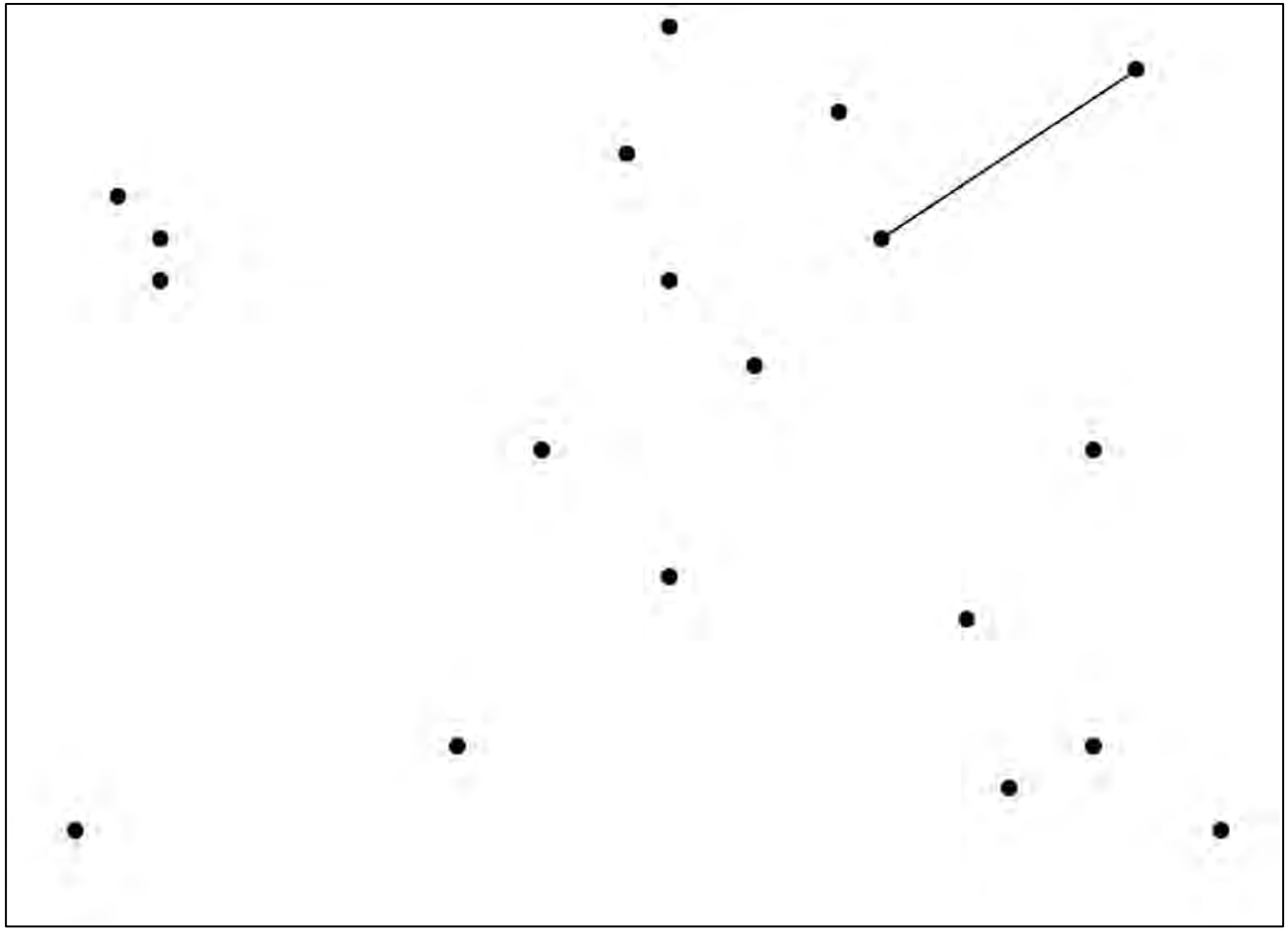
- Produces rich findings with 40-1,000 segments and 50 times as many words.

Unconnected Words in a Culturomics Analysis



Keyword Network Edge 1

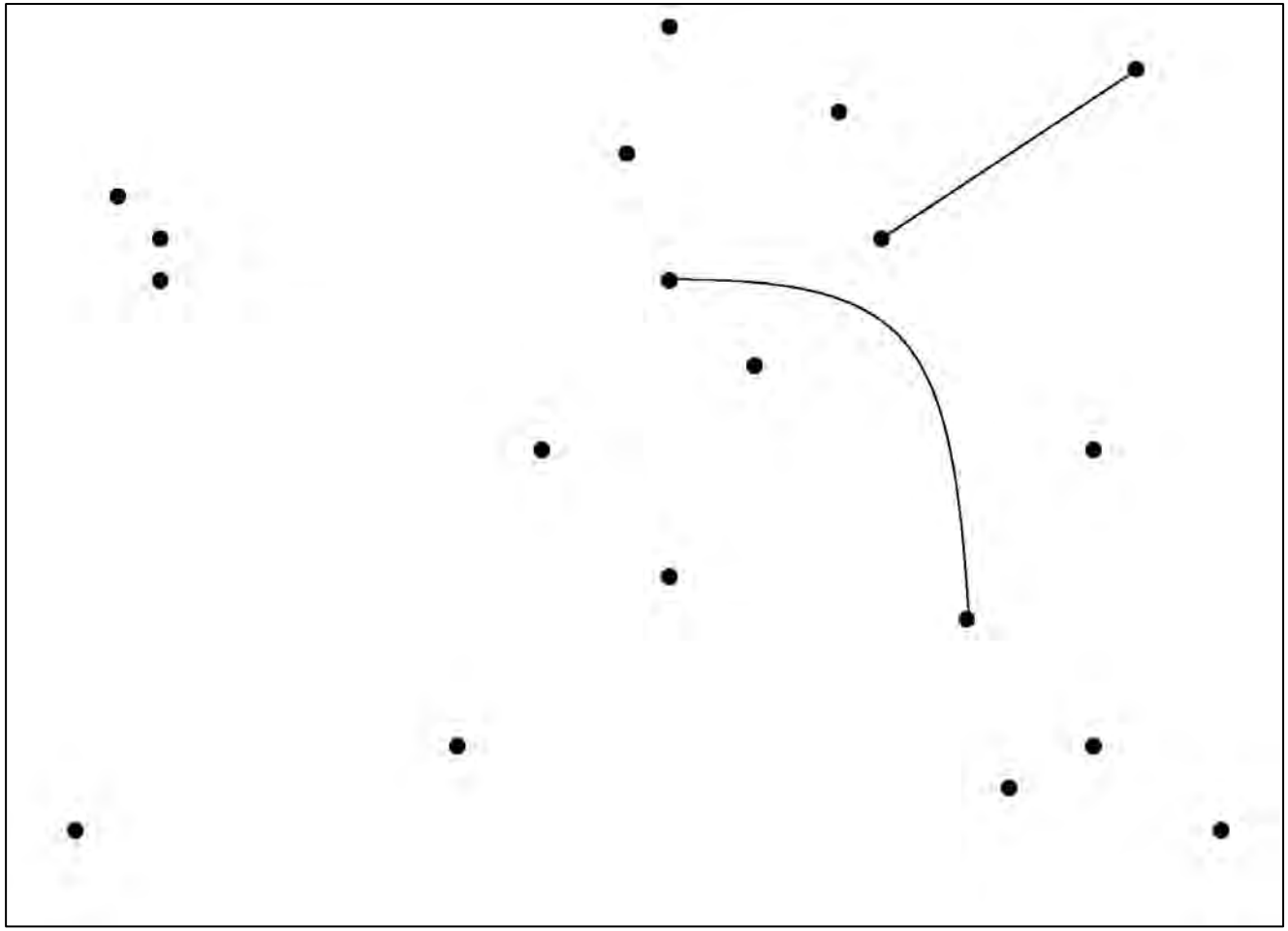
(two words appear in the same text unit,
such as a sentence or paragraph)



Maximum component size = 2 nodes

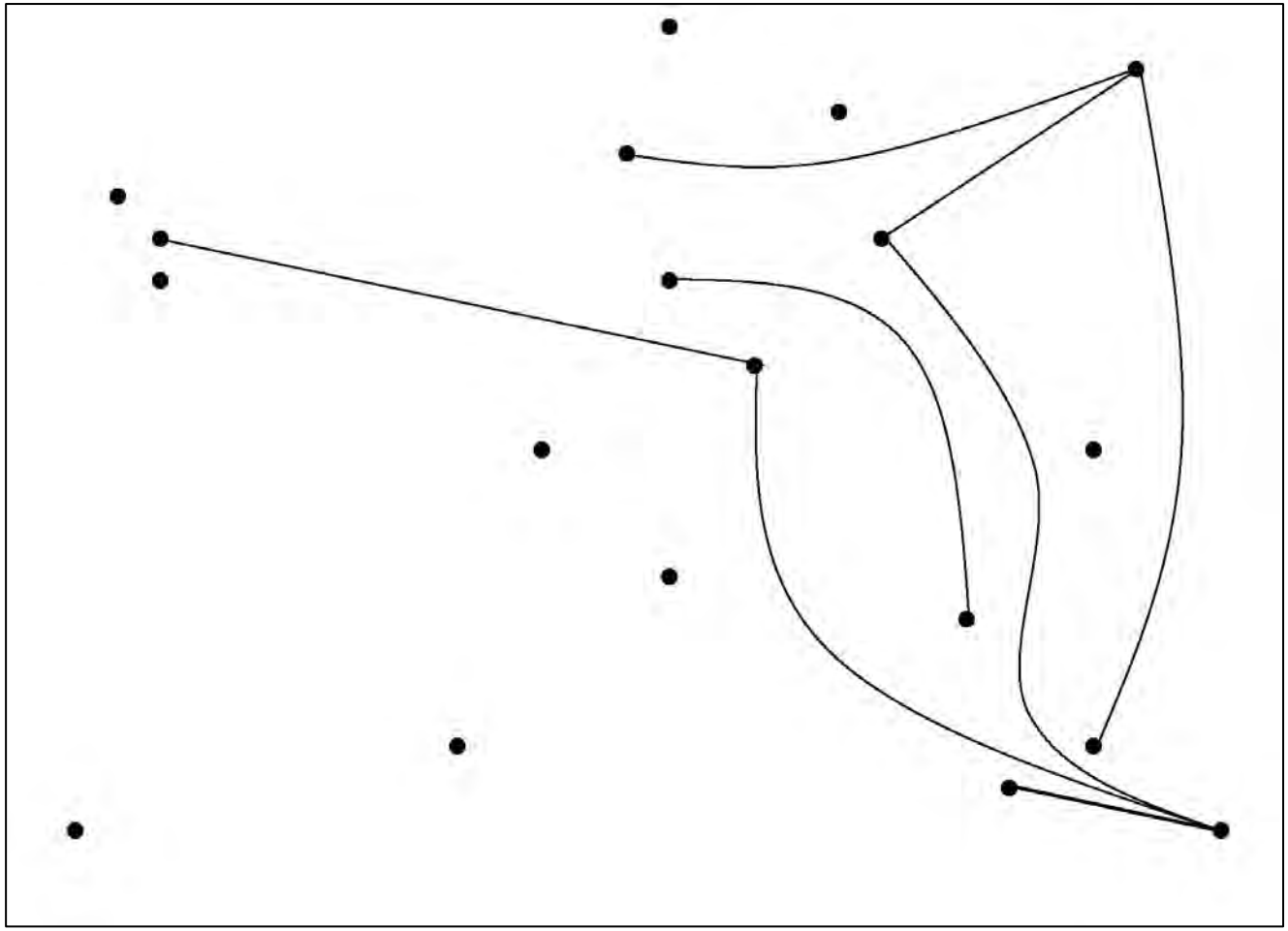
Keyword Network Edge 2

(two other words appearing in the same text unit).



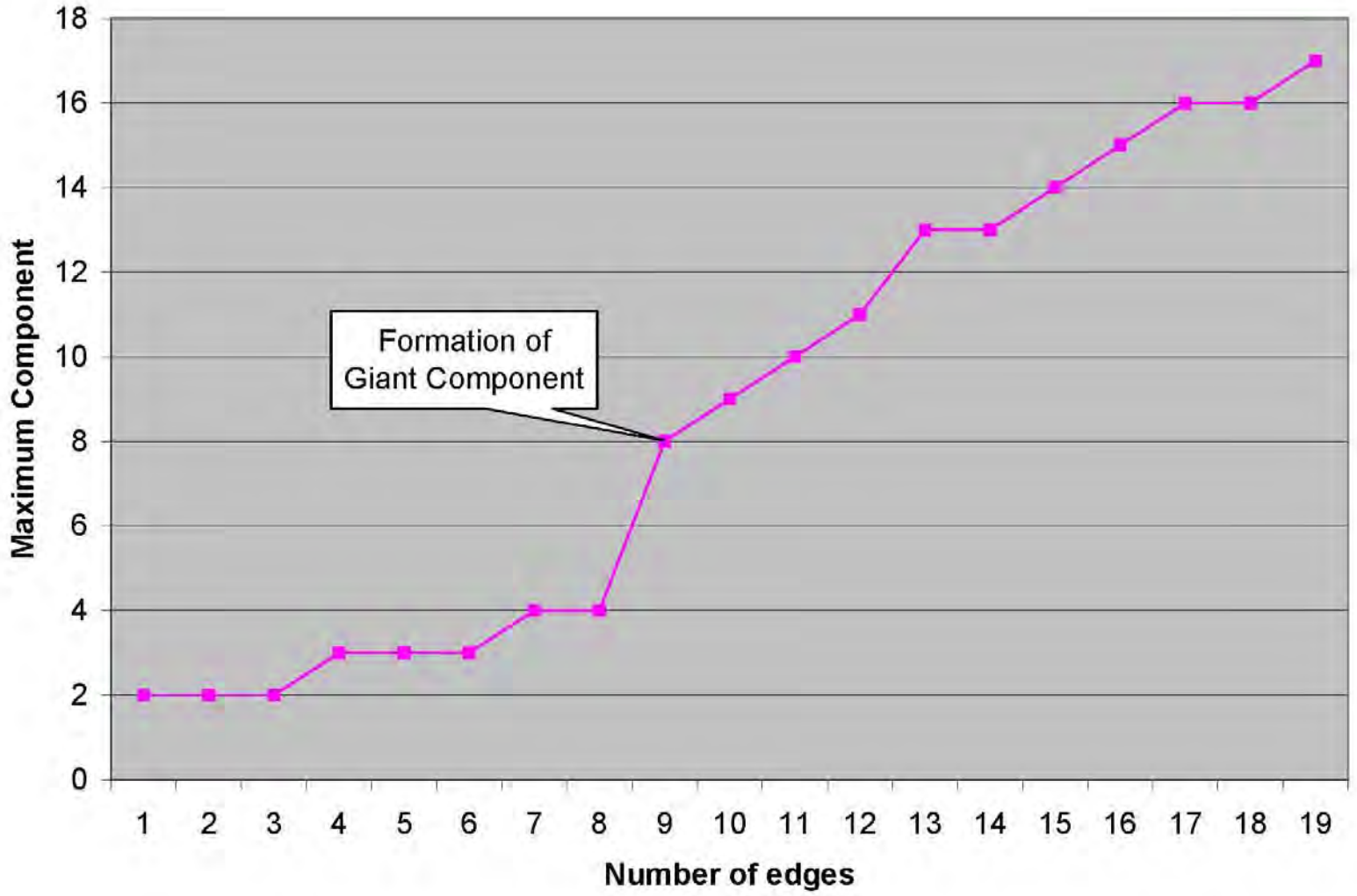
Maximum component size = 2 nodes

Edge 9 – Giant Component (Interconnected Group of Keywords)



Maximum component size = 8 nodes

Formation of Giant Component

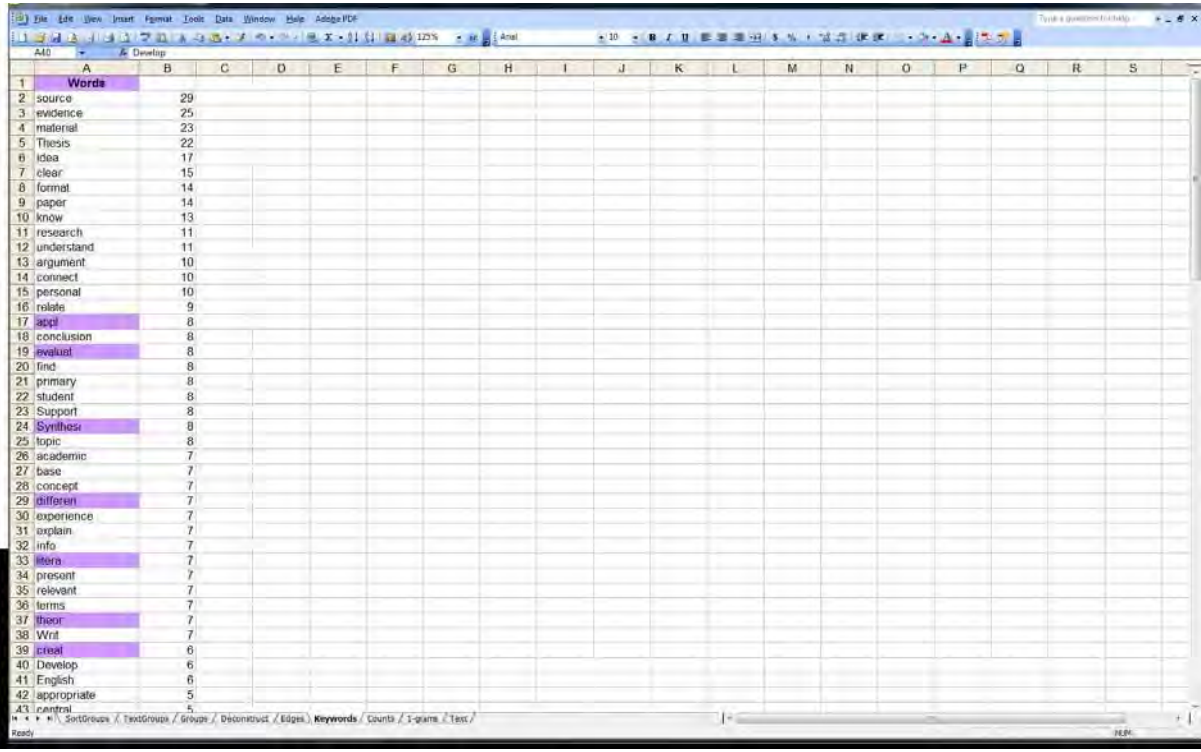


Network and Text

- Let
  - The nodes be keywords.
  - The edges be two keywords that appear in the same text unit.
  - The components be groups of edges.
  - A link be when a word has an edge in a group.
- Examples of text units:
  - Comments in a survey.
  - Sections of self-study working group reports.
  - Course descriptions or syllabi.
  - Mission or program statements.
  - Narrative assessment statements
  - The concatenation of all the levels in the same dimension of the same interview or rubrics.

Find Roots of Keywords

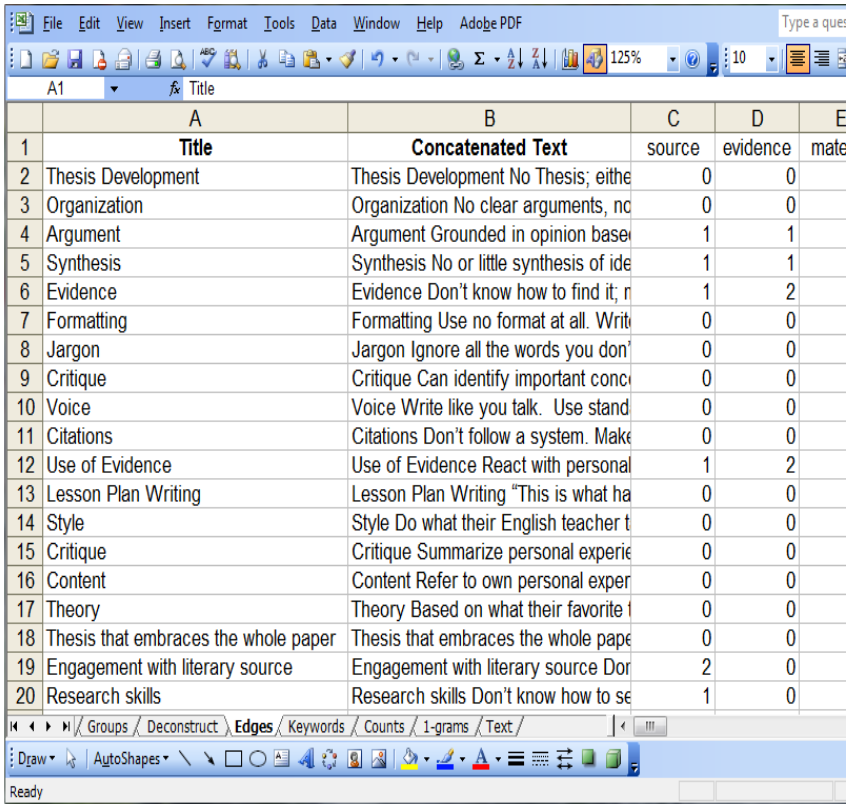
- Combine 1-grams into root words
  - Sort the column again in alphabetical order
  - Manually combine 1-grams with similar roots removing the letters that differentiated them
    - (e.g. if you have 6 uses of analyze and 4 of analysis combine them to 10 uses of analy)
  - Sort the roots descending by count
  - Remove any function words you missed
- Select keywords
  - Eliminate words with the lowest count to give approximately10 keywords per each desired dimension (if the goal is 10 dimensions, select about 100 keywords).



	A	B
1	Words	
2	source	29
3	evidence	25
4	material	23
5	Thesis	22
6	idea	17
7	clear	15
8	format	14
9	paper	14
10	know	13
11	research	11
12	understand	11
13	argument	10
14	connect	10
15	personal	10
16	relate	9
17	appl	8
18	conclusion	8
19	evaluat	8
20	find	8
21	primary	8
22	student	8
23	Support	8
24	Synthesi	8
25	topic	8
26	academic	7
27	base	7
28	concept	7
29	differen	7
30	experience	7
31	explain	7
32	info	7
33	litera	7
34	present	7
35	relevant	7
36	terms	7
37	theor	7
38	Writ	7
39	creat	6
40	Develop	6
41	English	6
42	appropriate	5
43	central	5

Count Edges for the Network

- Set up the Edges worksheet to do the keyword counts
  - Select all the columns headed by zero (highlight row 1 and find 0 and Look in values; highlight all remaining columns and delete).
  - Select from C1 to the bottom nonempty row and all columns with a word at the top and the last row with a formula
  - Use Insert, Name, Create, Top Row.
  - Click Yes at prompt to "Replace existing definition of …"



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A1 Title

	A	B	C	D	E
1	**Title**	**Concatenated Text**	source	evidence	mate
2	Thesis Development	Thesis Development No Thesis; eithe	0	0	
3	Organization	Organization No clear arguments, nc	0	0	
4	Argument	Argument Grounded in opinion base	1	1	
5	Synthesis	Synthesis No or little synthesis of ide	1	1	
6	Evidence	Evidence Don't know how to find it; r	1	2	
7	Formatting	Formatting Use no format at all. Writ	0	0	
8	Jargon	Jargon Ignore all the words you don'	0	0	
9	Critique	Critique Can identify important conc	0	0	
10	Voice	Voice Write like you talk. Use stand	0	0	
11	Citations	Citations Don't follow a system. Make	0	0	
12	Use of Evidence	Use of Evidence React with personal	1	2	
13	Lesson Plan Writing	Lesson Plan Writing "This is what ha	0	0	
14	Style	Style Do what their English teacher t	0	0	
15	Critique	Critique Summarize personal experie	0	0	
16	Content	Content Refer to own personal exper	0	0	
17	Theory	Theory Based on what their favorite t	0	0	
18	Thesis that embraces the whole paper	Thesis that embraces the whole pape	0	0	
19	Engagement with literary source	Engagement with literary source Dor	2	0	
20	Research skills	Research skills Don't know how to se	1	0	

Groups Deconstruct Edges Keywords Counts 1-grams Text

Draw AutoShapes

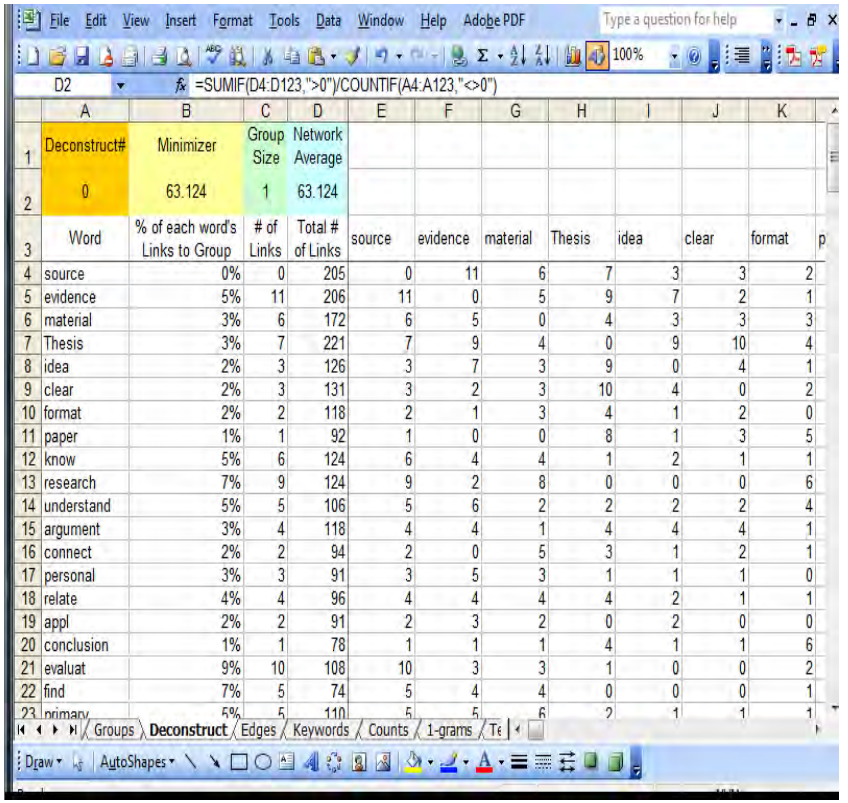
Ready

Deconstruct the Network

1. Setup the Deconstruct Sheet
2. Find the First Deconstruct Number
3. Find the Lead Keyword for the First Group
4. Find the Keywords in the Pairs Approximation to the First Group
5. Find Keywords in the % Approximation to the First Group
6. Store The First Group
7. Find the Remaining Groups

Setup the Deconstruct Sheet

- On the Deconstruct sheet clear Column A from row 4 down
- Set the Group Size (C2 the green cell) = 1
- Copy keywords from Edges C1 across to Deconstruct A4 down (use Edit, Paste Special, Values, Transpose)
- Notice the large number of links for each keyword (the average is in D2, the light blue cell). The network is far too connected to be meaningfully analyzed.



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D2 =SUMIF(D4:D123,">0")/COUNTIF(A4:A123,"<>0")

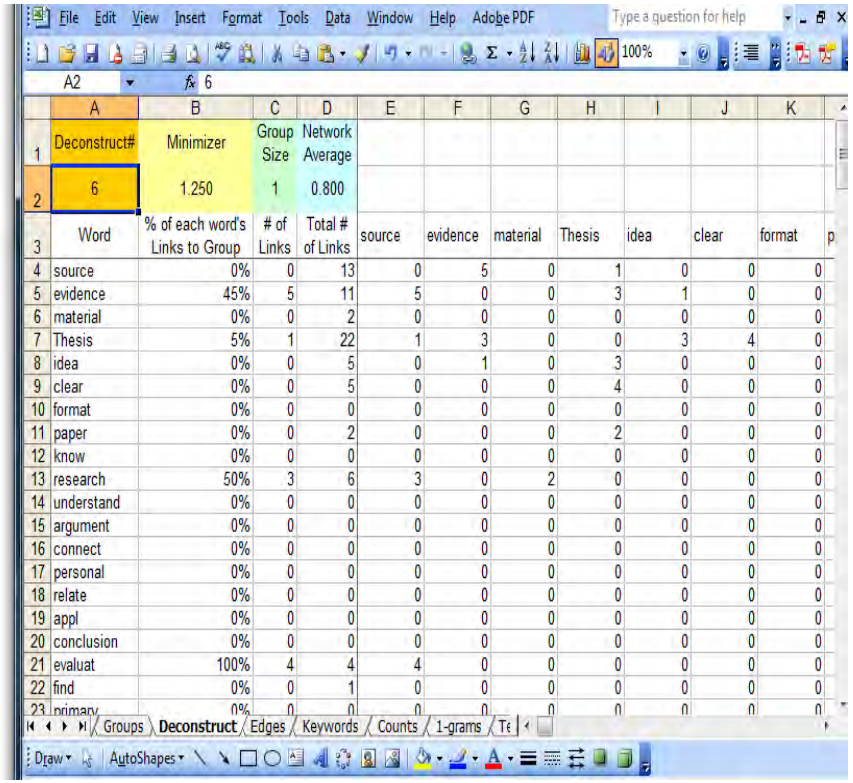
	A	B	C	D	E	F	G	H	I	J	K
1	Deconstruct#	Minimizer	Group Size	Network Average							
2	0	63.124	1	63.124							
3	Word	% of each word's Links to Group	# of Links	Total # of Links	source	evidence	material	Thesis	idea	clear	format
4	source	0%	0	205	0	11	6	7	3	3	2
5	evidence	5%	11	206	11	0	5	9	7	2	1
6	material	3%	6	172	6	5	0	4	3	3	3
7	Thesis	3%	7	221	7	9	4	0	9	10	4
8	idea	2%	3	126	3	7	3	9	0	4	1
9	clear	2%	3	131	3	2	3	10	4	0	2
10	format	2%	2	118	2	1	3	4	1	2	0
11	paper	1%	1	92	1	0	0	8	1	3	5
12	know	5%	6	124	6	4	4	1	2	1	1
13	research	7%	9	124	9	2	8	0	0	0	6
14	understand	5%	5	106	5	6	2	2	2	2	4
15	argument	3%	4	118	4	4	1	4	4	4	1
16	connect	2%	2	94	2	0	5	3	1	2	1
17	personal	3%	3	91	3	5	3	1	1	1	0
18	relate	4%	4	96	4	4	4	4	2	1	1
19	appl	2%	2	91	2	3	2	0	2	0	0
20	conclusion	1%	1	78	1	1	1	4	1	1	6
21	evaluat	9%	10	108	10	3	3	1	0	0	2
22	find	7%	5	74	5	4	4	0	0	0	1
23	primary	5%	5	110	5	5	6	2	1	1	1

Groups | Deconstruct | Edges | Keywords | Counts | 1-grams | Te

Draw AutoShapes

Find the First Deconstruct Number

- The Deconstruct# is in A2 (gold)
- The Minimizer is in B2 (yellow)
- Increment the Deconstruct# to select a value of the Minimizer nearest to 1.0.



File Edit View Insert Format Tools Data Window Help Adobe PDF — Type a question for help

A2 = 6

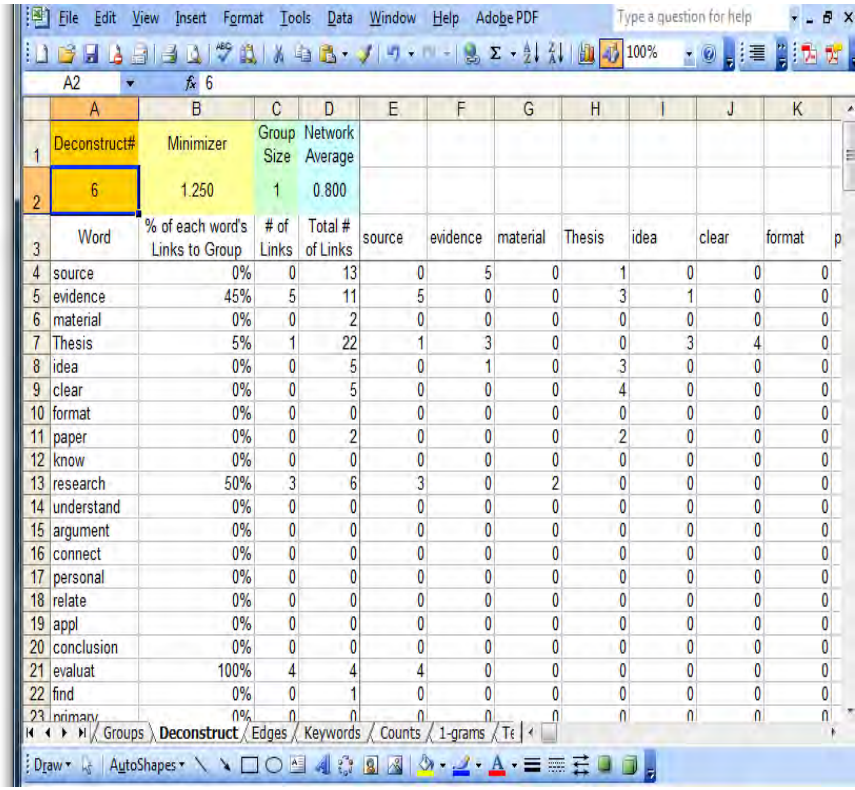
	A	B	C	D	E	F	G	H	I	J	K
1	Deconstruct#	Minimizer	Group Size	Network Average							
2	6	1.250	1	0.800							
3	Word	% of each word's Links to Group	# of Links	Total # of Links	source	evidence	material	Thesis	idea	clear	format
4	source	0%	0	13	0	5	0	1	0	0	0
5	evidence	45%	5	11	5	0	0	3	1	0	0
6	material	0%	0	2	0	0	0	0	0	0	0
7	Thesis	5%	1	22	1	3	0	0	3	4	0
8	idea	0%	0	5	0	1	0	3	0	0	0
9	clear	0%	0	5	0	0	0	4	0	0	0
10	format	0%	0	0	0	0	0	0	0	0	0
11	paper	0%	0	2	0	0	0	2	0	0	0
12	know	0%	0	0	0	0	0	0	0	0	0
13	research	50%	3	6	3	0	2	0	0	0	0
14	understand	0%	0	0	0	0	0	0	0	0	0
15	argument	0%	0	0	0	0	0	0	0	0	0
16	connect	0%	0	0	0	0	0	0	0	0	0
17	personal	0%	0	0	0	0	0	0	0	0	0
18	relate	0%	0	0	0	0	0	0	0	0	0
19	appl	0%	0	0	0	0	0	0	0	0	0
20	conclusion	0%	0	0	0	0	0	0	0	0	0
21	evaluat	100%	4	4	4	0	0	0	0	0	0
22	find	0%	0	1	0	0	0	0	0	0	0
23	primary	0%	0	0	0	0	0	0	0	0	0

Groups | Deconstruct | Edges | Keywords | Counts | 1-grams | Te

Draw AutoShapes

Find the Lead Keyword for the First Group

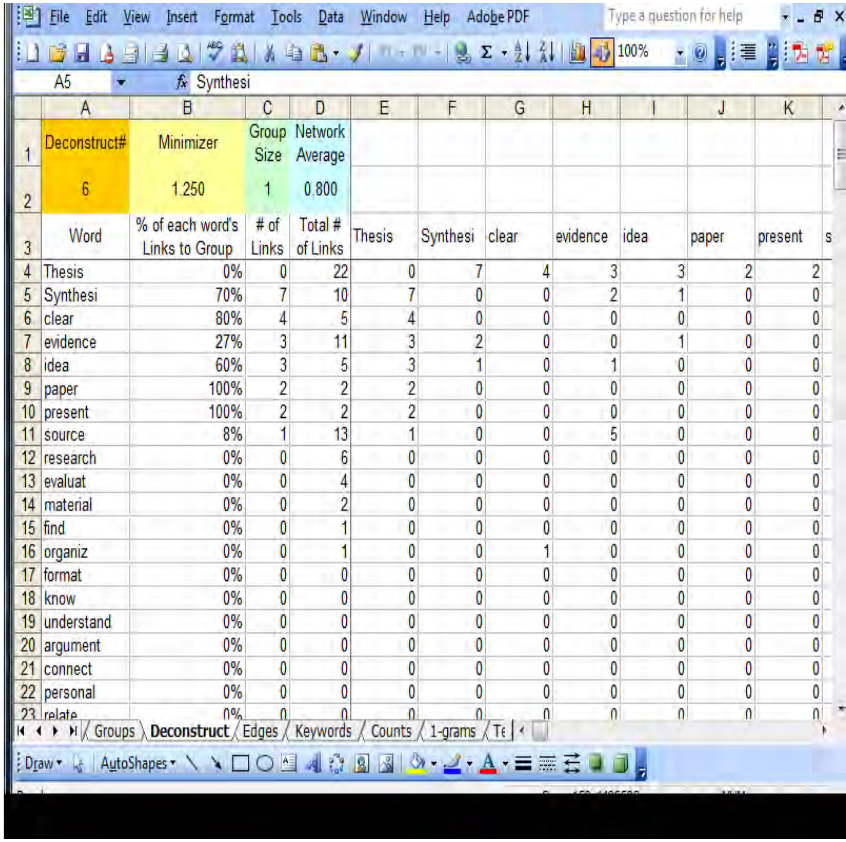
- The Deconstruct# is in A2 (gold)
- The Minimizer is in B2 (yellow)
- Increment the Deconstruct# to select a value of the Minimizer nearest to 1.0.



	A	B	C	D	E	F	G	H	I	J	K
1	Deconstruct#	Minimizer	Group Size	Network Average							
2	6	1.250	1	0.800							
3	Word	% of each word's Links to Group	# of Links	Total # of Links	source	evidence	material	Thesis	idea	clear	format
4	source	0%	0	13	0	5	0	1	0	0	0
5	evidence	45%	5	11	5	0	0	3	1	0	0
6	material	0%	0	2	0	0	0	0	0	0	0
7	Thesis	5%	1	22	1	3	0	0	3	4	0
8	idea	0%	0	5	0	1	0	3	0	0	0
9	clear	0%	0	5	0	0	0	4	0	0	0
10	format	0%	0	0	0	0	0	0	0	0	0
11	paper	0%	0	2	0	0	0	2	0	0	0
12	know	0%	0	0	0	0	0	0	0	0	0
13	research	50%	3	6	3	0	2	0	0	0	0
14	understand	0%	0	0	0	0	0	0	0	0	0
15	argument	0%	0	0	0	0	0	0	0	0	0
16	connect	0%	0	0	0	0	0	0	0	0	0
17	personal	0%	0	0	0	0	0	0	0	0	0
18	relate	0%	0	0	0	0	0	0	0	0	0
19	appl	0%	0	0	0	0	0	0	0	0	0
20	conclusion	0%	0	0	0	0	0	0	0	0	0
21	evaluat	100%	4	4	4	0	0	0	0	0	0
22	find	0%	0	1	0	0	0	0	0	0	0
23	primary	0%	0	0	0	0	0	0	0	0	0

Find the Number-of-Links Approximation to the First Group

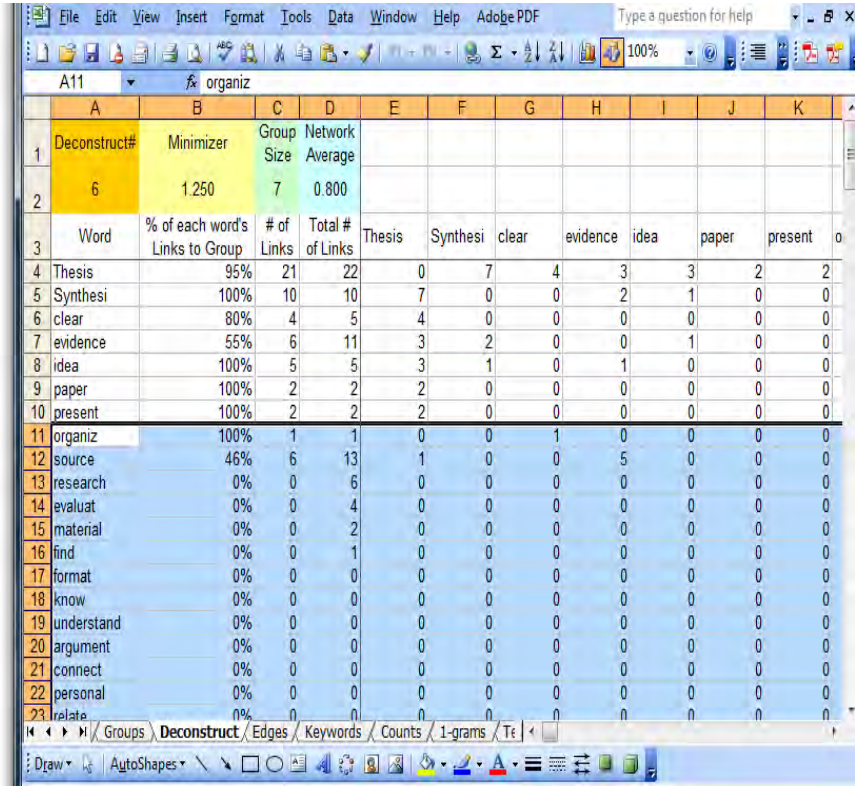
- Get Keywords linked to the Lead Keyword
  - Make sure the Group Size (in C2, **green cell**) is 1.
  - Select from Row 5 down
  - Sort descending with no headers by Column C.
- Count Keywords to get the number-of-links approximation to the first Group.
  - Count Keywords with two or more links.
  - Add 1 for the Lead Keyword.
  - If no other Keyword has two links to the Lead Keyword, decrease the Deconstruct# by one and redo the search for the Lead Keyword.
  - Insert the count into C2 (**green cell**).



	A	B	C	D	E	F	G	H	I	J	K
1	Deconstruct#	Minimizer	Group Size	Network Average							
2	6	1.250	1	0.800							
3	Word	% of each word's Links to Group	# of Links	Total # of Links	Thesis	Synthesi	clear	evidence	idea	paper	present
4	Thesis	0%	0	22	0	7	4	3	3	2	2
5	Synthesi	70%	7	10	7	0	0	2	1	0	0
6	clear	80%	4	5	4	0	0	0	0	0	0
7	evidence	27%	3	11	3	2	0	0	1	0	0
8	idea	60%	3	5	3	1	0	1	0	0	0
9	paper	100%	2	2	2	0	0	0	0	0	0
10	present	100%	2	2	2	0	0	0	0	0	0
11	source	8%	1	13	1	0	0	5	0	0	0
12	research	0%	0	6	0	0	0	0	0	0	0
13	evaluat	0%	0	4	0	0	0	0	0	0	0
14	material	0%	0	2	0	0	0	0	0	0	0
15	find	0%	0	1	0	0	0	0	0	0	0
16	organiz	0%	0	1	0	0	1	0	0	0	0
17	format	0%	0	0	0	0	0	0	0	0	0
18	know	0%	0	0	0	0	0	0	0	0	0
19	understand	0%	0	0	0	0	0	0	0	0	0
20	argument	0%	0	0	0	0	0	0	0	0	0
21	connect	0%	0	0	0	0	0	0	0	0	0
22	personal	0%	0	0	0	0	0	0	0	0	0
23	relate	0%	0	0	0	0	0	0	0	0	0

Find the % Approximation to the First Group

1. Select from the Row below the preceding approximation to the Group and sort with no headers by Column B.
2. Recount the number of Keywords this time counting all those with greater than 0.5 total links to the group (remembering to count the Lead Keyword) and put that number in C1.
3. Repeat steps 1 and 2 above until no new words are added.



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A11 — organiz

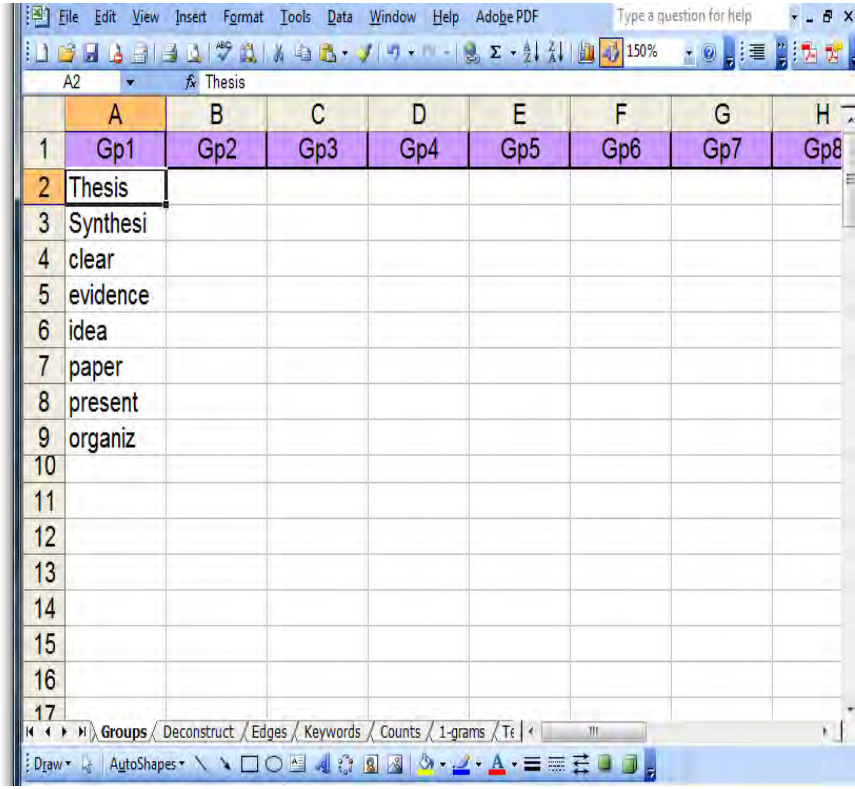
	A	B	C	D	E	F	G	H	I	J	K
1	Deconstruct#	Minimizer	Group Size	Network Average							
2	6	1.250	7	0.800							
3	Word	% of each word's Links to Group	# of Links	Total # of Links	Thesis	Synthesi	clear	evidence	idea	paper	present
4	Thesis	95%	21	22	0	7	4	3	3	2	2
5	Synthesi	100%	10	10	7	0	0	2	1	0	0
6	clear	80%	4	5	4	0	0	0	0	0	0
7	evidence	55%	6	11	3	2	0	0	1	0	0
8	idea	100%	5	5	3	1	0	1	0	0	0
9	paper	100%	2	2	2	0	0	0	0	0	0
10	present	100%	2	2	2	0	0	0	0	0	0
11	organiz	100%	1	1	0	0	1	0	0	0	0
12	source	46%	6	13	1	0	0	5	0	0	0
13	research	0%	0	6	0	0	0	0	0	0	0
14	evaluat	0%	0	4	0	0	0	0	0	0	0
15	material	0%	0	2	0	0	0	0	0	0	0
16	find	0%	0	1	0	0	0	0	0	0	0
17	format	0%	0	0	0	0	0	0	0	0	0
18	know	0%	0	0	0	0	0	0	0	0	0
19	understand	0%	0	0	0	0	0	0	0	0	0
20	argument	0%	0	0	0	0	0	0	0	0	0
21	connect	0%	0	0	0	0	0	0	0	0	0
22	personal	0%	0	0	0	0	0	0	0	0	0
23	relate	0%	0	0	0	0	0	0	0	0	0

Groups | Deconstruct | Edges | Keywords | Counts | 1-grams | Te

Draw — AutoShapes

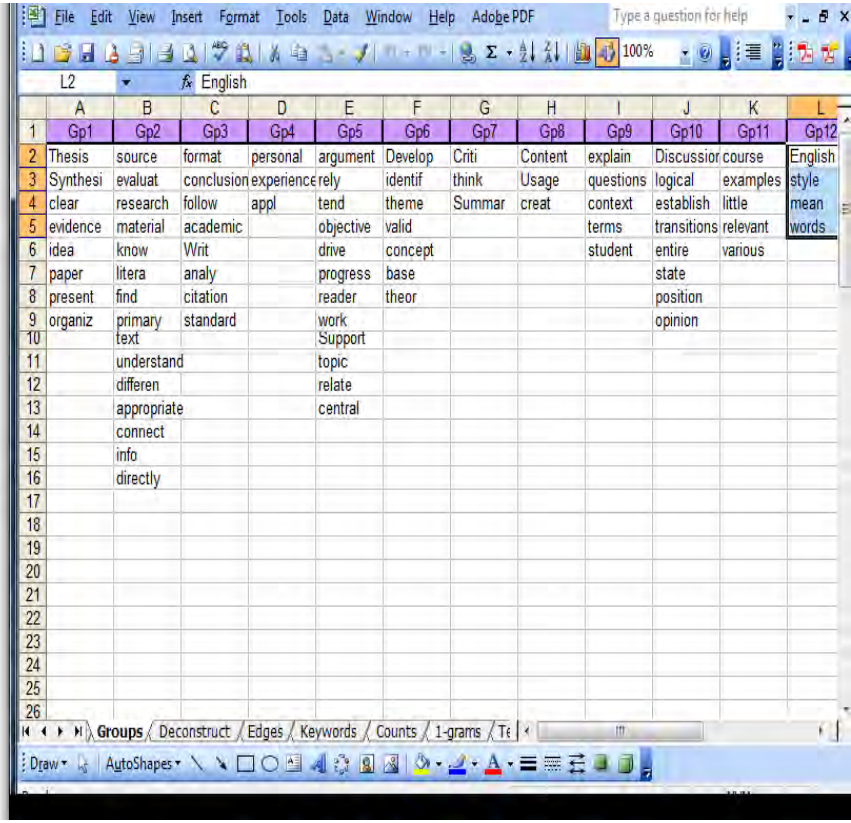
Store The First Group

- Go to the sheet called Groups
- Select from A4 to the last word with more than 0.5 of its links to the first group.
- Copy and paste underneath Gp1.



Find the Remaining Groups

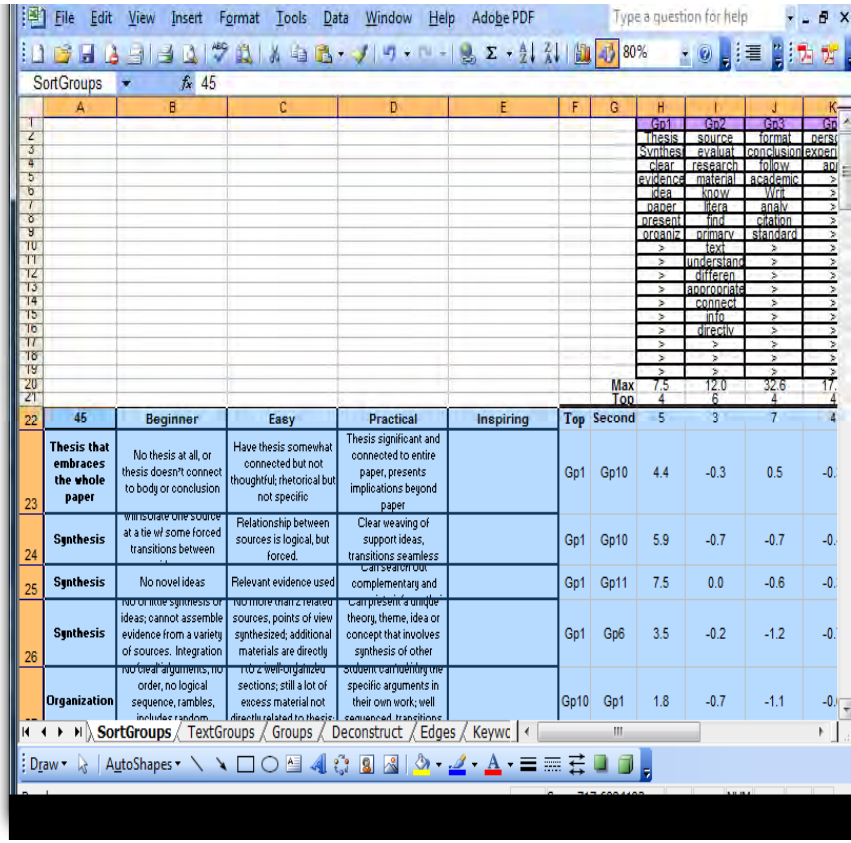
1. Clear the Preceding Group from the Deconstruct Sheet
   - Go back to the Deconstruct Sheet
   - Select the Group just stored.
   - Delete its rows (Edit Delete Rows)
   - Decrease the Deconstruct# to the lowest value of the Minimizer (B2) and set the Group Size (C2) back to 1
2. Repeat the steps from the "Find the Lead Keyword" to the preceding slide, copying each to Groups.
   - Find the Lead Keyword by sorting on Total # of Links
   - Approximate the Group using # of Links and reset Group Size to the number of Keywords with 2 or more Links.
   - Approximate the group using % and reset the Group Size by counting Keywords with 50% or more.
   - Redo % approximation until no new Group Keywords are found
   - Store the Group on the Groups sheet
3. Repeat Step 2 until there are no keyword pairs left.



	A	B	C	D	E	F	G	H	I	J	K	L
1	Gp1	Gp2	Gp3	Gp4	Gp5	Gp6	Gp7	Gp8	Gp9	Gp10	Gp11	Gp12
2	Thesis	source	format	personal	argument	Develop	Criti	Content	explain	Discussior	course	English
3	Synthesi	evaluat	conclusion	experience	rely	identif	think	Usage	questions	logical	examples	style
4	clear	research	follow	appl	tend	theme	Summar	creat	context	establish	little	mean
5	evidence	material	academic		objective	valid			terms	transitions	relevant	words
6	idea	know	Writ		drive	concept			student	entire	various	
7	paper	litera	analy		progress	base				state		
8	present	find	citation		reader	theor				position		
9	organiz	primary	standard		work					opinion		
10		text			Support							
11		understand			topic							
12		differen			relate							
13		appropriate			central							
14		connect										
15		info										
16		directly										
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												

Group the Original Text Using the Keyword Groups

- Copy the TextGroups to SortGroups
  - Go to TextGroups (key in Ctrl-G and key in TextGroups as the reference).
  - Copy (Ctrl-c)
  - Go to A1 on the SortGroups sheet
  - Edit, Paste Special, Values (hold the Alt key down and add in sequence e,s,v)
- Sort the original text units by Keyword Groups
  - Go to SortGroups (Ctrl-G and enter "SortGroups").
  - Sort by "Top" and then by "Second"
  - The original text is now grouped for further analysis.



Further Analysis We Have Done

- Write abstracts of each level of grouped dimensions to make developmental rubrics.
- Compare texts of different reports (e.g., different regional accreditation teams).
- Find developmental differences in texts written at different stages of a program.
- Compare course descriptions to mission statements.

This presentation (1 MB) and the Excel file (2 MB) are free for academic users but not for commercial applications without permission. We are glad to support users the same way.

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Bankers, Biomes and Bogeys

David Dirlam
Methodology Community of Practice
Association for the Assessment of Learning in Higher Education
and
HUC-JIR wiki on Assessment Methodology

Return here by Monday, October 31 to learn what Halloween has to do with rubrics and what the three terms in the title have in common. If you just can't wait, there are clues in "Grass Trumps Trees with Fire" (*Science*, Oct. 14, 2011), "A Formula for Economic Calamity" (*Scientific American*, Nov., 2011) and Developmental Interviewing Tools.

There have been postings to this Methodology Community of Practice that advocate or describe dynamic models. Such models present analytical and interpretive problems that match the depth of analyzing and interpreting the development of learning itself. This series of Forum topics concerns how to find meaning in the chaos.

Freedman's Bogey

Everybody knows that banks blew it in 2008 by bundling subprime mortgages. They were having a joyride right up until Lehman Brothers collapsed. They all used "sophisticated" models to predict risk, but all the models failed to account for "lack of liquidity." Their failing was that the models all assumed there would always be a buyer for every seller. According to David Freedman's "A Formula for Economic Calamity" all the models have some such failing. He adds in a *Scientific American* Web Exclusive that "economic models are always wrong." His evidence for models being wrong is that when we try to match data to dynamic models, there are always multiple sets of parameters that maximize the goodness of fit and the different parameter sets often result in dramatically different predictions. Freedman rightly identified the problem, so we'll call it Freedman's Bogey. It emerges whenever we enter the world of chaos. Freedman thinks to banish the Bogey by abolishing or at least ignoring models. Click in as this Forum topic unfolds to learn other ways.

The Biome Bogey

In Freedman's Bogey we learned that, we in the higher education assessment community did not get much mileage from the economics writer, David Freedman. In his *Scientific American* article, he bemoaned the uncertainty of nonlinear dynamic models. On that basis he offered the Luddite conclusion that to avoid economic disaster, we should avoid the models. I promised you better and we find it in two brilliant analyses of global ecology from *Science*, October 14, 2011. The up-front summary triumphantly encapsulates their conclusions with "Grass Trumps Trees with Fire." Beautiful writing but the real story is in the beautiful analysis.

On a global basis the authors showed that grass competes with forest by encouraging fire, while forests fight back by suppressing it. Trees need each other to succeed—a critical mass of 60% tree cover is required to suppress fire and maintain forest resilience. Biomes with 50% to 60% are at a bifurcation ("tipping point" in the vernacular) and can easily lapse into savanna. That critical mass of trees needed to maintain resilience can be disrupted by drought, grazing or human construction. Once the tree cover is

gone, 100 inches of rain spread evenly over each year, fire protection, and decades of time are necessary to replenish it. This is the "Biome Bogey" in the title.

So what's this have to do with assessment methodology? For now, we will begin with an allegory. In the next posting, there will be a description of how to turn the allegory into reality. Imagine showing your provost a graph of thousands of data points and summing it up with "Perfunctoriness trumps innovation in times of crisis." When you capture her or his attention you add that "Feedbacks involving resources, institutional crises and productivity govern transitions between innovation and perfunctoriness." To avoid the ensuing loss for words, you quickly pull out your data. First, there's a graph of innovations per group across the institution. As expected, there are a few groups with many innovations. When you pull out another graph comparing this with the resources per group, it's obvious that the groups that produce the most innovations have the most resources. You do not need a separate study to support the idea that groups which innovate garner resources and those resources help to maintain their high level of innovation. You also explain that large, close knit, innovative groups are the most resilient. They bounce back from times of crises easier than the rest. But then you point out that your graph of group innovation is not just a straight line back from paragon groups to the least productive ones. Rather, there are two ranges with very few groups in them. Basically, only 20% of the groups are paragons. Another 20% are well established in perfunctoriness. In between is a majority of semi-productive groups.

You then pull out a new graph showing the number of crises per group over a few decades and there's no doubt: the least productive groups have the most crises. The fascinating finding in this graph, however, occurs in the transitions from paragon to semi-productive or worse. The transitions happen when resources fluctuate too much. They also happen when some external factor interferes. Sometimes the interference is an outside institution siphoning off members of the top performing groups. Other times, it is a wholesale disruption of the discipline due to external factors, such as the decline in print journalism. It is also clear from your historical graph that once such a paragon group is lost, it takes far more resources to re-establish it than it took to maintain it. Change is neither smooth, nor easily reversible.

Of course, your provost is going to ask what use this information has. You answer that the institution needs to monitor the productivity, especially of both its paragon and normal groups. An extensive period of high resources poured into semi-productive groups has the chance of turning them into paragon groups. Also, quick identification of a decline in a paragon group makes intervention possible. Protection against loss of individual members combined with supplementing the resources during difficult times might stave off the disaster of the group disintegrating altogether. You also have to end with the caveat that you have aggregated the data and that predicting the precise tipping points for individual groups still depends on information not in your models. But the overall conclusion is compelling. Perfunctory groups compete with innovative groups by encouraging crises, while innovative groups fight back by suppressing them.

If all this sounds too far out of the realm of assessment data, return for the next posting. The discussion there will be about how to collect and analyze data that will produce answers with a richness that approximates the work of the ecologists.

Balancing the Bogey

Development is a dynamic process of increments among competitors. The competitors may be corporations, plants, learning outcomes or other entities that increase in frequency over time in an environment that includes entities that cause decreases in frequency. It is very difficult to discover any

principles of development by taking samples far apart in time. The gaps obscure the processes. It would be extremely difficult to provide the provost with anything like the data described in the “Biome Bogey” posting by taking beginning, midpoint, ending samples of data. But that has been the easy habit in assessment. Fascinating data start to emerge when we sample often. Discoveries about program learning outcome become likely when the data include one sample per student per course.

Our discussion of biomes was very global. The productive forest can be restored by providing water while suppressing fire and human development. But there’s more to it than that. A region with an 80% cover has a 20% buffer before the forest comes close to the 60% tipping point into savannah. That would seem a safe margin. But think again. Our eastern forests contain 25-60% of stately and productively useful ash trees. When the emerald ash borer beetle enters a locale, it kills nearly 100% of the trees in three years. The buffer is not only used up, but in many cases is drastically exceeded. Perhaps the real biome bogey was that the data analysis was too narrow. It is not just that each tree needs water and suppression of fire and axe. It is that we need to examine several dimensions of each locale at once.

Both biome and learning program outcomes seem to be overwhelmingly complex. At the very least millions of patterns need to be considered. We can make this apparently overwhelmingly complex problem accessible by a simple mathematical trick. Consider small groups of 2-4 competitors. When two such competing groups are independent of each other, we call each group a dimension. Ten to twenty such dimensions are quite sufficient to account for a million patterns. That means that we need to identify only 10 to 20 outcomes to account for a million patterns of learning. That is certainly enough patterns of learning to give us ideas of how to improve programs.

The first tests of multidimensionality need not achieve perfect independence to be useful. Thus, data might surprisingly show that an outcome from one dimension influences the frequency of an outcome from another dimension. It might slow down the use of an easy strategy or facilitate the use of a more advanced strategy. Either result could be very useful for generating innovations.

Such an abstract discussion may lead some to conclude that it is all too vague to be useful. But wait! Identifying 10 to 20 dimensions of competing outcomes is not terribly hard, especially if we focus on developmental competitors. I’ve shown (see my 2003, open access paper) that four competing strategies are common in development, so we just need 10 dimensions. Before the College-Institute where I work even had an assessment specialist a group of Rabbis identified 47 dimensions of the development of Rabbinical expertise. That’s too much—we don’t need to study an octillion patterns to find useful innovations. But it shows that generating 10 dimensions should not be an overwhelming task for any group of program faculty. Based on our large-sample studies and interviews, we now use the following four ideas to help people generate developmentally competing outcomes:

Beginning Takes minutes to try the dimension. Everybody starts here; it does not grow in usage.
Easy Takes months to learn about the dimension. Grows very fast in usage and leads to burnout unless replaced.
Practical Takes years to learn enough to earn a living using the dimension—gets boring after a decade of usage.
Inspiring: Takes many years to make innovations or contributions to knowledge using the dimension.

Once a program has described ten such dimensions, any project from any student in the program can be rated as easy as taking a 10-item multiple choice test that you have taken dozens of times.

Notice that the “Easy” strategy described above sounds like a crisis and the alternative “Inspiring” strategy is the product of those groups who are always looking for where their next innovation is coming from. They suppress the crises by innovating. When they are in the midst of creating an innovation, the group attains the inspiring state of “flow” described by Csikszentmihalyi. They become Keith Sawyers’ genius groups. People cannot get to flow without skill and achieving flow is much more fun than living in crisis. Acquiring enough development to know how to achieve inspiring results is the way to balance the bogeys, not only of programs, but also of life. Assessment becomes great fun when we help programs to accomplish this.

Trillions of Ways to Design

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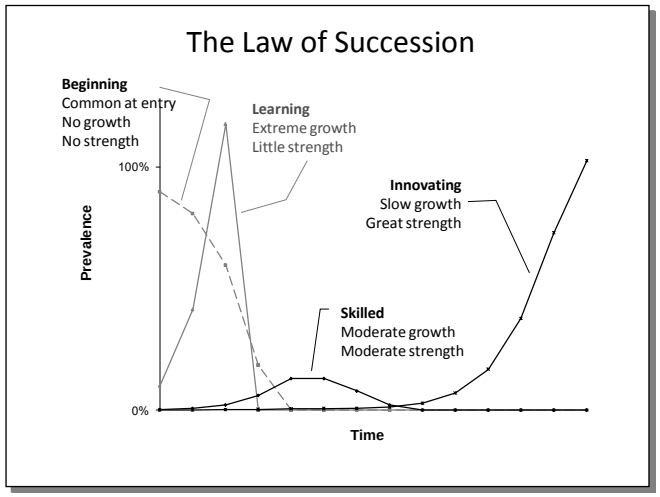
❑ A Common Language for Design

- Efficient
- Powerful
- Intersubjective
- Comprehensive
- Useful
- Multidisciplinary
- Progressive

❑



MODEL Rubrics		
Term	**Problem**	**Solution**
Matrices	Trillions of ways to design. Limited memory for terms.	Multiple discrete dimensions
Organized	Interacting with students requires fast retrieval.	2-4 terms per dimension
Developmentally	A common basis is needed for developmental theories.	Law of succession
Expertise	Where can we get the theories?	Experts
Labeling	How can we combine theories from different experts?	Keyword networks

Interview Tool				
	Beginning	**Learning**	**Skilled**	**Innovating**
Decision	Try	Learn	Become proficient	Make contributions
Practice Time	None	Weeks to months	A few years	5 years to start, 10 to use regularly
Effects	Peripheral Participation	Take little practice; get some reward	Enable living wages but no excitement	Enable Discoveries
Helpful Prompts	If the expert has difficulty with this first level, save it for after the Learning strategy.	If a student is still using a learning strategy when about to graduate, you feel discouraged.	This one is the "sandwich filling." Save it for after the Learning and Innovating approaches have been identified.	What have your students or colleagues done that surprised you with its appropriateness?

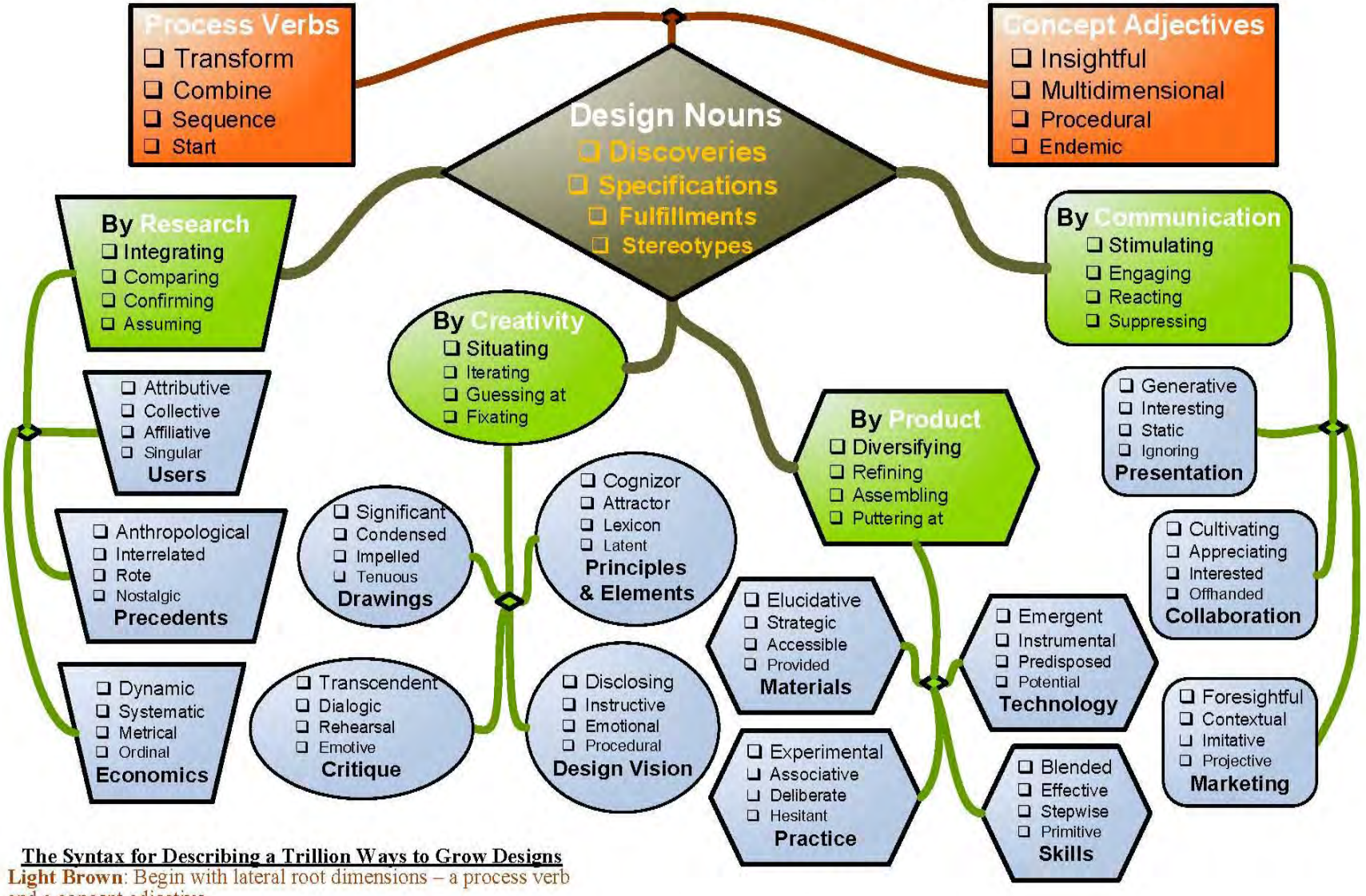
❑ Benefits

- Unified theory of the development of disciplinary expertise
  - ✓ Collective—less biased, more buy-in
  - ✓ Comprehensive—18 dimensions create 70 billion ways to design
  - ✓ Efficient—2 hours per faculty member, 4 hours each for coordinator
- Stimulate dialog
- Recognize unique contributions
- Applicable to client-designer relations
- Use for authentic, yet expert interactions with students

❑ Become a *Trillion Ways* Collaborator

- Add your name and email to the sign-up list.
- Email us a description of how any Trillion Ways concept changed…
  - ✓ A design project (yours or a student's)
  - ✓ An interaction (with a student or colleague)
  - ✓ A course or lecture (content or objective)
- All authors of contributions used in the book will be listed in it and acknowledged with their contribution.

Describing Trillions of Ways to Grow Designs



The Syntax for Describing a Trillion Ways to Grow Designs

Light Brown: Begin with lateral root dimensions – a process verb and a concept adjective.
Brown: Choose a taproot dimension – a type of design.
Green: Add branch dimensions – By phrases
Blue: Add flowering dimensions – use adjective and noun for each
Diamonds: Common choice paths (bidirectional)

Savannah College of Art and Design 9-15-2008

MODEL Rubrics Describing Trillions of Ways to Design.

Dimension	Beginning	Learning	Practical	Inspiring
Design	**Stereotypes** Understand intent only as function based on stereotypes from growing up. Equate design to visual style and beautiful or ugly with what they like or dislike in a way that is self-referential without being self-reflective. Understand design as three steps: problem, solution and implementation.	**Fulfillments** Fulfill simple lists of requirements, but forget that intentionality has to be carried throughout the design. Try to incorporate user thinking and develop hierarchies of use. Learn to identify the elements of design (line, shape, value, texture, form, space, color) and the organizing principles (unity, harmony, balance, rhythm-movement-repetition, and emphasis).	**Specifications** Identify many methods to achieve any design goal. Master a few familiar methodologies within their applied specialty. Accommodate needs of diverse users and the multiplicity of relations among uses, programs, and human experiences. Explore beyond requirements to aesthetic frameworks (e.g., composition, proportion, contextual continuity). Detail specification and implementation sufficient to be producible.	**Discoveries** Create and diagram so many changeable possibilities for thought that it expands people's attention. Use (learn, if necessary) methodologies within small creative practice communities according to problem and design opportunities. Simulate significant, unexpected experiences by integrating symbolic or theoretical functions with aesthetic dimensions (observation-use, inside-outside, inert-dynamic, structure & materials-perception) and pragmatic concepts (social, historical, economic, global interaction, environmental and technology).
Design Vision	**Procedural** Define their work by describing the formal aspects of what they did technically step-by-step. Hesitant, safe, fearful, follow the rules. Disconnected from emotions, techniques, and visual or verbal language used.	**Emotional** Answer why to their choices in terms of personal and shared environment. Choose subjects that automatically evoke emotions (often human figures). Set up a dramatic vision (caricature or distortions). Use negative areas meaningfully with positive areas. Isolate an aspect of the subject (e.g., an element such as line, tone, texture or shape).	**Instructive** Are in full control of emotional expression, but see it as an end in itself. Have settled on a method they developed themselves through practice, but still searching for their voice. Connect with historic periods and functions as well as elements and principles of design.	**Disclosing** Isolate a dominant visual event and connect it to emotions that open the functional, cultural or symbolic meaning of the event and sustain the user's or viewer’s attention.
Critique	**Emotive** Either present work and remain quiet or attack and defend in intellectual competition. Avoid task and concepts or self-consciously struggle to understand how to approach them. Make observations and ask questions based on agreeableness with no rationale (I do/don’t like it) and respond defensively (offended when others express dislike). Look for parental-like reassurance.	**Rehearsal** Purposefully focus as both artist and audience on the elements and principles of design, sometimes one at a time. Attend to where they look and what attracts attention. Discuss with another artist or in small groups what to do next plus where each other have been and are going.	**Dialogic** Know and introduce before critiques the ideas they focused on, plus their influences and cultural limitations. Acknowledge others can provide technical input on getting their message more obviously understood or new intellectual tools for re-evaluating precedent. Recognize recurring "problem areas" in work of peers and themselves.	**Transcendent** Engage in conversations that transcend the work and create discoveries for all participants, enabling them to rethink their practice or understand more clearly what drives others. Publish accessible, direct, efficient, and often humorous reviews so that everyone understands the accomplishment. Work with a group of artists long enough to see them develop.

Dimension	Beginning	Learning	Practical	Inspiring
Practice	**Hesitant** Afraid or nervous about what they do not know. Do not understand instructions. Want to be shown repeatedly. Know that repetition improves memory but claim there is no time to practice outside of class or do not see the need to practice. Out of shape physically and mentally.	**Deliberate** Do techniques slowly but believe they already know everything they need. Despite knowing that application improves memory, they do not practice to automate skills, engage in demonstrations, or take notes. Yet they want to be told about possibilities or even what to do. The struggle with technique causes them to lose the art.	**Associative** Want to know everything. Discover practicing can be fun and try many new things that fail. Know that memory depends on associations with a place, personal emotions, locations, intentionally learned activities, and having questions posed that evoke them. Break complex problems into component parts and sequence them without losing a unified vision.	**Experimental** Love to learn. Know practice hides its own existence. Unafraid of making mistakes. Know when to experiment and do research. Explore the broadest range of possibilities, including new technologies, until they find what transcends the needs of the project and directs the viewer's vision beyond incidentals to a deeper understanding of profound content.
Principles & Elements	**Latent** Only say or write intuitively that they like or dislike the results and do not think about why or have the language to answer. Act within and describe the orders around them. Respond to questions about structure and relate their answers to their emotional impressions. Balance with symmetry. Know color mixing of paints.	**Lexicon** Use elements-and-principles vocabulary without specificity and consistency. Create balance by weight, shape area and symmetries; colors by hue, saturation and luminance; composition by foreground-background; emphasis by contrasting a few elements; perspective and space with effort; point of view by convenience; rhythm by simple changes (e.g., mark spacing); and unity by similarity grouping.	**Attractor** Create increasingly complex designs by using all the elements and principles. Analyze by combining elements and principles with history, technique, and interdisciplinary concepts and applications. Use asymmetrical, multi-element balance. Use color theory intentionally but conventionally. Use composition, emphasis, and rhythm to control viewer attention plus the project's perceptual and conceptual unity.	**Cognizor** Play with principles of design to broaden their definitions and affect people's worldviews. Open new generators of order (e.g., literature, nanotechnology, sustainability, fractal theory). Add media and meaningful spaces to reinforce emphasis. Connect own and other designers' sensibilities with history, other traditions, and biography to create trends and new thematic principles. Organize multidisciplinary, collective, innovative communities.
Users	**Singular** Relate design to selves, assuming users will like whatever they do without restrictions. Use a single method (e.g., survival, direct observation, determining where users shop). Define community participation by the groups they belong to. Understand design synthesis as improving quality and durability. Leave users confused or disengaged. If leader, ignore followers.	**Affiliative** Relate designs to other people. Follow instructions to apply two or more observation methods with multiple users. Try to hide design weaknesses. Forget human and designed object flexibility equating users with tendencies, emotions and needs, and designs as static. Identify community groups outside their own group. If leader, spend time with followers.	**Collective** Relate object beyond users to communities, brands, market niches, or environments. Do behavioral research over time using multiple methods and applying conclusions to the design problem. Have sensitivity to diverse needs and use care in every encounter. Reframe problems using metaphor to understand the role that a design plays. Design to improve users' lives.	**Attributive** Relate designs to families of objects. Use innovative methods from other fields, like participant observation, to discover unexpressed user desires. Help users re-imagine wants and needs, integrating them with aesthetics, sustainability and life-cycle costs. Affirm and expand on others' input. Design not objects but their roles in user experience. Include selling method in the design.

Dimension	Beginning	Learning	Practical	Inspiring
Process	**Start** Follow instructions seeking validation after each effort. Start project and describe its development as if preparation is not part of the process. Do not know basic classifications and questions or who or even whether to ask. Choose any idea whether useful or not, using only the history they have personally experienced.	**Sequence** Follow directions but fail to assess each step so miss destructive errors. Try several alternatives using a memorized process but selected options are often too obvious and pragmatic. Learn the competition between ideas by describing rejected ideas. Choose problems they can solve but use techniques not practiced enough or avoid ones they should know.	**Combine** Respond to situational (customer) needs. Assess, correct errors, and record what happened for use on next project. Describe process stages using basic story structure of setup, problem-creating event, rising conflict, decisive event and resolution. Use multiple sources to design workable relationships between needs, resources and stakeholders, accounting for skill constraints of self and collaborators.	**Transform** Make the unexpected seem inevitable. Connect processes in different times and cultures. Invent techniques, tools, materials or shapes. Incorporate project development in life development. Help others make discoveries or develop skills. Go beyond facts to reinterpret, creating designs that transform historical into inspired human experience. Understand how designs "learn" (change with future use).
Research	**Assuming** Presume their first ideas, points of view and problem understandings to be sufficient. Try to do final drawing without indirect painting. View art history and nature as closed books with names, dates, and places. Consider internet and popular media as information. Resist ordering their thoughts. Omit citations, research techniques and comparisons.	**Confirming** Recite how research inspires design but begin without it. Haphazardly collect references, interview experts, and engage in hands-on learning, without identifying goals or applying information to process. Note elements and principles of design in everyday world and art history. Seek and use rules, procedures, and measures but allow no conflict with previous opinions.	**Comparing** Do visual and verbal research of local environment, historical or cultural designs to create a mood or technique. Compare multiple sources. Measure ideas against criteria. Feel conflict between changing the uncontrollable world and doing unimportant things. Use qualitative and ethnographic research to identify subcultures and understand people's thinking and behavior. Base research on long-term interests.	**Integrating** Integrate visual, verbal, natural, interdisciplinary and user research into life choices, unifying art history and nature with self. Collect experiences from projects and art around the world and put into historical and future contexts. Participate in users' lives. Choose methodological issues and topics drawn to since childhood. Design for all viewpoints they discover.
Technology	**Potential** Develop awareness and basic definitions of technical choices. Learn the names and examples of products. Avoid touching tools. Watch what others are doing. Follow directions inconsistently with abrupt, non-functional breaks in the process. Have a single concept per machine. Use default patterns in computer.	**Predisposed** Classify technical choices and expand awareness of definitions. Achieve comfort with one or two technologies and have shortsighted complaints about others (e.g., the learning curve outweighs the benefits). Choose overly complex or unworkable tool because of comfort. Work too fast to avoid needing time-consuming corrections. Know safety rules but overconfidently disobey them with familiar tools.	**Instrumental** Use new communication and production technologies and multiple methods, techniques, tools. Determine technologies for enhancing design solutions. Compare and contrast technical choices with a useful concept of production, but may put technique before expression or waste material. Use machines for tasks they were designed for. Follow safety rules. Seldom have to redo operations.	**Emergent** Create new or emergent techniques for both communication and production. Use machine possibilities to create components that serve the design concept and user experience. Automatically use tools as extensions of their bodies. Know many processes; experiment with new ones. Quickly identify problems and potential solutions. Optimally use materials, accounting for special qualities. Anticipate potential hazards.

Dimension	Beginning	Learning	Practical	Inspiring
Skills	**Primitive** Need specific instruction in use, treatment and safe handling of materials and industrial machines as well as constant monitoring to keep from practicing mistakes. Retreat to the comfort zone, afraid to try or using a personal signature that excludes other skills. Rush to specifics, work small, and apply wrong amount of pressure for situation.	**Stepwise** Unlearn habits and try uncomfortable strategies including familiar or easy-to-use techniques with basic industrial machinery. Learn how tools feel when making simple movements, performing one step at a time. Rush through projects without correcting errors or caring whether they are well-crafted. Neglect the composition and structure of drawings.	**Effective** Use effective techniques, tools and materials properly and in a planned time frame to serve the project purposes. Create an identifiable style but technique may override statement. Use areas of discomfort to guide new learning. Leave some bad habits uncorrected by avoiding or justifying them. Compose object relationships first and then move into detail.	**Blended** Blend contrasting methods (classical and digital, multicultural or even errors) to create surprising outcomes, appropriate to the topic. Put technical skills to uses that further the design dialogue. Constantly acquire new techniques. Challenge selves by changing mechanics or content. Get familiar enough with components of forms to reproduce them and give them individuality.
Creativity	**Fixating** Come up with only one idea to solve a problem and think it their best. Think development equals inspiration. Listen to every detail but misunderstand key problems. Mimic without realizing it. Know too little of existing products or designs to know what is new.	**Guessing at** Try several ideas and variations but let preconceptions interfere or take too long to record ideas to avoid losing many more. Miss basic process steps if not told. Haphazardly use techniques like analogies, metaphors, humor, reframing, role playing, stream of consciousness, breadth of thought, verbalizing and visualizing.	**Iterating** Provide many resourceful, informed and fresh solutions. Use processes automatically including research, ideation and finalization. Draw for speed in order not to lose ideas that will be selected later. Continue using creativity tools and heuristics until they fail. Fit new ideas into given genres.	**Situating** Integrate problems into their lives influencing their ways of seeing and choices of focus. Continually extend understanding through metaphor, code, deconstruction and reframing the design problem by bringing in new bodies of knowledge, experience or understanding. Empathize with, notate, analyze and integrate other people's understandings and perspectives.
Drawings	**Tenuous** Draw small shapes front-and-center view, slowly, with discomfort, in the middle of the page, using short, tenuous lines of uniform weight and width. Show little control over a few limited tools (pencil, charcoal, crayon, and brush). Consider drawing unrelated to their major. Choose content from personal memories with goal of rendering.	**Impelled** Draw the minimal amount and do not revise or notice distracting elements in their drawings. Vary line weights but close all forms resulting in stylized figures lacking individuality. Sight and measure one object at a time and select meaningful window sizes and locations. Draw objects by tracing computer printouts.	**Condensed** Draw to communicate, design, influence, to support instruction, text or productions or for pleasure and practice. Use as a process, creating concept sketches or exploring composition (using thumbnails). Critically think about, dynamically mix, and efficiently use various media for sketching, drawing, modeling and computer drawing. Look at objects to render them realistically.	**Significant** Communicate and collaborate with drawing, integrating form and function into designs with no distracting flaws. Create new, beautiful ways of looking at multi- layered information by researching ideas and images beyond their discipline. Connect sketching with principles of design to create exciting results. Experiment with media, colors or other design elements.

Dimension	Beginning	Learning	Practical	Inspiring
Presentation	**Ignoring** Respond to specific directions but produce sloppy results that distract from the work. Have no idea of their impact on others and need to be there to explain the work. Text has is not proofread and fails to engage the reader. Too short with lack of awareness of what to include.	**Static** Start with getting people's attention to their source of inspiration, but paradigm is too broad to influence design and lacks consistency and implementable detail (missing information on process, techniques, or medium). Different sources are not made into one cohesive document. Does not account for audience differences or respond to the audience.	**Interesting** Integrate presentation throughout their design process. Use graphics plus words that synthesize the research, analysis and concept development. Start with main concept or quality and add hidden structure of their design process by including stages of design development, historical overview, and contrasting good and bad designs. Create effective silent or succinct presentations.	**Generative** Tell a story from concept to detail where each drawing (or setting, environment, interactive website, video, sound, or light) communicates the design considerations or mockup. Lead audience from a question, conflict or action to an intriguing concept that suggests a novel, attractive solution. Respond to their reactions, even collaborate with them to produce something beyond the presentation.
Materials	**Provided** Use either what they are given or stick to comfort zones. Often choose some material from their past usually formal education that is cheap, plentiful, and marketed by art or building materials purveyors. See technology as separate from design.	**Accessible** Use the cheapest and most accessible materials even if their inherent properties are not appropriate to the function or their production plans. Do little exploration. May use non-traditional sources (e.g. trash or recyclables) or choose materials for their own sake (e.g., because they are pretty), without considering how they will use them.	**Strategic** Combine materials effectively and flexibly based on their vision of the project (goals, scale, and budget) but do not break conventions or boundaries. Choose material including recyclables or found objects in service of the design. Research before using and experiment with qualities of a few small samples of new materials and media.	**Elucidative** Choose materials that logically contribute to project vision, form, goals, and scale. Add surprising materials sometimes from other cultures. Develop skill with new materials and use in projects only when proficient. Experiment with new techniques to try ideas and create images that incorporate their interests and vision.
Economics	**Ordinal** Can rank materials and human time by cost without knowing the actual values. Know that someone controls the purse strings but cannot describe the differences between a debit and credit or between accounting and finance. Lack awareness or only vaguely concerned about the environment. Equate sustainability with saving energy.	**Metrical** Know how the economics of design is present in client budgets but focus on one aspect of the problem (e.g., fail to integrate materials, function, cultures, local laws, and sustainability). Specify types of materials, processes and machines to change environment. Understand how contract types like lump-sum or cost-plus distribute risk between client and designer.	**Systematic** See design as a system of skills composed of professional practice, client service, culture and precedent, graphics and modeling, sustainability, production, and project management. Discuss creating business models involving all aspects. Respond to both financial challenges and sustainability in engineering ways that simplify possible outcomes and use buildings, not just machines, as environment changing system.	**Dynamic** Find surprisingly effective ways using new connections and smart workarounds to save money and improve lifetime sustainability and cost without sacrificing other key aspects of design like user experience and safety. Combine administrative practice, ethics, and sustainability of society and environmental to re-imagine for a design business, what, how and why to do it.

Dimension	Beginning	Learning	Practical	Inspiring
Concept	**Endemic** Use popular concepts stated in common ways. Can't see beyond themselves to avoid portraying obtuse, cartoonish characters. Think design and life are not related. Cannot integrate others pain or joy in their designs.	**Procedural** Simplify the concept by relating new to known skills, equating design with technical skill, and incorporating material with vague justification. Look to content from own experience without research. Connect with what they already know with guidance.	**Multidimensional** Base conception on a multidimensional matrix including types and interface opportunities. Make a series of designs that richly explore complexity through applying design principles. Do research and immerse selves in topic enough to narrow it down to an aspect that interests them	**Insightful** Gives insight to user or audience. Base conception on the life enrichment potential of the spaces or objects over time. Follow a flow of investigation. Use visual thinking as part of life and develop new applications or ways to visually represent their thoughts. Knows the appropriateness of related disciplines, current events, and social influences. Identify new opportunities for human communication and life enhancement.
Precedents	**Nostalgic** Precedent is personal (what they have used in everyday experience). Judge and compare rather than understand other cultures as global opportunities. Use dates to name periods rather than to sequence trends. Overlook or deny relevance of other's views or of politics. Seek knowledge about precedent through haphazard choices of informants, sources and questions.	**Rote** Memorize and identify trends, movements, cultures, but do not relate to design process. Understand that we can learn from the reasons behind differences between regions, but wait to be given categories before analyzing them. Learn sequences and trends from informative sources but still pose presumptive questions and problems.	**Interrelated** Know professional resources to explore and learn from the formal and functional causes of temporal and local variation. Recognize and identify precedents in their own work. Identify the communities and connections of stakeholders along with the power, benefits and burdens of each. Use questions that affirm user's circumstances. Know the chronology of their specialty.	**Anthropological** Anticipate the next big attraction by recognizing how personal accounts construct need and circumstances contribute to behavior. Design to improve lives. Research, even live in a target culture to discover how people interact, what they need, and learn the cause-effect reasons behind traditional forms. Visualize them in fresh ways without compromising the culture.
Marketing	**Projective** Unaware of how marketing affects their choices. Produce what they like and assume others will also. Make assumptions without using research. Don't know where to begin looking for trends. No user context provided for marketing.	**Imitative** Re-create what they know with a sense of demographic differences. Make surface reactions to issues without review, or evaluation (fail to compare competitors or designers). Research a few websites. Promotional materials do not clearly address or would be unattractive to intended target group. May consider non-traditional market segments that will use the product.	**Contextual** Anticipate market conditions and consumer needs based on extrapolating from published cultural, technical and economic trends through desk research. Market identity and promotional materials describe items attractively and with consistent style and format to the intended target group(s). Consider the experience around the product in addition to use, including purchase, customization and sharing.	**Foresightful** Consider company in the long term. Identify latent consumer needs and trends within market distinctions. Research physically where people work, live, and shop. Go to trade shows. Market identity and promotional materials attract target group(s) in novel ways. Create trust and interest in the company and products. Use special techniques (bundling, scarcity, and user conferencing).

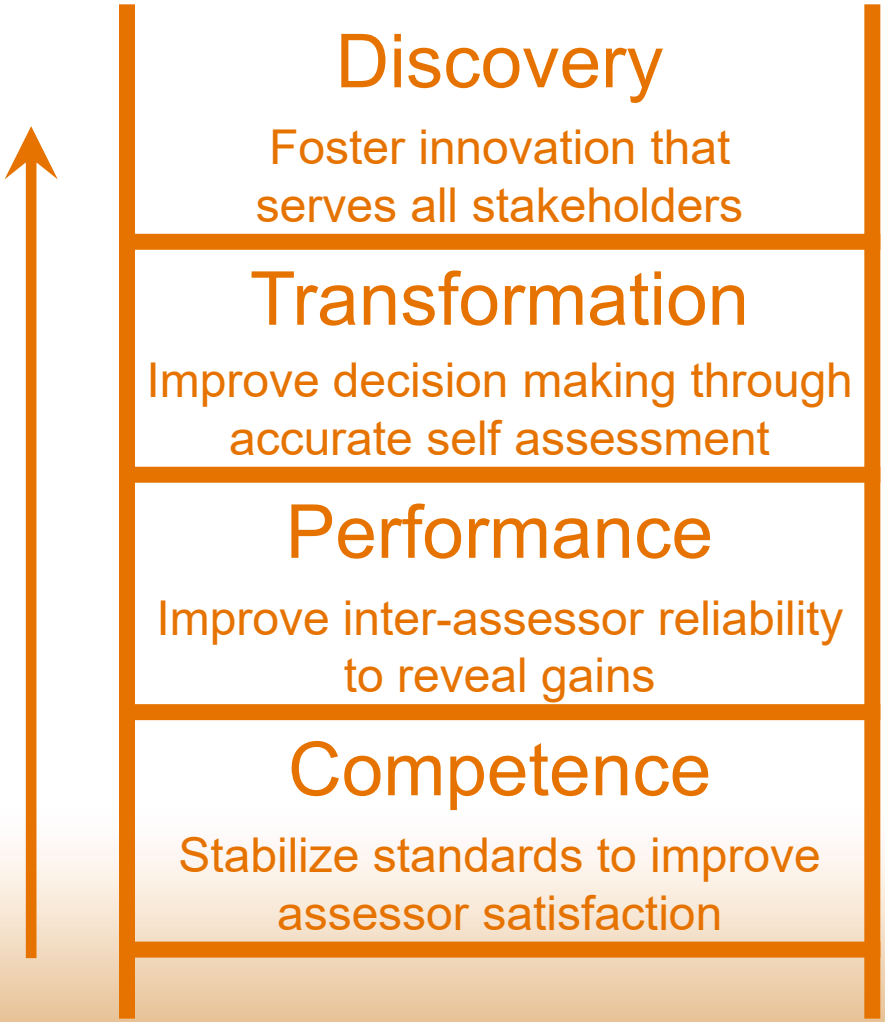
Dimension	Beginning	Learning	Practical	Inspiring
Product	**Puttering at** Unaware of product cycle and overwhelmed by the artistic process. Fail to finish design. Crudely made prototype or model that is heavily derivative and made with multiple errors, unresolved craftsmanship, and unnatural or basic forms leaving audience painfully aware of the medium. Do not think about production.	**Assembling** Articulate components of product cycle. Create novelty by making obscure, useless items or items experts often see. Derivative items have accurate symmetry, proportion and scale. Complex products are incomplete, inconsistent and show little evidence of being tested enough to avoid disrupting the user experience. Focus more on skill development and process than production.	**Refining** Know basics of marketing, sales, finances, manufacturing, and distribution. Beautifully interpret even simple objects with a high level of craft and materials, but still ordinary and less satisfying than drawings. Use mockups to test design and user experience. Products are of average difficulty to produce. Give in to production demands, rarely revisiting failures.	**Diversifying** Know how each product cycle step informs the design solution. Build several models to test proportions, functions, user experience and production in efficient and knowledge-producing ways. All elements have meaningful complexity and qualities. Resist quantity demands to increase quality. In long projects, resurrect failures and sometimes succeed with them.
Collabo-ration	**Offhanded** Work by themselves or frozen into unreflective group processes. Do not know how to resolve conflicts. Lack balance between too much and too little confidence. Say whatever is on their mind with little understanding of its impact. Confront others with their ideas. Proclaim own accomplishments and innovations while denigrating those of others.	**Interested** Ask others what they think without it having an impact on their own thinking. Participate in group projects but think their own is the best way. Begin to know what they don't know and show it by confusion. Try to get an authority to resolve conflicts or resolve by dividing the labor and working separately.	**Appreciating** Understand there are other minds than their own and that differences don't imply competition. Respect others' opinions because they have discovered the human resources (varied talents) of the group. Talk out differences without attacking those who disagree with them. Agree on design, with some compromises, grateful for opportunities to participate in doing right, regardless of acclamations.	**Cultivating** Present complex ideas in a well-thought-out way that plants the seed of change. Lead multidisciplinary teams by managing time, setting standards and direction, inviting ideas different from their own. Help members learn from each other, using whole world as a resource carried into daily actions. Enable participant contributions and group responsibility for the collective experience.
Communi-cation	**Suppressing** Wish or want to communicate but don't know where to start and wait for someone to open the door. Frozen into unreflective group processes. Restricted to their habitual ways of holding or expressing themselves.	**Reacting** Recognize standard vocabulary and others' potential but do not spontaneously use either when obvious opportunities occur. Deconstruct lifelong habits. Resolve conflicts by seeking an authority or dividing the labor and working separately. Try to pitch a design without discussing issues relevant to one major category of the audience.	**Engaging** Discover the human resources of the group, each being a unique equal. Adapt language to those involved. Address concerns of all major aspects of the audience. Talk out differences without attacking those who disagree with them. Able to express viewpoints of others accurately.	**Stimulating** Invite ideas from other disciplines and cultures in hopes that the final ideas will be greater than those of any single participant. Adapt language and expressive movement to audience and situation. Help group members find ways to learn from each other while doing their own part.

Integrated Assessment Theory

Foundations for a Technology of Assessment

SCAD

IAT's Ladder of Assessment Goals



SCAD

IAT's Technology of Assessment

Goal	Principle	Rubric Type	Mathematical Formulation *	Ascending Commitments
Discovery	Multidimen-sional patterns	MODEL	Small world networks	To Graduate Students or Individual Experts
Transformation	Decisions in Utility Systems	Develop-mental	Law of Succession	To Small Class or Skilled Workgroup
Performance	Speed and accuracy	SWELL	Power Law of Practice	To Large Class or Trained Workgroup
Competence	Self reflection	PAGE	Stevens-Kano	To Large Program or Temporary Workgroup

* Graphics only discussed here.

For details, see handout called "Elements of Integrated Assessment Theory"

SCAD

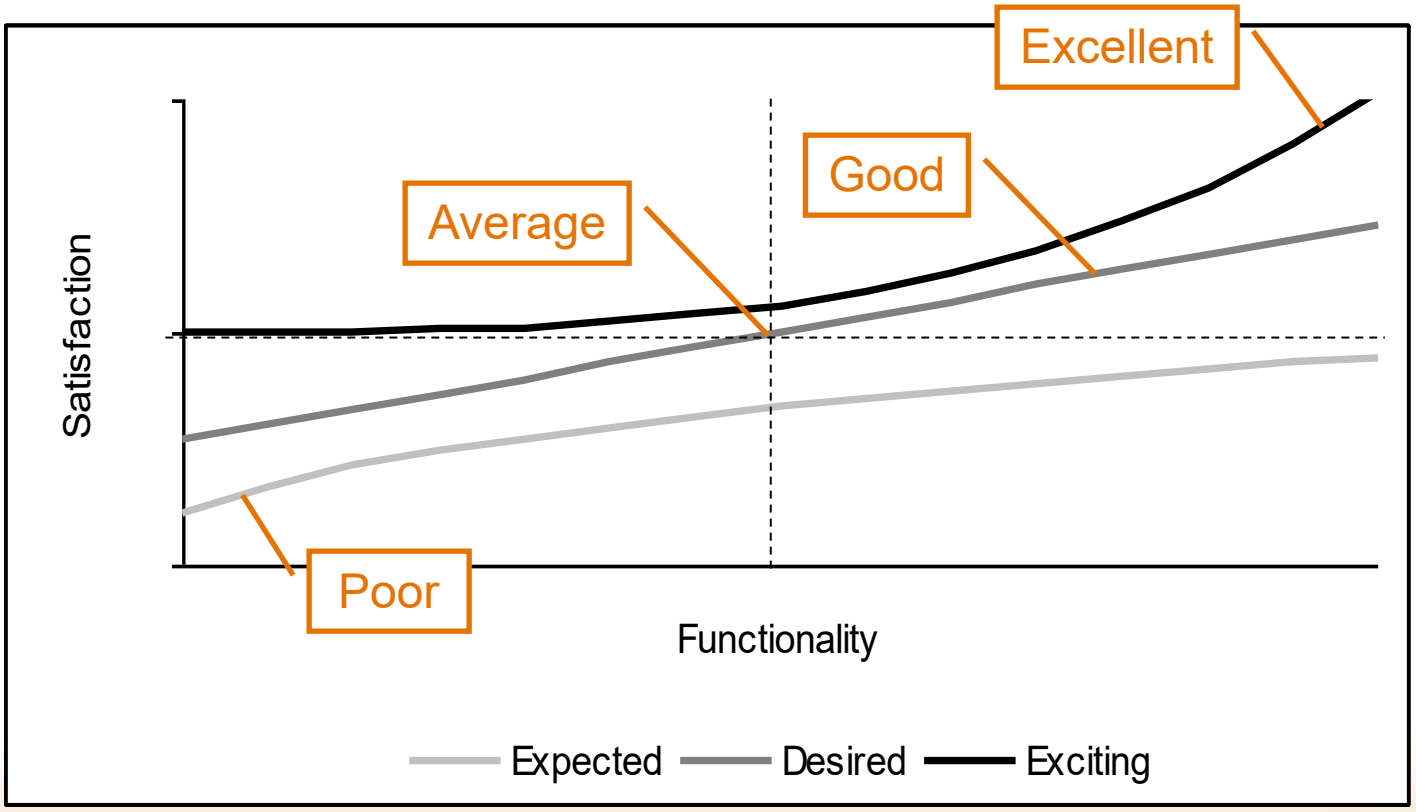
IAT's *Competence Principle.*

We understand other people's competence by examining their products or services for…

a. **Our** satisfaction.
b. **Our** ease of learning.
c. **Our** long-term transformation in expectations.
d. **Our** satisfaction with multiple quality elements.

SCAD

Stevens-Kano law of product or service quality.



The subjective experience of a stimulus is directly related to its functionality raised to a power that is characteristic of the stimulus less the value below attractiveness that typifies the stimulus category.

$$E = cS^n - K$$

where…

K = the Kano constant (the value below exciting that typifies the expected or desired quality elements of the product or service)

Rubric Type: PAGE Rubrics:

Poor, Average, Good or Excellent

SCAD

IAT's *Performance Principle.*

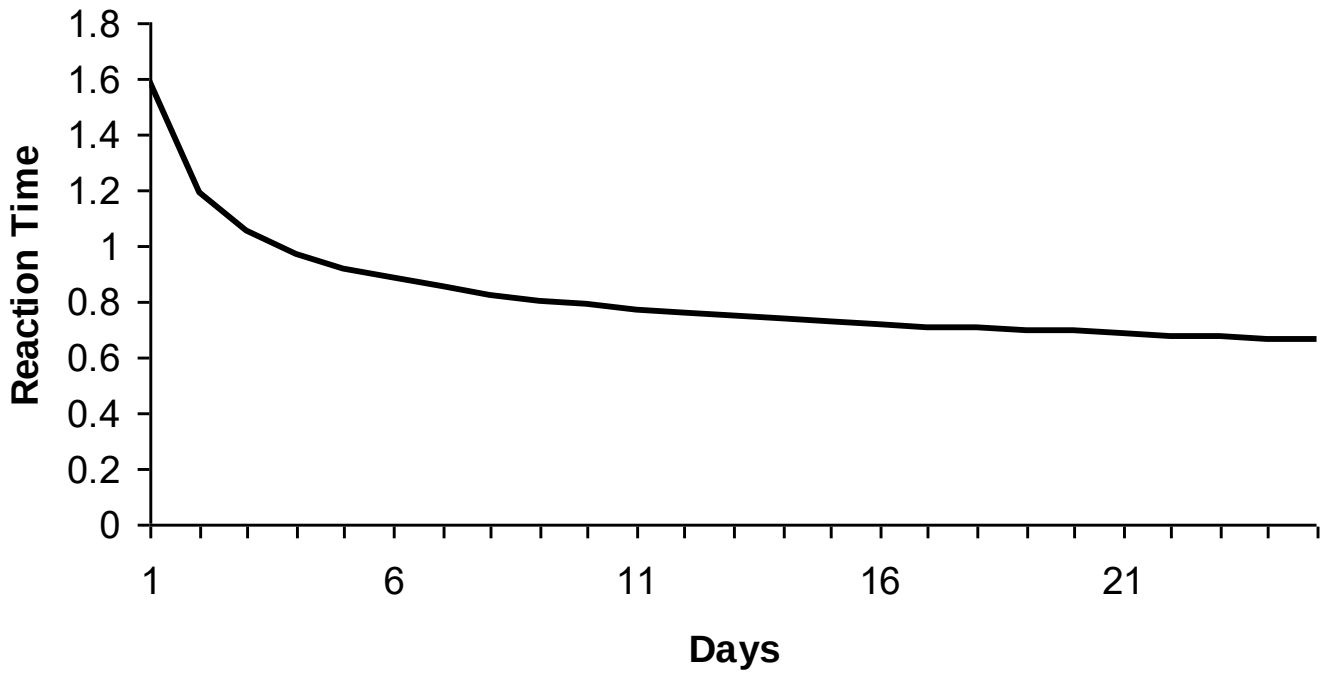
We understand other people's performance by…

(a) Determining **their** relative speed and accuracy of accomplishing discrete tasks.

(b) The number of alternatives **they** consider in a given time frame..

Power Law of Practice

(Time to recognize a sentence from Anderson, 1983).



The time it takes to perform a task is proportional to the number of trials raised to a power that indicates the learning rate.

$$T = B * N^{\lambda} + m$$

where…

T = the time to perform a task,
N = the number of trials,
λ = the learning rate,
B = a constant related to the task, and
m = the minimum performance time

SWELL Rubrics:

Sequences Which Expand Little by Little

SCAD

IAT's *Transformation Principle.*

Identify other people's transformations by

(a) Competing rules.

(b) Utilities to maximize with each rule.

(c) Relative frequencies of use.

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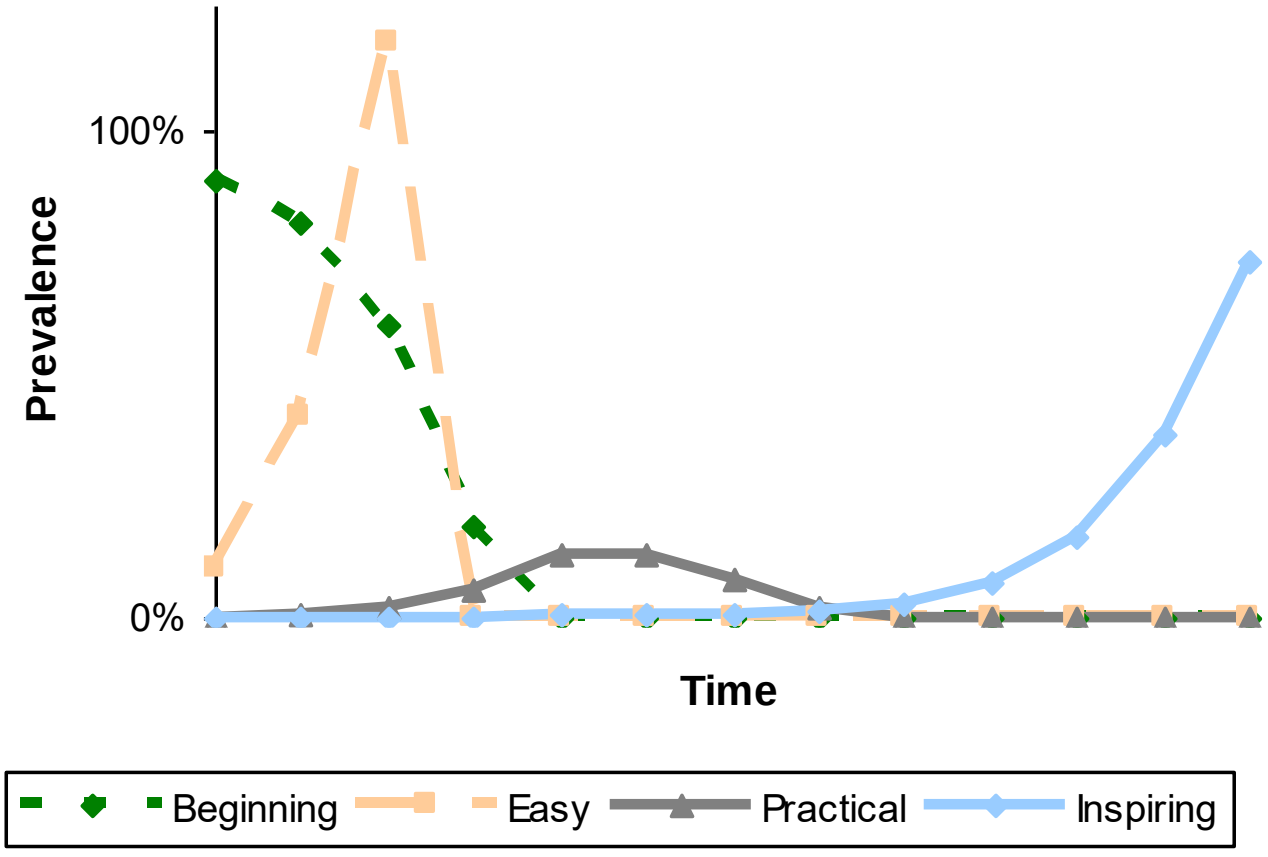
The Law of Succession



The frequency of use of a strategy depends on its initial prevalence, growth rate, competitive strength, and maximum (equilibrium) usage.

$$x' = x[1+r(1-x/k) - \Sigma c_i y_i],$$

where…

x = proportion of products coded with the same rubric during the immediately preceding instance.

r = potential growth rate of x, r>0.

k = equilibrium usage of x, $0 \leq k \leq 1$ (k is understood as 1 minus the rate of abandoning a strategy divided by the rate of new acquisitions of it).

y_i = current proportion of *i*th competing strategy, $x \neq y$.

c_i = the competitive strength of y_i, $\Sigma c_i = 1$.

r, k and c_i are constant characteristics of a strategy.

SCAD

IAT's *Innovation Principle.*

Identify other people's discoveries by…

(a) Multiple **dimensions** of competing rules.

(b) Performance **patterns**.

(c) Novel **connections**.

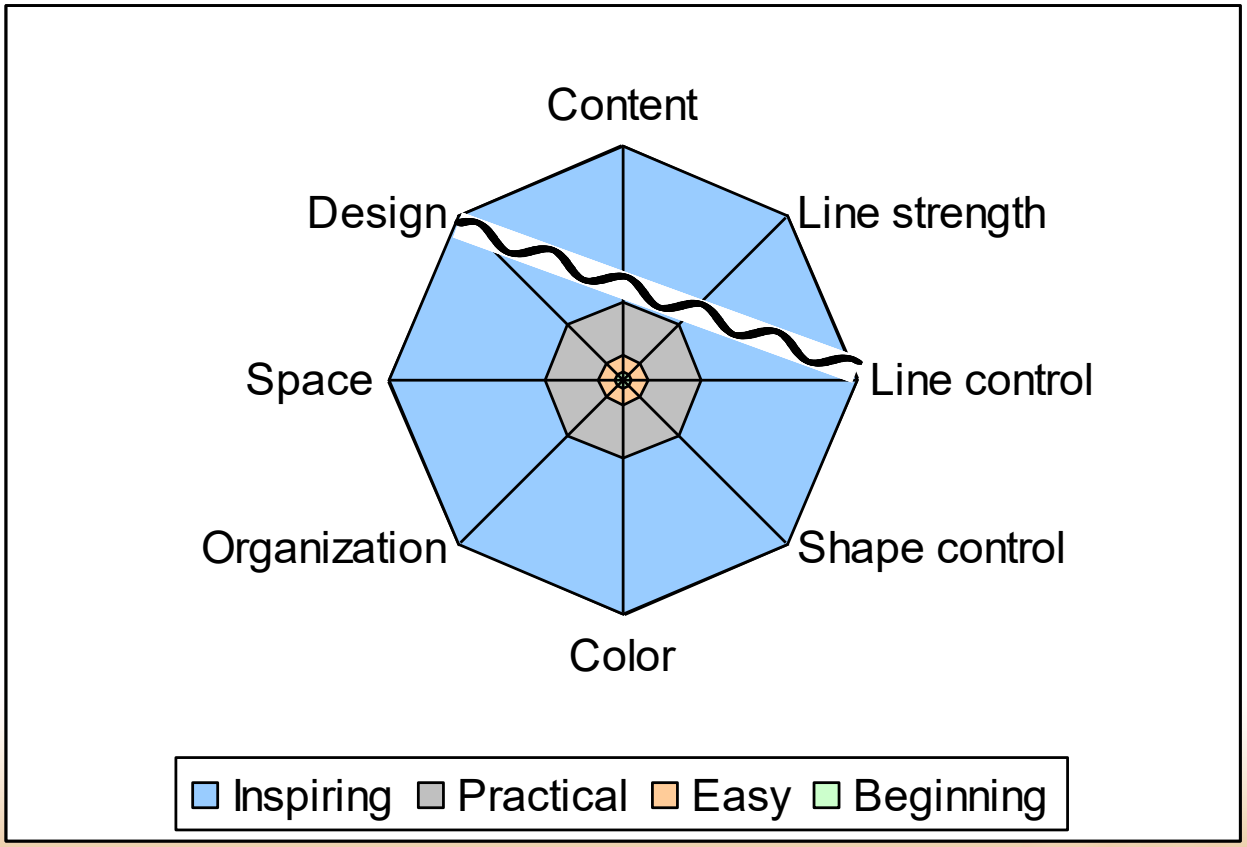
SCAD

Multiple Dimensions Create MODEL Rubrics:

Matrices **O**rganized **D**evelopmentally with **E**xperts and **L**abeling

Dimensions of Drawing				
	Beginning	**Easy**	**Practical**	**Inspiring**
Content	Movement	Representation	Realism	Message
Line strength	Uniform lines	Segmented line strength	Graduated line strength	Mixed media
Line control	No line control	Controlled Length	Controlled curves	Chiaroscuro
Shape control	No shape control	Geometric Shapes	Solid Objects	Controlled Proportions
Color	Single color	Meaningless colors	Representational colors	Designed color use
Organization	Unorganized	Base Line	Base Plane	Accurate perspective
Space	Haphazard	Object focused	Meaningful insides	Meaningful negative space
Design	No Design	Decorations	Schematic	Principled design

Spider Graphs Show Performance Patterns with MODEL Rubrics



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"Needed are classroom and large-scale assessments that help all students learn and succeed… by making as clear as possible to them, their teachers, and other education stakeholders the nature of their accomplishments and the progress of their learning."

Board on Testing and Assessment, National Research Council, 2001
Knowing What Students Know: The Science and Design of Educational Assessment, p. 1.

The Interview Process

Interviewer

Helps

Experienced Faculty

Use

Developmental Principles

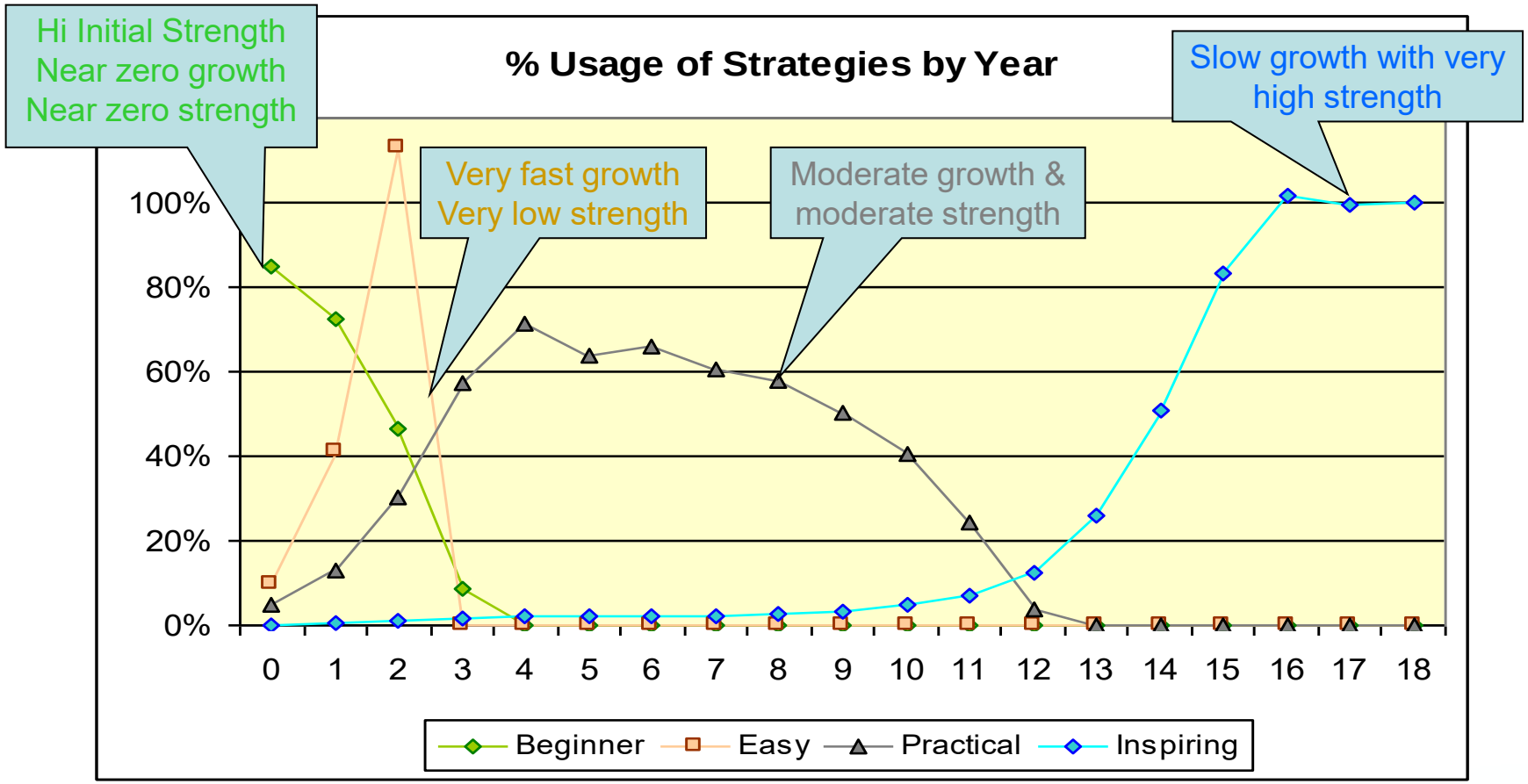
To

Organize Memories of Student Strategies

Into

MODEL Rubrics

SCAD


% Usage of Strategies by Year
Hi Initial Strength
Near zero growth
Near zero strength
Very fast growth
Very low strength
Moderate growth &
moderate strength
Slow growth with very
high strength
100%
80%
60%
40%
20%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Beginner
Easy
Practical
Inspiring

SCAD

	Beginner	Easy	Practical	Inspiring
Decision	Try	Learn	Become proficient	Make contributions
Practice Time	None	Weeks to months	A few years	5 years to start, 10 to use regularly
Effects	Peripheral Participation	Take little practice; get some reward	Enable living wages but no excitement	Enable Discoveries
Helpful Prompts	If the respondent has any difficulty, save this for after the Learning strategy has been identified.	If a student is still using a learning strategy when about to graduate, you feel discouraged and wonder where they have been for the last four years.	This one is the "sandwich filling." Save it for after the Learning and Innovating approaches have been identified.	What have your students or colleagues done that surprised you with its appropriateness?

Outcome	Criterion	Beginner	Easy	Practical	Inspiring
Research	Goals	Justification	Information	Comparisons	Design Criteria
	Contextual Inquiry	One Context	Multiple Contexts	Converging Contexts	Synthesized Contexts
	Participants	Self Oriented	Other Individuals	Markets	Hunanity
	Design Criteria	Unconstrained	Fact-based	Analysed and Understood	Reframed and Multidimensional
Creative Problem Solving	General Creativity	Idea seeking	Preparative	Cumulative	Collective
	Problem Identification	Monologue	Dialogue	Disciplinary	Holistic
	Development Process	Isolated	Dependent	Multi-step	Multi-Dimensional
	Drawing	Ambiguous	Sketchbook	Communicating	Connecting
	Test Models	Crude	Basic	Refined	Changeable

Outcome	Criterion	Beginner	Easy	Practical	Inspiring
Presentation	Oral Communication	Opinion Based	Procedure Following	Project Serving	Consensus Seeking
	Technical Choices Articulation & Defense	List	Classify	Contrast	Emergent
	Principles of Design	Recognition	Recall	Application	Innovation
	Presentation Models	Rough	Crafted	Multi-sensory	Testing
	Portfolio	Function	Performance	Process	Reflective
Project Management	Professionalism	Passive	Participating	Working	Contributing
	Contracts	Need Details	Need Advice	Protective	Mutual
	Project Management	Unplanned	Basic Plans	Efficient	Inventive
	Product Cycle	Unaware	Delineated	Art to Part	Design Integrated

Goals & Contextual Inquiry

	Justification	Information	Comparisons	Design Criteria
Goals	Think their first few ideas are sufficient. Don't understand need for research and development. When assigned, they look at the internet and popular media as information. Have no understanding of interdisciplinary opportunities	Understand that designers gather information to inspire designs. Seek to distinguish related products (ease of use, understanding, integration with other products, marketing). Review literature using consumer reports, trade publications and professional journals. Consult experts in the field. Value engineering, manufacturing, social sciences and design disciplines besides industrial design	Compare multiple sources other disciplines to help solve problems. Talk to users (what are the good/bad issues with the product). Examine relation with peripheral products. Measure ideas against criteria established from research.	Synthesize information and apply to solutions. Discover flaws in criteria. Look at peripherals. Use any source of information, but focus on what is beneficial to design.
	One Context	Multiple Contexts	Converging Contexts	Synthesized Contexts
Contextual Inquiry	Use a single method (e.g., immerse self in a task and observe) when instructed.	Apply two or more methods with multiple users, such as the 5 why's, measuring, creating surveys, doing library reading, taking apart related objects, going to store and noting brands, prices and features,	Do standard methods without support. Include ethnographic research, qualitative data, and cameras to document user-product interaction, identify subcultures and opinion groups. Draw conclusions from all approaches and apply them to the design problem	Create innovative methods (e.g., use participant observation to remove effects of being observed, by becoming part of a group that includes the target group of the design problem). Synthesize new methods and tools from other paradigms (e.g., advertising or cognitive sciences). Apply results to creating design criteria.

Participants & Design Criteria

	Self Oriented	Other Individuals	Markets	Humanity
Partici-pants	Self, teacher or any available person and focus on documenting their own point of view.	Ask friends and study body measurements, needs-wants-desires of other users, but fail to assess most of what is available.	Use 5 or 6 interviews, primary and secondary sources. Find opportunities in the marketplace and have thorough knowledge of what is available. Identify market niches (give a name to the "other people")	Deal with relevant "big picture" issues: society, future, global, product life-cycle analysis, sustainability. Compare what is available to fit, enhance and inform lifestyles. Use surveys and questionnaires to gain more thorough substantiation.
Design Criteria	Unconstrained	Fact-based	Analyzed and Understood	Reframed and Multidimensional
	Doodle. Design without constraints. Ask how many sketches to do. Specify material choice and manufacturing process globally (e.g., "Model out of plastic.")	Come in with a long list of fact-based criteria. Specify types of materials and processes (e.g., injection molding, casting, stamping, blown).	List many findings from research analysis and use them to design and evaluate design. Incorporate goals outside of contextual research from understanding clients, cultures or personal experiences. Specify detailed advanced process and draw specifics of tooling including slides and gates.	Address or create new markets by reframing the issue and use criteria to convince producers. Use multidimensional analyses of behavior, activities and facilities to compare markets. Specify several alternatives including the texture sustainability and durability of materials as well as the safety, cost and sustainability of processes

Creative Problem Solving (a)

General Creativity	Idea seeking	Preparative	Cumulative	Collective
	Views designers as stylist with one great idea but creates derivative results.	Go to popular culture, media and nature to find inspiration. Verbalize and visualize what makes a product uniquely pleasurable. Reframe them. Role-play different personalities to understand opportunities. Use humor. Learn the iterative quality of creation (multiple solutions, based on analysis).	Explore multiple solutions by continually practicing the critique of products in relation to users and intentions, testing assumptions, exhaustively applying creativity tools and developing ideas from drawing.	Collaborate with people past and present in industry, diverse disciplines and the public by drawing, verbalizing, creating new heuristics and seeking disruptive innovations.
Problem Identification	Monologue	Dialogue	Disciplinary	Holistic
	Relate problems to selves. Misunderstand details of briefs. But can recognize trends when told about them. Don't think about how it's manufactured. Write crude, non-detailed scenarios of self as user.	Relate object to others but fail to listen carefully and take notes. Look up trend-tracking organizations. Design for process, knowing specifics of various plastics. Write or storyboard detailed scenarios of familiar processes (e.g., for a toaster, "go to kitchen, get bread...)	Relate object to a brand or group of people. Look at history of product, futurist authors, demographers, and disciplinary journals. Detail specification and implementation sufficient to be producible. Critique scenarios to find hidden opportunities	Relate object to a system or family of objects and means of distribution. Notate and analyze perspectives of others. Understand the history-based forecast and apply it to design. Know how to attract early adopters. Specify new emergent materials and technologies. Apply new understandings to solutions.
Development Process	Isolated	Dependent	Multi-step	Multi-Dimensional
	Think that development equals inspiration, the idea is enough. Design for themselves.	Need to be told each step of the process. May throw out early work and start over at the finalization step. For ideation they take too long (even an hour) to do a sketch and therefore lose many ideas.	Use process steps automatically including research, ideation and finalization. During ideation they draw for speed in order not to lose ideas. Know that every sketch is a potentially great idea, ideas come faster than drawings and ideas need to be selected.	Pick methods most appropriate to the project complexity (number of parts, number of people involved, number of ways of interacting with the product or service). May specialize in one part of the process and find or create special tools that serve specific types of projects.

Creative Problem Solving (b)

Drawing	Ambiguous	Sketchbook	Communicating	Connecting
	Draw cartoon-like, slowly, with limited motor skills and miss key aspects of the object drawn so that it is too ambiguous to make a model from.	Create sketchbook quality (thumbnails and thinking sketches) slowly, with distracting errors in proportion, balance and layout. Make slight changes by asking questions. What is the existing object? How does it work? What's good / bad about it? Begin to use more than one line weight. Identify their drawings (title, name, date).	Draw quickly manually and electronically with balance, proportions and body positions that can be observed. Create concept sketches (one sheet describing a single idea, showing functions and maybe annotated) that provide enough information to build on. Explore by doing 30-40 sketches and evaluating them. Use drawings as a record of ideas.	Creatively communicate collaboratively through drawing. The drawing quality motivates excitement necessary to sustain the modeling process by building emotional connections between people and objects while exploring multiple views. Create new ways of looking at information and search for ideas beyond the boundaries of the discipline (e.g., dance, film, fine art)
Test Models	Crude	Basic	Refined	Changeable
	Sketch or make crude (e.g., with symmetry errors) foam, cardboard or clay models. Hesitant to do things that are not "right"	Create basic models and quick mock-ups to get a sense of scale and time with enough craftsmanship to produce accurate symmetry, proportion and scale. Use more refined and expensive materials that allow finer control of details. Respond to outside pressure rather than to a brief.	Create refined models by adding details that communicate clearly to other designers and test specific aspects of the design including scale, hand grips, mechanical or ergonomic functions. Deliver a prototype before the ideas cool. Know models may not have as satisfying proportions as drawings. Alternate between drawing and models.	Create changeable models that allow average clients to provide feedback that provide new information to everyone involved.

Presentation (a)

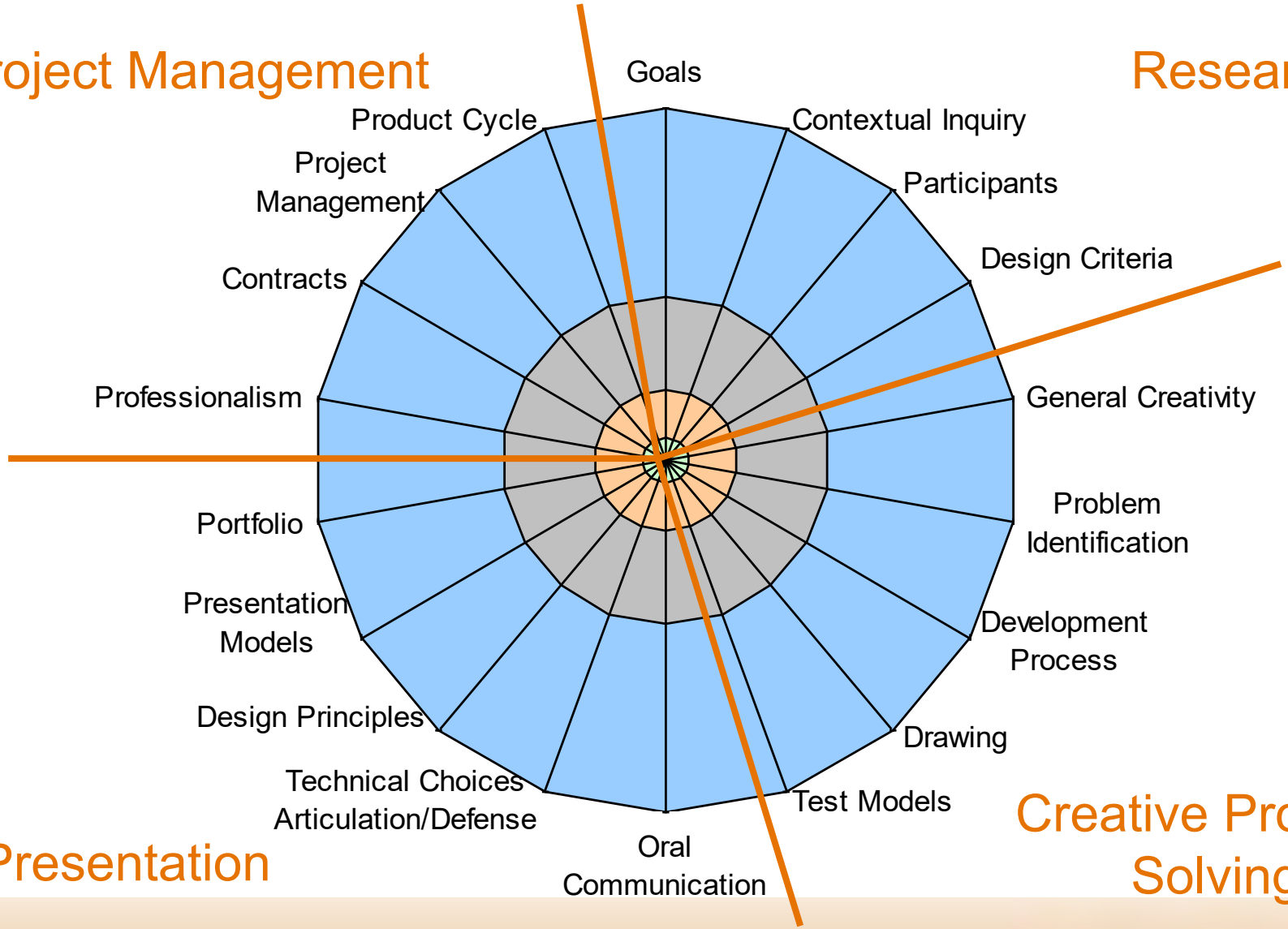
Oral Communi-cation	Opinion Based	Procedure Following	Project Serving	Consensus Seeking
	See what they like or don't like but do not notice problems. Have difficulties addressing a group	Informal discussion with negative judgments common. Do not make people aware of specific problems unless instructed to address every idea (pin-up) by identifying merits and comparing related designs. In groups, use non-verbal tools. Need reminders to slow down. Use note cards and ppt slides, but read the slides.	Answer why they have an emotional reaction to the design. Compromise on problem and know that the customer sketch does not always represent the best idea. Evaluate the ideas and skills of the presenter and help to move them to the next design stage. In groups, apply non-verbal techniques spontaneously.	Relate the presentation beyond what is in the room (e.g., bigger picture, personal meanings) in order to convince others. Seek consensus that transcends compromise. Don't need props to sell their ideas or engage an audience. Use humor and anecdotes.
Technical Choices Articula-tion and Defense	List	Classify	Contrast	Emergent
	Develop awareness and definition of technical choices	Classify technical choices and expand awareness of definitions	Aware of new technologies for both communication and production. Compare and contrast technical choices. Have a useful concept of production.	Create new or emergent techniques for both communication and production.
Principles of Design	Recognition	Recall	Application	Innovation
	Recognize the principles of design	Articulate principles of design	Can use the principles of design to control perception and cognition of the viewer (e.g., direction and duration of engagement)	Can bend the principles of design to create discovery responses.

Presentation (b)

Presentation Models	Rough	Crafted	Multi-sensory	Testing
	Poor craftsmanship	Well-crafted but still missing key aspects of the multi-sensory experience of using of the model (e.g. may not weigh anything like the intended product)	Mix a variety of materials and test production techniques. Creates accurate multi-sensory experience	Use a mix of materials including rapid prototyping to solve problems and create models that accurately replicate the intended design and actually work as planned (maybe with cannibalized parts from existing products).
Portfolio	Function	Performance	Process	Reflective
	Exercises focusing on functional and ergonomics issues	Visceral and behavioral projects focusing on complex functionality and how it performs	Reflect how critique led to revision. Includes vocational, commercial, live and sponsored projects	Abstract, provocative projects. Reflective (contribution to culture and society)

Project Management

Professionalism	Passive	Participating	Working	Contributing
	Plaster drawings on the wall in a sloppy way. Label materials in hand writing. Read professional papers	Take control of design interactions. Pin up presentation material neatly and label disks and drawings neatly and clearly. Go to conferences and participate in other people's research	Use care in every encounter and work easily with others. Submit papers to local journals or conferences	Present at conferences. Write articles for trade journals. Become known for quality. Communicate effectively, affirming and expanding on others' input.
Contracts	Need Details	Need Advice	Protective	Mutual
	Asks a pro	Has a concept of charge and contract points but need advice	Know amount of risk for time and materials (and not to exceed), fixed fees, royalties. Consider nondisclosure clauses or fulfillment fees.	Need no help in creating contract and make money with it. Match complexity of contract to situation, liability and future usage.
Project Management	Unplanned	Basic Plans	Efficient	Inventive
	Often late or unfinished. Use basic time management skills when instructed (make a list of activities and estimate time for each)	Success with limited design criteria. Deal with a few techniques at once. Use Gantt charts and apply them to multiple resources (e.g., designers and staff) over project calendar.	Create quality product on time and within budget while recording what happens for use as historical data on next project. Include physical, material and equipment as well as people in resource planning. Can manage 2 or 3 projects simultaneously. Identify and obtain resources and allocate time efficiently	Create new theory and new tools for managing complexity. Use historic data to make good enough estimates to drive profits.
Product Cycle	Unaware	Delineated	Art to Part	Design Integrated
	Unaware of product cycle	Can articulate the components of product cycle	Can create a product ("art to part") in a few months. Know marketing, sales, finances, integrated solutions across product line. Manufacturing, sales, distribution.	Manage product cycle (when to pull marketing in, sales) and how each part informs the design solution.



Spider Graph of 18 Dimensions

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Interview Tips

- Start with a friend or two.
- Use many reminders of the developmental progression (interview starting ideas) in the first ten minutes.
- Use a “Yes, and…” approach.
- Ask questions until you understand everything you are being told.
- Expect 7-15 dimensions.
- Group the results of several interviews into 10-20 total dimensions (3-5 dimensions per outcome).
- An ongoing development of IAT is labeling the collective interviews based on a text analysis which finds giant components of scale free networks.

SCAD

Creating Rubrics for MODEL Assessment

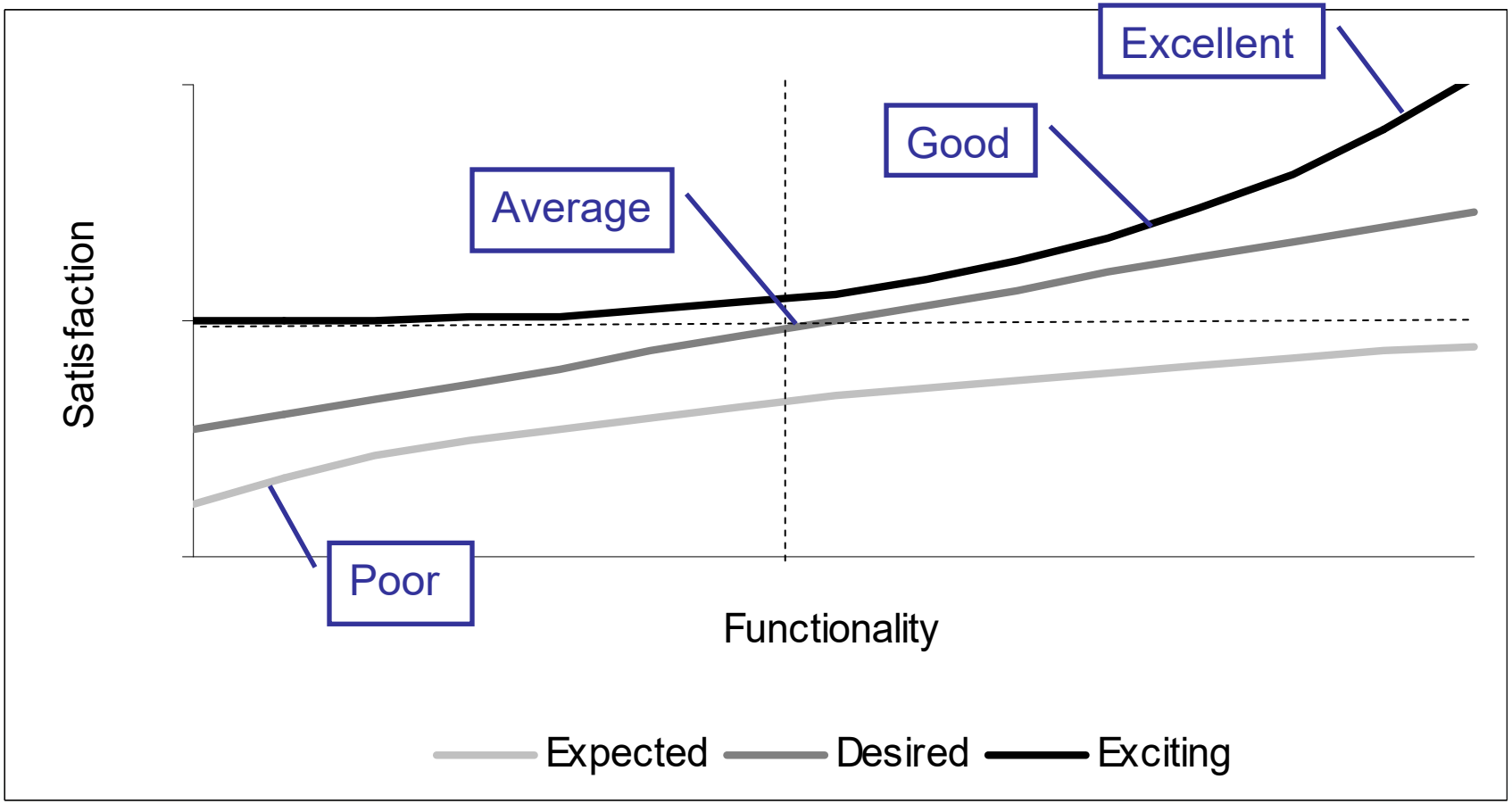
David Dirlam
Senior Assessment Coordinator
and
Thomas Gattis
Chair of Industrial Design
Savannah College of Art and Design

SCAD

What are you assessing for?

1. Competence
2. Performance
3. Transformation
4. Innovation

For Competence Use PAGE Rubrics



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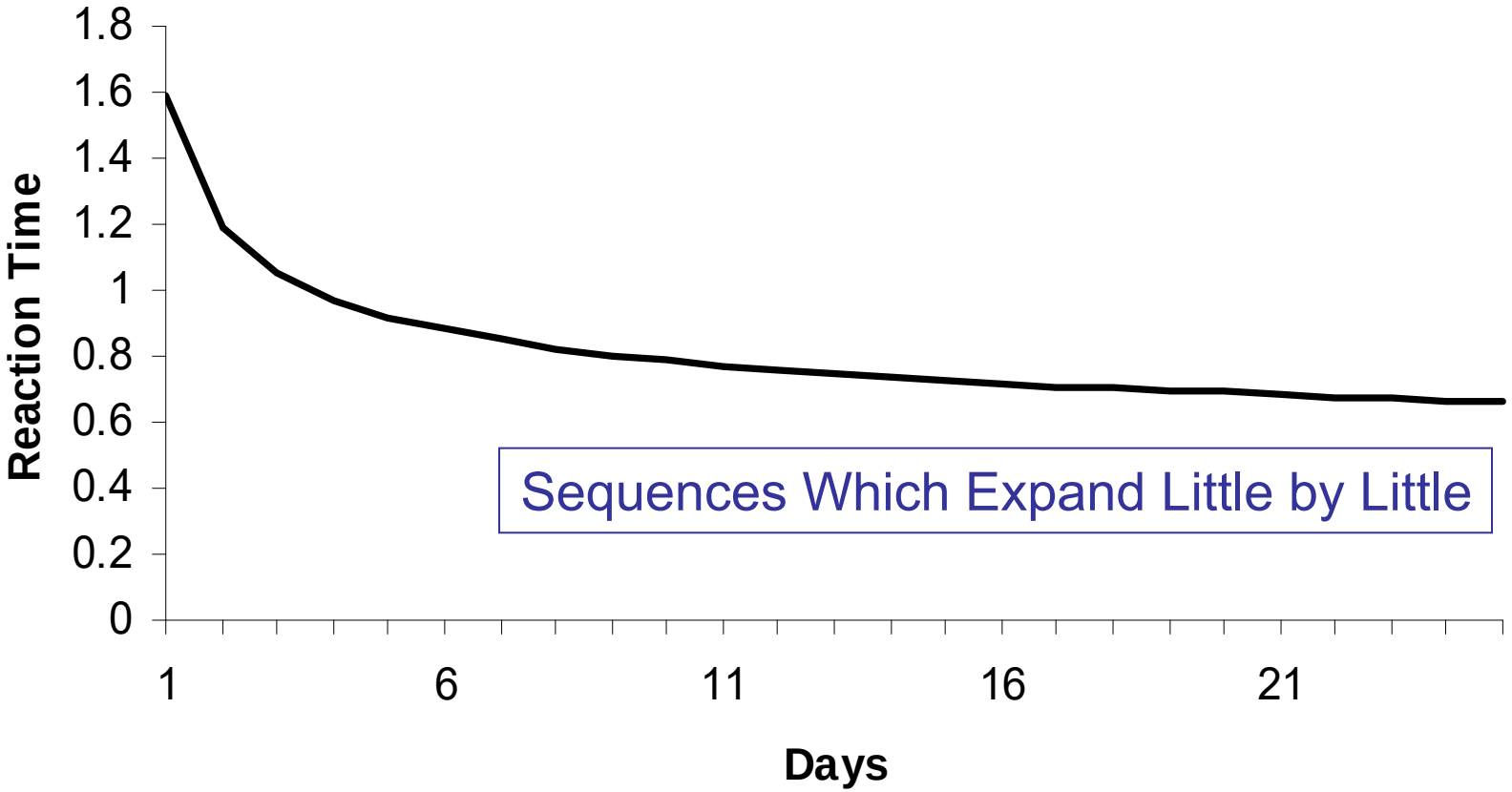
Rating Product or Service Quality

	Check one box for each criteria			
Criteria	Poor	Average	Good	Excellent
1				
2				
3				
4				
5				

For Performance Use SWELL Rubrics



Time to recognize a sentence from Anderson, 1983

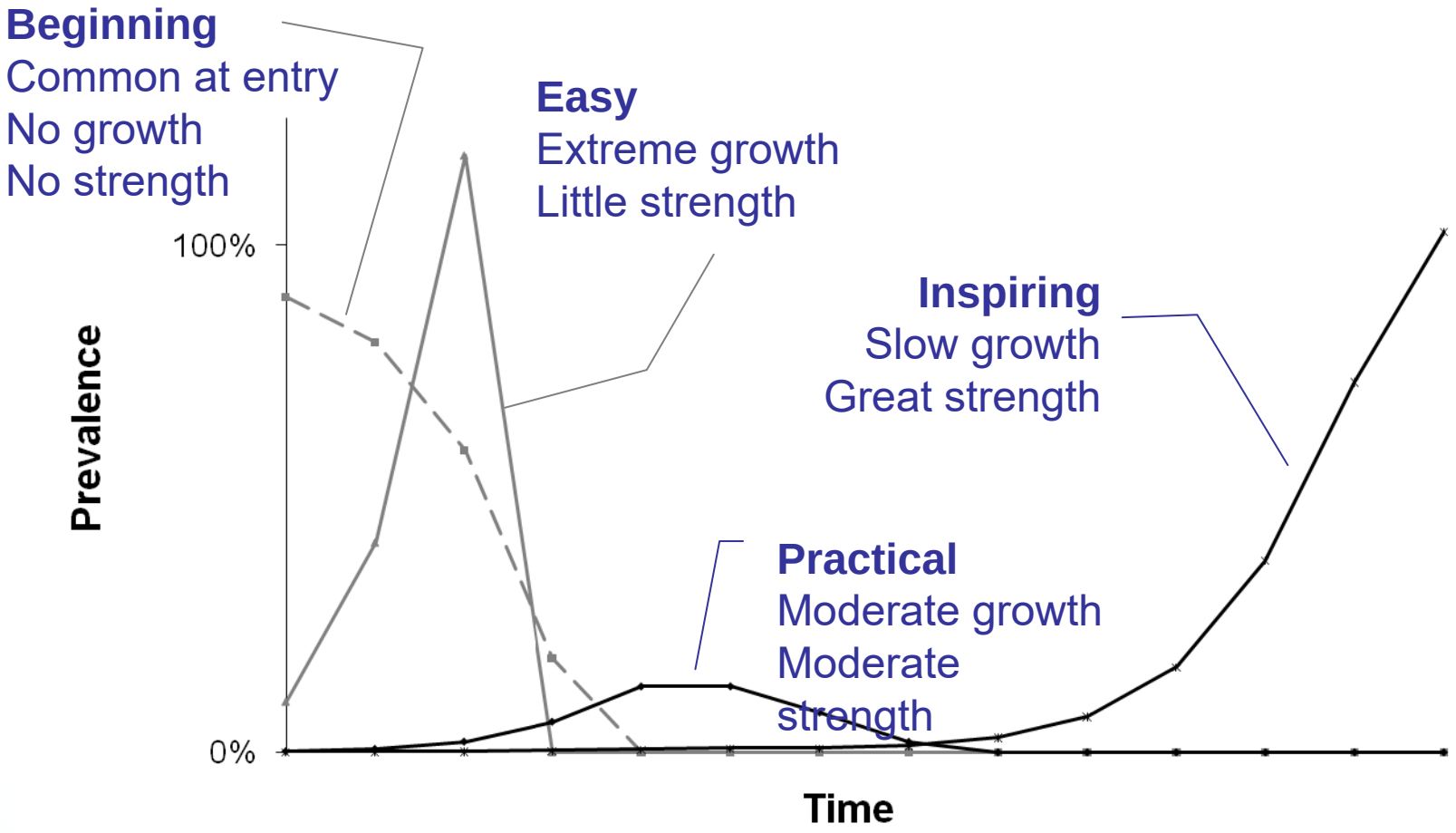
SCAD

Rating Performance Speed and Accuracy

	Check one box for each criteria			
Criteria	None	Some	More	A Lot
1				
2				
3				
4				
5				

SCAD

For Transformation Use the Law of Succession



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Record a Transforming Choice

	Circle the most accurate summary of the person's choices			
	Beginning	**Easy**	**Practical**	**Inspiring**
Development of a Particular Activity	*Describe a practice that people do when they first try the activity (e.g., a hands-on workshop).*	*Describe the easy things people learn to do in the activity during their first few months of effort (e.g., an introductory course with a project).*	*Describe what people do after they have spent a few years learning the activity (e.g., a senior thesis in a major field).*	*Describe methods people use to change the activity for themselves and others (e.g., a contribution to the discipline).*

For Innovation Use MODEL Rubrics

Term	Problem	Solution
Matrices	Trillions of ways to design. Limited memory for terms.	Multiple discrete dimensions
Organized	Interacting with students requires fast retrieval.	2-4 terms per dimension
Developmentally	A common basis is needed for developmental theories.	Use the law of succession
Expertise	Where can we get the theories?	Interview Experts
Labeling	How can we combine theories from different experts?	Analyze keyword networks

Interview Tool

	Beginning	Learning	Skilled	Innovating
Decision	Try	Learn	Become proficient	Make contributions
Practice Time	None	Weeks to months	A few years	5 years to start, 10 to use regularly
Effects	Peripheral Participation	Take little practice; get some reward	Enable living wages but no excitement	Enable Discoveries
Helpful Prompts	If unsure, save for after the Easy strategy.	If a student still uses this strategy when about to graduate, you feel discouraged.	Save this "sandwich filling" for after the Easy and Innovating approaches.	What have your students or colleagues done that surprised you with its appropriateness?

Interview Process*

Beginning Strategy

- Start with a friend or two.

Easy Strategies

- Interview people in their office or classroom (memory is place dependent).
- Remind them of their classes and students by using “targeted small talk.”
- Introduce the transforming choice.

Practical Strategies

- Present the Law of Succession, the MODEL rubrics table, and the Interview Tool in 5-10 minutes.
- Record brainstorms in the first 10 minutes and later remind them of the dimensions these suggest.
- Use reminders of the developmental progression (interview starting ideas) in the first ten minutes. Rehearse the meanings of the four levels. Make sure that “easy” strategies are fast growing or that “inspiring” ones require deep understanding of the needs of their discipline.
- Remind the interviewee that the goal is to describe behaviors or strategies that people can reliably identify. Try to imagine what observable “traces” or “products” would be clear indications.
- Make sure the interviewee explains technical or disciplinary language enough so that an introductory student could understand.
- Expect 7-15 dimensions.
- Group the results of several interviews into 10-20 total dimensions (3-5 dimensions per outcome)

SCAD

* Prepared after discussion with fellow MODEL rubrics interviewer, Regina Lowery

Interview Process (continued)

Inspiring Strategies

- Use Keith Sawyer's "Yes, and…" approach. Make connections with own experiences or with other interviews. Especially mention ideas that add to the understanding of both you and the interviewee.
- If you have more than 50 dimensions from several interviews, contact us for our organizing tool: a MS Excel workbook to do keyword network deconstruction. After grouping the dimensions, write a 50-word maximum abstract of each level. Then give an easily remembered title to each abstract.
- Compare your results with *Trillions of Ways to Design* and send comments to ddirlam@scad.edu (all comments used in book will be acknowledged).

* Prepared after discussion with fellow MODEL rubrics interviewer, Regina Lowery

Industrial Design Department
MODEL Rubrics

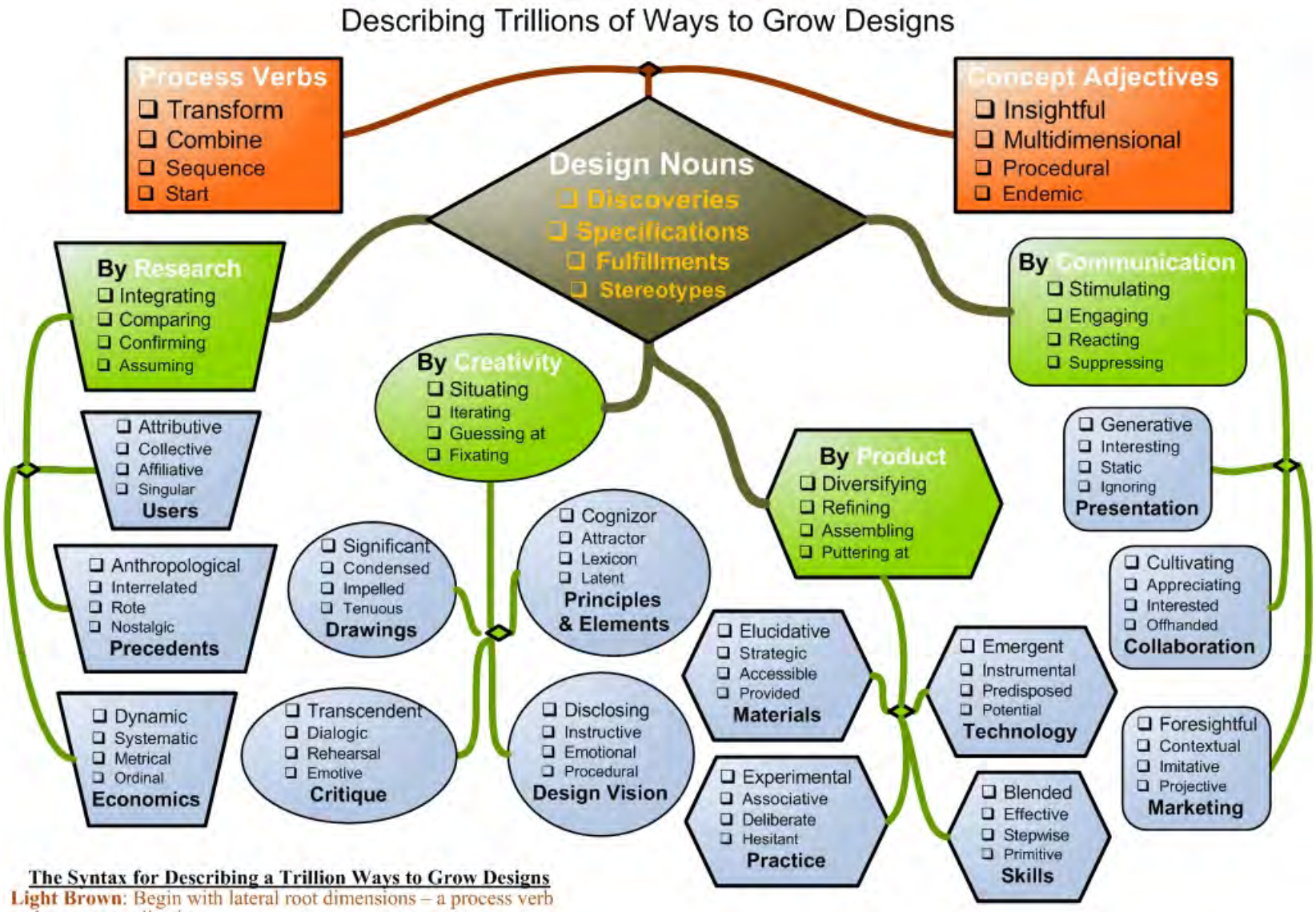
Student: _____ Rater: _____ Date: ____/____/____

Criteria / Outcome	Beginner	Easy	Practical	Inspiring	Student Ratings (B, E, P, I) 1	2	3	4	5	6	7	8	9	10
Outcome 1	**Research**													
Goals	Justification	Information	Comparisons	Design Criteria										
Contextual Inquiry	One Context	Multiple Contexts	Converging Contexts	Synthesized Contexts										
Participants	Self Oriented	Other Individuals	Markets	Hunanity										
Design Criteria	Unconstrained	Fact-based	Analysed and Understood	Reframed and Multidimensional										
Outcome 2	**Creative Problem Solving**													
General Creativity	Idea seeking	Preparative	Cumulative	Collective										
Problem Identification	Monologue	Dialogue	Disciplinary	Holistic										
Development Process	Isolated	Dependent	Multi-step	Multidimensional										
Drawing	Ambiguous	Sketchbook	Communicating	Connecting										
Test Models	Crude	Basic	Refined	Changeable										
Outcome 3	**Presentation**													
Oral Communication	Opinion Based	Procedure Following	Project Serving	Consensus Seeking										
Technical Choices Articulation & Defense	List	Classify	Contrast	Emergent										
Principles of Design	Recognition	Recall	Application	Innovation										
Presentation Models	Rough	Crafted	Multi-sensory	Testing										
Portfolio	Function	Performance	Process	Reflective										
Outcome 4	**Project Management**													
Professionalism	Passive	Participating	Working	Contributing										
Contracts	Need Details	Need Advice	Protective	Mutual										
Project Management	Unplanned	Basic Plans	Efficient	Inventive										
Product Cycle	Unaware	Delineated	Art to Part	Design Integrated										

Benefits

- Unified theory of the development of disciplinary expertise
  - ✓ Collective—less biased, more buy-in
  - ✓ Comprehensive—the 18 Industrial Design dimensions create 70 billion ways to design; the 21 dimensions from 20 disciplines create 4 trillion ways.
  - ✓ Efficient—2 hours per faculty member, 4 hours each for coordinator
- Stimulate dialog
- Recognize unique contributions
- Applicable to client-designer relations
- Use for authentic, yet expert interactions with students

If you would like to be a *Trillion Ways to Design* collaborator, please add your name, email and some areas from the chart below to the sign-up list.



The Syntax for Describing a Trillion Ways to Grow Designs

Light Brown: Begin with lateral root dimensions – a process verb and a concept adjective.
Brown: Choose a taproot dimension – a type of design.
Green: Add branch dimensions – By phrases
Blue: Add flowering dimensions – use adjective and noun for each
Diamonds: Common choice paths (bidirectional)

D. Dirlam, T. Gattis, J. Leong, L. Ng, S. Singeisen, & C. Williams
Savannah College of Art and Design 9-15-2008

Assessing New Media Expertise

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Abstract.

Assessment is a fundamental human activity, far broader than “psychological assessment” and encompassing all aspects of our joint existence including risk, self, environment, quality, programs, health, economics, and careers, as well as education and mental health. Psychology’s overwhelming finger movements and self reports (Baumeister, 2007) has not only seriously hampered the advance of psychology, it has also misled the public into such unproductive initiatives as “No Child Left Behind.” A prime example is the current use of rubrics, which were invented 35 years ago to address the psychological science problem of precise description of freely occurring human behavior. Originally, rubrics were unique, reliable definitions of developmental levels along several dimensions. Applied to education they enabled the nation’s first natural language writing competency test (in New York in the mid 1970s). Now, the vast majority of rubrics users adopts some easy, unreliable variant of PAGE or SWELL definitions (“Poor Average Good Excellent” or “Sequences Which Expand Little by Little”). Further, despite the efforts of accrediting agencies to inspire a cycle of assessment - improvement - reassessment, educational programs too often adopt a cycle of self justification that deludes both the doer and receiver of assessment. Product evaluation is another important area.

Helping experts articulate and test their theories of how their expertise develops.

It is time to establish a true assessment science.

Integrated Assessment Theory

combines scientific principles of sensory and quality measurement, learning, development and cognitive insight to create assessments targeted to educational or management goals of competence, performance, transformation and innovation.

We interviewed seven faculty experts in Interactive Design and Game Development, asking them to organize their experience with students into four levels of strategies: (A) *Beginning* attempts neither grow nor compete and require decisions only to try, which takes no time to learn; (B) *Easy* learning grows fast without competing, and require commitments to learn which take a few months to realize; (C) *Practical* skills grow and compete moderately and require commitments of a few years to realize; (D) *Inspiring* contributions grow slow and compete strongly and involve a decision to contribute to or make discoveries within a field that require several years to realize. The Interviews generated 66 dimensions of the development of new media expertise. A collective discussion edited the number of dimensions down to 36 (mostly based on generality) and organized the rubrics into rating sheets. The new organization was tested through creating a semantic network of keywords by deconstructing the number of co-occurrences in interview dimensions. Emergent effects included a framework for faculty dialogue, a high-level, developmentally organized knowledge base, a keyword index to the knowledge base and ultimately, inspiration for students.

As its name implies *new media* is relentlessly innovative. Assessing program effectiveness through competency testing was accepted practice in 20th century academia, but is irrelevant to new media because it assumes that test authorities know all the possible answers and the forms those answers will take. Innovation, on the other hand, is unpredictable in both source and content. Simple judgments are also inappropriate because of their thoroughly documented unreliability. Integrative Assessment Theory provides a technological framework for understanding the assessment of innovative expertise. We first outline the theory and then show how we have applied it to construct a powerful system for assessing new media programs.

Integrated Assessment Theory

Integrated Assessment Theory (IAT) provides an organizing procedure for the ever broadening field of assessment. It is rooted in cultural, historical and natural science approaches to understanding development ranging from individuals to societies. It emphasizes the natural science aspects of assessment as supports for local program designs, analogous to the way engineering supports architectural or industrial design. It provides a path beyond the top-down or authoritarian approach that characterized 20th Century assessment and scholarship, which is so anathematic to the user-centered culture engendered by new media.

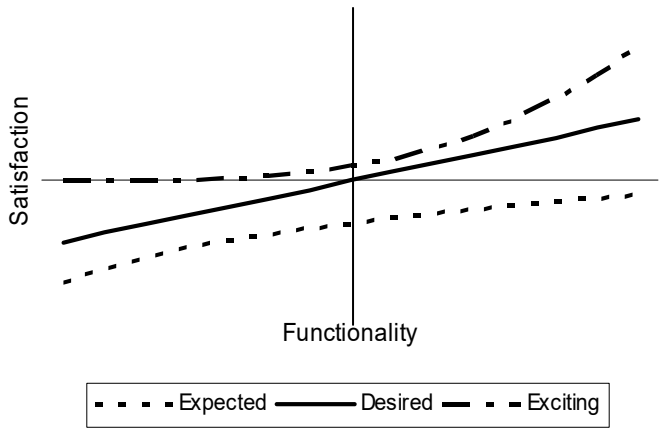
IAT distinguishes four types of assessment goals of all participants in the assessment process, including students, educators, employees, managers, citizens and policy makers. The four goal types are competence, performance, transformation and innovation. Each goal type is defined, measured, analyzed and applied to education, training, and product or service development in relation to an organizing law or computational model. Applications of these laws result in an IAT principle for each assessment goal.

Three basic assumptions frame the understanding of the four assessment goals of IAT:

1. Human strategies are the unit of analysis for assessment,
2. They are measured in terms of the origin, distribution and interaction in time and space.
3. With sufficient number and accuracy of measurements, the first choice for analysis is validated scientific laws of measurements.
4. Since strategies are fractal in nature (some practiced for millennia across nearly all human habitations and others occurring in one individual for only a single fleeting moment), such analysis is conducted and interpreted across multiple orders of magnitude of time and space.

Competence

Competence concerns what those being assessed can do, not how they came to be able to do it. We assess competence when experts select candidates, products or services using judgments like poor, average, good or excellent. Competence is defined from generalizing Stevens' (1957) (psychophysical) Law to accommodate the Kano Model of product or service assessment. Stevens' Law compares the subjective intensity of a stimulus with its objective intensity. Different stimulus modes show different exponents: brightness less than one, length equal to one, and electric shock discrimination above one.



Steven's-Kano Law

The subjective experience of a stimulus is directly related to its functionality raised to power (n) that is characteristic to the stimulus less the value below attractiveness that typifies the stimulus category.

$$E = cS^n - K$$

K = the Kano constant (the value below exciting that typifies the expected or desired quality elements of the product or service).
c = a constant that typifies the stimulus.

Figure 1. Stevens-Kano law of product or service quality.

Kano, Seraku, Takahashi, and Tsuji (1984) proposed to assess product or service quality elements based on subjective satisfaction and objective functionality. We assess satisfaction through user ratings and functionality through user learning time. A constant K is needed to generalize Stevens' Law into the Stevens-Kano Law. It indicates how far from satisfied we feel when judging a particular quality element of a product or service. Kano (summarized in Löfgren and Wittel, 2008) demonstrated the fractal nature of the law by showing that remotes for TVs were exciting features in 1983, desired in 1989 and expected by 1998. The value of K reflects this change by increasing over time and usage. Kano's depictions imply a discontinuous change that is simultaneous with changes in the value of c and n. In short, the change is transformative rather than gradual.

> IAT's C*ompetence Principle.* We understand other people's competence by (a) our degree of satisfaction with their products or services, (b) the amount of improvement in our use of them from one encounter to the next and (c) the transformation from one type of quality to another.

Performance

When we assess performance, we move beyond the products or services of those being assessed to the degree of learning required to produce those products or services. This is in part the opposite of competence. Instead of assessors considering their own time to learn, they now consider time to learn of the person being assessed (student, candidate, or employee). Performing persons are more than products or services, even if their only commitment is to participate in the learning process. Performance is defined from the Power Law of Practice assuming control of accuracy and choice multiplicity. Increased demands for accuracy or number of choice alternatives decrease speed according to laws of Fitts (1954) and Hick (1952).

> IAT's *Performance Principle.* We understand other people's performance by (a) determining their relative speed and accuracy of accomplishing discrete tasks and (b) the number of alternatives they consider in a given time frame.

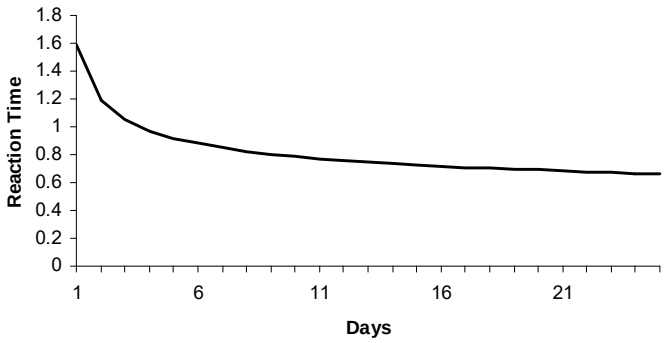


Figure 2. Power law of practice

Power Law of Practice

The time it takes to perform a task is proportional to the number of trials raised to a power that indicates the learning rate.

$$T = B * N^{\lambda} + m$$

T = the time to perform a task,
N = the number of trials,
λ = the learning rate,
B = a constant related to the task, and
m = the minimum performance time

Transformation

Development involves more than practice. Stage theories are common in discussions of the evolution of ecosystems, historical eras, children and adults, groups, organizations and communities. But "stage" is a mysterious concept. Until recently, there has been an explanatory law of such changes only in the context of ecosystems. There, the succession of species that follows a catastrophe is known to obey the Lotka-Volterra law, one version of which is given in the text box with an example in Figure 3. According to it, developmental successions occur because of initial frequencies, growth rates, competitive strengths and equilibriums that are characteristic of the competing species involved. The transformation process is defined from a generalization of this Law of Succession to the acquisition of expertise and historical change (Dirlam, Gamble and Lloyd, 1999) that is combined with Phillips' (1999) Complex Systems Model of Choice.

Dirlam et al. found their generalization of the Lotka-Volterra to provide precise fits to ratings of 1,222 drawing by children aged 5 to 19 and ratings of research strategies in 912 developmental articles written from 1930 to 1992. Phillips (1999) model begins with the assumption that strategies compete when they satisfy the same utilities. Thus, food choice strategies depend on healthfulness, accessibility (cost and availability), simple taste, and habitualness. Each factor is scaled in a way represented by the Stevens-Kano Law. Changing an entrenched habit means finding new ways to satisfy the utilities. Slight changes don't work, but radical ones (e.g., changing a burger and fries diet to a vegan diet) may work if time is allowed for relearning. These decisions result in the changing frequencies uncovered by the Law of Succession.

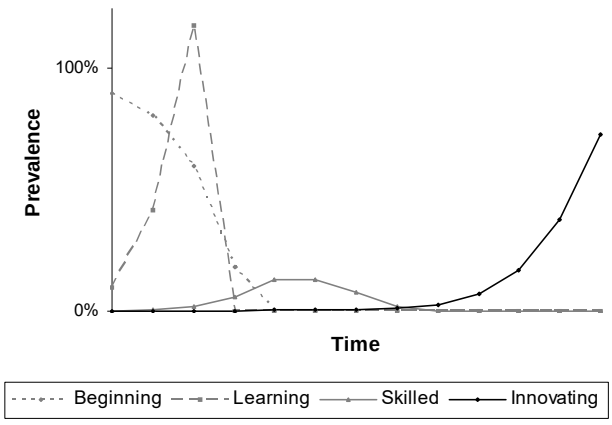


Figure 3. Competing Strategies based on the Law of Succession

Law of Succession

The frequency of use of a strategy depends on its initial prevalence, growth rate, competitive strength, and maximum (equilibrium) usage.

$x' = x[1+r(1-x/k) - \Sigma c_i y_i]$, where…
x = proportion of products coded with the same rubric during the immediately preceding instance.
r = potential growth rate of x, $r>0$.
k = equilibrium usage of x, $0 \leq k \leq 1$ (k is understood as 1 minus the rate of abandoning a strategy divided by the rate of new acquisitions of it).
y_i = current proportion of *i*th competing strategy, $x \neq y$.
c_i = the competitive strength of y_i, $\Sigma c_i = 1$.
r, k and c_i are constant characteristics of a strategy.

In an insightful series of experiments, Baumeister (2008) showed that people perform poorly at almost any self-control task for some time after they had just performed a self-control task. IAT implies that this deficiency is due to the competition between the two strategies that require less and more self-control.

> IAT's *Transformation Principle.* We understand other people's transformations by (a) identifying the set of competing rules that govern an activity, (b) identifying the utilities that users hope to maximize through using any of the competing rules, (d) observing the relative frequency of use of the alternative rules, and (d) observing the cognitive strain involved in the performance of new strategies.

Innovation

Expertise and innovation both require more than one dimension. The convergence of these two ideas is a major outcome of IAS which is represented through the synthesis of two models: developmental classifiers (Dirlam, 1980) and small world networks of either creative collaboration (Uzzi and Spiro, 2005) or cognitive insight (Schilling, 2005). Developmental classifiers were constructed to create a *powerful* unit of analysis. *Power* in that context means (according to Dirlam, 1980) sufficiently rich to code human expertise using a small enough number of terms to be readily memorized. A classifier is an n-dimensional Cartesian product with a small, number of discrete terms per dimension (2 to 4 according to Dirlam, 1972, Simon, 1974 and Cowan, 2001). Note that 4 items for 10 dimension codes over a million patterns ($4^{\wedge 10}$) with 40 (4*10) concepts. It is developmental if the terms can be empirically sequenced. Since 1997, the sequencing method has been understood to be the law of succession.

One of the primary applications of IAT involves using the principles of development contained in it to help experts reorganize their experience with people acquiring their expertise. A five minute summary of these principles has enabled 100 experts to identify an average of 10 dimensions of their expertise each with four uniquely defined developmental strategies:

(1) beginning—decide to try and take no time to acquire),
(2) learning—decide to learn and devote a few months to it,
(3) skilled—decide to make a living at it and take a few years to learn, and
(4) innovating—decide to make discoveries or contribute to a field and take many years to become proficient at it.

Such developmental interviews can then be turned into MODEL rubrics, Matrices Organized Developmentally with Experts and Labeling. The result is rubrics that are so objective that non-experts, even those being assessed, can reliably use them.

Social relationships can be represented by a network where nodes indicate people and lines relationships, such as whether they know (Milgram, 1967) or collaborate with each (Uzzi and Spiro, 2005). Cognitions can be represented by a network where nodes are ideas and lines are connections or associations between the ideas (Schilling, 2005). Watts and Strogatz (1998) defined two parameters for measuring such networks: clustering (interconnected groups of people or ideas) and path length (the number of degrees of separation between the clusters). They showed that connecting a single line between remote

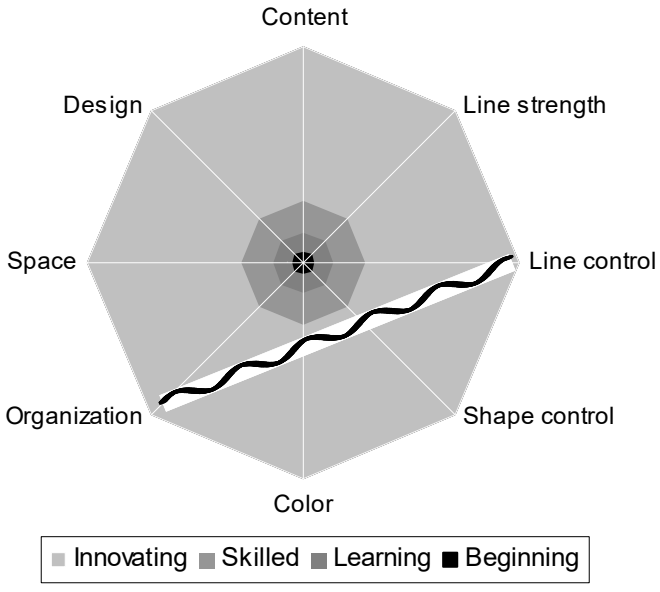


Figure 4. Spider Graph for MODEL Rubrics

clusters can leave the clustering coefficient nearly unchanged but have a dramatic effect on the path length—hence the “small world” description. Schilling argued that the cognitive realization of the small world effect is insight.

Small world networks and MODEL rubrics can be integrated in a spider graph. The cluster of interrelated ideas is represented along each radial of the graph. Innovative, insightful ideas connect separate dimensions (the wavy line in Figure 4). A method for discovering dimensions by deconstructing networks of keywords in them is described in the section on the New Media Study.

> IAT’s *Innovation Principle.* We understand other people’s innovations by (a) identifying various dimensions of competing rules that govern an activity, (b) determining the pattern of individual performances along each dimension, (d) observing connections between innovative levels of performance in some of the dimensions, and (e) validating through converging practical information.

IAT Overview

Table 1 gives an overview of Integrated Assessment Theory. Ultimately the theory is proposed as the technical arm of a cultural psychological approach to assessment. Consequently a natural source of rubrics criteria for reflexively assessing IAT arises from that discipline. Cole (1996) identified 5 criteria for cultural psychology: (1) theoretically cultural and historical, (2) methodologically cultural and scientific, (3) situated where practitioners are both participant and analyst, (4) enters into the process of helping things grow, (5) drawing on knowledge gained from cultural and natural science forms of psychology and allied disciplines, and (6) tested by its ability to create and sustain effective systems.

The issue of practitioner participants has mushroomed far beyond expectations that Cole had just over a decade ago. Fully half of NMC’s 2007-2008 *Calls to Scholarship* included an assessment issue. The Social Networking call included a demonstration project for exploring “how work accomplished by using social networking tools can be assessed.” The User-Created Content call included a needed tool “to find and evaluate resources that users may want to incorporate.” The New Scholarship and Emerging Forms of Publication call included a demonstration project in which students would “take on the role of reviewers and producers, rather than the role of consumers of knowledge.” Providing reliable, accessible and formative tools like MODEL rubrics can help both to produce transformative and creative responses to the opportunities provided by social networking, user-created content, and new scholarship.

Table 1. Overview of Integrated Assessment Theory

Goal	Principle	Rubrics Type	Assessment Data Analysis	Ascending Commitments	Participant Use
Innovation	Multidimen-sional patterns	MODEL	Small world networks	To Graduate Students or Individual Experts	Stimulate Creativity
Transformation	Decisions in Utility Systems	1-D	Law of Succession	To Small Class or Skilled Workgroup	Clarify Decisions
Performance	Speed and accuracy	SWELL	Power Law of Practice	To Large Class or Trained Workgroup	Improve Production
Competence	Self reflection	PAGE	Stevens-Kano	To Large Program or Temporary Workgroup	Accept or Reject

The overview of IAT showed that expertise in new media requires making connections within the context of multidimensional transformations. If assessment is to foster this activity, the first step is to identify the dimensions and the transformations within them. The new media study accomplished this in three methodological steps: (1) conducting interviews of individuals to discover dimensions of transformations that commonly occur, (2) collectively editing and organizing the interviews and (3) testing the organization through a analysis of keywords based on network theory.

Interview Methods

Seven full-time faculty members in the Department of Interactive Design and Game Development at the Savannah College of Art and Design were interviewed (c.f., Acknowledgments at the end of the paper). Interviews required one to two hours and began with a 5-10 minute overview of MODEL rubrics. The overview described the growth patterns for beginner, easy, practical and inspiring approaches as well as the decision type for each approach (see Table 2). During the first 10 minutes the interviewer (DKD) provided many reminders of the developmental progression, adhered "Yes, And…" rule (Sawyer, 1999), and asked questions until each concept could be understood by a beginning student. The interviews resulted in 66 dimensions.

Table 2. Growth Patterns and Meanings of Four Developmental Strategy Types

Strategy Type	Beginning	Easy	Practical	Inspiring
Growth Patterns				
Initial Frequency	High	Low	Lower	Lowest
Growth rate	Near zero	Very High	High	Moderate
Competitive Strength	Near zero	Very Low	Moderate	Very High
Meanings				
Decision	Try	Learn	Become proficient	Make contributions
Practice Time	None	A few weeks	A few years	A decade or more
Effects	Peripheral Participation	Take a little practice; get some reward	Enable living wages but no excitement	Enable Discoveries

Edited and Organized Interviews

A collective meeting of the departmental faculty removed 30 dimensions as too specialized for program evaluation and organized the remainders as in the four major sections in Table 3.

Table 3. MODEL Rubrics from ITGM interviews, collectively edited and organized.

Criteria	Beginner	Easy	Practical	Inspiring
Process: Concept/ Pre-production	**Uncritical**	**Uncertain**	**Methodical**	**Risk Taking**
Research	Have no conception that research is needed. Think the entire production comes from people's memories	Minimal research. Wait until the end of the process. Minimal research. Collect references but do not apply information to process.	Make many references. Demonstrate relationship of research to process.	Research multiple sources and apply appropriate portions to their own work.
Sources of Inspiration	Imagine computers think for them (e.g., all you need to **create** a model is to scan one in)	Believe that mastery of software sufficient for success. Limited exposure to other disciplines.	Explore other disciplines for inspiration. Realize that inspiration comes from outside the discipline	Draw inspiration from several disciplines; not pigeonholed into working with inspirations from the same media. Know the appropriateness of related disciplines, current events, and social influences.

Development Methods	Unorganized. Unaware of major steps in process. Tend to use the "one-shot" linear development method.	Show some knowledge of a design process but tends to miss steps or exclude details. Allow own idiosyncrasies to interfere with application of methods.	Meet basic requirements and show familiarity of design process. Tend to show some explorations during pre-visualization.	Surpass project requirements and explore a wide range of possibilities in design. Design documents demonstrate professionalism and work is meticulous.
Presentation of Ideas	Crude rough sketches. Exclude informative design considerations. Minimal effort in communicating any ideas.	Show representational sketches or forms with questionable details. No effort to make different sources of references into one cohesive document.	Designs and forms are polished and communicate some but not all elements/facets of design.	Presentation is polished and professional. Clear communication of all design considerations needed for a successful project.
Initial Execution	**Unskilled**	**Fragmentary**	**Usable**	**Illustrative**
Color	Use colors that don't complement each other and may actually conflict. Miss important details.	Use some colors with saturation, hue or brightness problems	Color is mostly aesthetically pleasing but does not utilize color to layout/block priorities. May be inappropriate to design considerations outside of visual aesthetics.	Color incorporation demonstrates consideration to visual aesthetics, audience, and appropriateness of genre.
Functionality	The project does not work or contains multiple errors.	The project works but is incomplete and the user experience is disrupted.	Enable the testing of the user experience.	Flow of the user experience is continuous. Functionality enhances overall design.
Visual Balance	Visual design is kept too rudimentary that balance is not a consideration.	Layout, form, detailing and composition are heavy ended in concentrated areas.	Work is visually balanced without consideration to context. However, there may be some missing components.	All visual designs are engaging and well balanced with consideration to functionality, audience and context.
Visual Rhythm	Show some application of rhythm but with missing components.	Make attempt to incorporate rhythm. Succeeds in some areas but fails in others.	Use rhythm on some important characteristics but some parts are still disjointed.	Use of rhythm takes the user through space. Create a predictable environment or connectedness within a space or composition.
Scale and Proportion	Visual proportions are off and no visual reference of scale	Can only match proportion to one perspective. Placement of objects inaccurate or prohibits functionality	Objects are proportionate within their context but not within the environment.	Almost perfect or perfect proportions. With deviations only when they enhance the experience.
Visual Harmony	Put unrelated items together.	Achieve some harmony, but parts are chaotic.	Accomplish a good visual experience, however a few details are missing or unbalanced.	Achieve a well balanced visual experience **creat**ing a high level of user engagement.
Visual Unity or Focal Point	Do not have a focal point.	Attempt to achieve unity by applying some elements of design, but missing others.	Have a definite focal point and applies most elements of design to specific objects but not necessarily the entire scene or visual.	Achieve strong unity at both the visual and conceptual level.
Theme	Non-existent or inconsistently applied to project.	Relate theme as a fan without adjustments to purpose or audience. Thematic errors to faithfulness of project.	Unified thematic applications only to visuals. Thematic metaphors for interaction and behavior may not be present.	Unified theme on visuals as well as behavioral/ interactive components.
Anatomy	Do not know the relation of forms, scale and proportions. Unable to relate to movement. Focus on parts rather than the whole.	Use tubular construction techniques with no indication of relation between mechanics and muscle. shape Creates perfectly symmetrical characters.	Create accurate anatomy, but realism falls short through some proportional mistakes Some symmetry is broken by variations in geometry or texture.	Understand forms well enough to achieve the aesthetic they want. Know how muscles function. Executes asymmetry in both geometry and texture.
Final Execution: Implementation/ Polish	**Tedious**	**Unpolished**	**Effective**	**Inspiring**
Usability	Fail to consider the user.	Sequential access to content much like a page-turner. No evidence of direct manipulation or other forms of interaction.	Support direct manipulation and other methods of interaction. A good match to the user's mental model.	User is completely immersed in environment. Affordances support flow. Successfully use commonly known devices in uncommon ways.

Dynamics (User Immersion)	Fail to achieve flow. Players play the game, but are often working to understand its mechanics or rules. Alternately, they are disengaged and don't care about playing. Possible poor choice of mechanics.	Games succeed in achieving flow or play state for a limited time before game mechanics or interface interrupt. Better mechanics may have been selected.	Games achieve flow or play state for a longer period of time. Players are disengaged or interrupted from this state due to lack of strategy, or non-optimum play mechanic choice.	Engaging play or "flow" is created. Players enjoy the experience of play thoroughly, and when finished, sincerely want to play the game again.
Game Mechanics	Poor mechanic choice to achieve hoped for play dynamic. Mechanics are heavily derivative or promote uninspiring play. Games are likely to have bugs and be unbalanced. Design may mimic existing game design.	Adequate mechanic choice to achieve hoped for play dynamic. Mechanics are derivative. Games may have a bug, and are likely to be unbalanced. Show little evidence of being adequately play tested.	Good mechanic choice to achieve hoped for play dynamic. Mechanics are not derivative, but show evidence of being selected to achieve desired dynamic. Show evidence of being tested. Likely to have minimum balance issues.	Innovative mechanic choice to achieve hoped for play dynamic. Play dynamic or game design is surprising and atypical of other submissions. Show evidence of play testing and are mostly free of balance issues.
Game Play Aesthetics (desired emotional response)	Ignore the game aesthetic or at least does not intentionally create one. Game mechanics and dynamics do not promote aesthetic.	Do not begin with aesthetic or miss key elements of it (e.g., design a cooperative game that does not allow people to talk). Game mechanics and dynamics moderately promote aesthetic.	Start with a well-realized aesthetic. Game mechanics and dynamics promote aesthetic.	Intended and realized aesthetic is carried out in all aspects of play. Game mechanics and dynamics promote aesthetic.
Game Core	Do not have a defined core or has multiple cores. Games do not focus on one thing (e.g. what is the one thing this game is about?), and their feature sets may be sprawling or non-integrated.	Games have multiple cores, and focus on one or more "key" things. Their feature sets are diluted amongst these things.	Defined core but still have some few superfluous mechanics that do not strengthen the core	Simple mechanics with a tight core. All game features strengthen the core.
Design Document	Do not create design documents or create ones that contain nothing that can be directly implemented (e.g., concepts, not concrete details). Note: do not apply to agile design which uses no documentation.	Design documents created, but lack consistency and implementable detail. Also, show lack of understanding of audience (programmers, artists and other designers) of document.	Design documents contain most necessary details for implementation and show understanding of audience.	Design documents contain all necessary details, show understanding of audience and present details in a clear, consistent manner.
Self Critique	Unable to see obvious errors.	See obvious errors but may justify them (e.g., as intent or as the best they can do).	See obvious errors and make diligent efforts to fix them.	Able to critique own work, deliberately seek out critique of others and respond with solutions beyond the critique or their past results.
Texture Mapping	Do not know what a shader is or do not know how to create proper texture maps. Apply color but do not know about other surface properties such as specularity, bump mapping, and reflection. Have failed to create a UV layout or do not know how to.	Knows what a shader is but may not know which shader type is appropriate for a given surface. Creates UV layouts but do not know how to maximize efficiency. Know what a shader is but may not know which shader type is appropriate for a given surface. Create UV layouts but do not know how to maximize efficiency	Use the appropriate shader for the given surface. Know how to affectively create texture maps to control surface properties i.e. color, secularity, bump and normal maps. Have very few inconsistencies in outcomes. Create efficient UV layouts. Know what texture baking is and occasionally uses it	Not only use the appropriate shader for a given surface but have also created new shaders. Know how to affectively create texture maps and control surface properties i.e. color, specularity, bump and normal maps. Know how to texture bake and consistently make use of it.

Believability	Have unnatural and basic forms throughout composition. Audience is painfully aware of the medium.	Able to emulate representational forms. However, detailing and functionality are inconsistent to the rest of the project.	Localized objects or elements are designed to professional standards but overall effect is broken.	Successful in achieving suspension of disbelief. Audience is more interested in content than methods of achieving it. Makes sure that all elements have the complexity and qualities to belong in the space
Application of Tools/Techniques	Unable to recognize or apply	Sticks to what they know	See something new and try to replicate it	See something new and use it in a new setting
Environment Design	Unaware of construction method such as modular design. No consistent theme/setting, focus or visual style. Many unintentional issues with scale and proportions in both modeling and textures. Flaws in most areas such as modeling, construction methods, lighting, and texturing and effects. Limited in detail or detail is not appropriate for intended outcome. Environments are static or unresponsive to player interactions. May run at undesired frame rates.	Have consistent themes/settings or foci but not both with inconsistencies in visual style. Several scale and proportional issues in modeling and texturing. Environment is still unresponsive to interaction but there may be active element (e.g., trees or flags that blow in the wind). Apply detail through textures or modeling but not both. May have begun to implement visual effects such as particles which tend to have aesthetic issues with the visual style of the environment. May run at undesired frame rates.	Have consistent themes/settings, foci and visual styles that have been developed with concerns of narrative or game play issue. Scale and proportions are accurate. Apply detail in texture and modeling. Environments have many elements that respond to player interactions. There are many active elements. Environments run at desired frame rates Have implemented visual effects such as particles with no aesthetic issues with the visual style of the environment.	Have consistent themes/settings, and foci which have been developed around narrative and game play issues with strong, well-defined visual styles. Scales and proportions are accurate or have been altered to help establish a mood or emotional response and are consistent with visual styles. Environments are highly responsive to user interaction and has many active elements. Have demonstrated the use of consistent production practices that are effective in large group environments.
Level Design	Create paths and designs without thinking through play of the level.	Focus on basic capture the flag levels without concern to game play. Concentrate on environmental beauty instead, as in architecture, stage setting and interior design, but still predictable	Think about planned uses of the level, but functionally similar to other games	Create a dynamic, open system that can be used effectively in unexpected ways
Modeling	Use only primitive objects. Do not know about different methods of modeling. I.e. box modeling. Do not know or understand issues of topology such as Edge looping. There are very limited or no visual details.	Rely on one method or technique. Know some modeling methods but typically rely on one, such as box modeling. Know about issues of topology but do not know how to effectively apply them. I.e. quads vs. triangles, Horizontal and vertical modeling, and edge looping. Visual detail is starting to be considered but is limited or applied only in texture. Tend to focus on modeling one type of object such as structural or mechanical objects.	Use multiple methods and techniques. Topology is being applied with some issues. i.e. edge looping. Mesh density is usually appropriate for the level of detail and the visual detail or complexity of the object is consistent and appropriate for its intended use. Are able to model multiple types object such as structural, mechanical and organic objects.	Use all modeling methods and techniques or develops alternative methods to achieve the final result Issues of topology are implemented well. Mesh densities are appropriate for the level of detail. Visual detail is high or appropriate for the work and its intended use. Are able to effectively model all types of objects – structural, mechanical and organic.
Lighting	Rely on default lighting	The space is lit but fails to have well defined light sources. Lighting is present but fails to add depth or dimension to the space. Do not consider light and shadow color (tends to work in only yellows white tones)	Use light and shadow color to convey a mood or a desired emotional response.	Use lighting not only to illuminate and establish a mood but to guide the viewer/player.

Visual Design Principles	Do not believe in or is unaware of principles. Allow idiosyncratic tendencies to overtake design.	Usually unable to synthesize more than a few basic principles in a project (typically color and size). Blindly follows conventions without examining effect.	Apply most visual design principles to a static environment. Start to examine principles of motion and time based elements. Incorporate some thought to audience.	Extend visual design considerations to motion and time based art. Test and break conventions without the design suffering.
Technical Skills and Software Usage	Are unfamiliar with basic tools. Have trouble understanding their application.	Button-pusher. Know the basic tools but are unable to apply.	Know the software fairly well and are able to apply the tool most of the time.	Good mastery of the toolsets. Are able to apply tools in creative ways and learn new methods of application.
File Organization	Files are unorganized. Do not use folders. Filenames are not meaningful.	Try to organize files into folders. Filenames may not be consistent. Do not meet required conventions or follow instructions.	Files are organized according to required convention or instructions.	Understand the benefit of file organization. Are able to design schemes for organizing files and manage version control.
Presentation	Need to be present to explain their work. Presentations do not stand on their own.	Presentations show work without context. Missing some information on process, techniques, or medium. Attractive but not useful. Do not understand that different delivery options (stills, movies, web sites, PowerPoint) require different formats.	Presentation styles are suitable for delivery options. They have all the necessary information but tend to be unengaging and conventional.	Demonstrate awareness of audience of the presentation and take advantage of the delivery options. Set a mood and tone to presentation in addition to the necessary information for the content.
Portfolio	Lack cohesion (elements are disjointed and randomly pulled together)	Have frequent design errors such as mixed layouts (landscape & portrait), cramped pages and misspellings.	Well-designed as a whole and within pages.	Exhibit understanding of treatment and technique in every element both within and between pages
Application of Broader Concepts	**Absent**	**Imitative**	**Questioning**	**Synthesizing**
Perspective of the Field	Unaware and/or shows lack of interest, or has incorrect perspective.	Aware of some individuals or fields but limited to what they have personally experienced.	Aware of the broader field. Are familiar with key players in the field. Are aware of the relationship between the multiple disciplines that influence the field.	Understand that interactive media is unprecedented in the history of mankind and that we are just barely beginning to explore the opportunities it will create. Identify new opportunities for human communication and life enhancement that interactive media enable. Understand how new techniques create new opportunities for profit. Entrepreneurially always looking for new techniques. Apply them to standard activities in novel ways.
Study of Masters	Only aware of examples shown or most popular works in field. Imitate what they see. Unable to articulate their own design vision.	Are familiar with some seminal works and masters of the field, but tend to stick within their time and cultural range. Need to be told or shown the sites or concept artists to start sketching from. Are not able to articulate their design vision.	Are familiar with many seminal works and masters in the field, and actively explore beyond their time and cultural range. Are able to articulate the design vision for numerous masters. Often look at what they are told to look at with no further effort.	Use individual artists from diverse times and media. Are familiar with most seminal works and masters in the field, and actively explores beyond their time and cultural range. Encourage conversation about the topic, teach others and articulate the design vision of many masters.

Trend Observation	Do not understand the impact of technology on the field. Are unaware of or do not think about trends. Rely on passively gained information about trends through lectures, readings, etc. Tend to echo what has been told to them.	Interested in technology but not as an artist. Do not bother to learn what is going on. Can distinguish relevant trends but only able to appreciate them as a consumer, not as a designer.	Do research online. Use tutorials but do not contribute to or use new sources. Start to incorporate trends into design and examine their appropriateness in new media.	Go beyond Internet research. Attend conferences, posts to forums and posts work online. Examine trends and projects to future possible uses in own discipline.
Narrative Character Building	Create characters that fail to elicit emotional responses, and are "characters" in visual appearance only.	Characters are largely based on visuals, but may occasionally show personality.	Characters have visual presence with defined personality that comes through in play.	Characters have histories, complex personalities and emotions and visuals to match. Seem well integrated into game environment.

For assessors new to a set of MODEL rubrics, assessment can take up to a minute per dimension. This is certainly justified for single projects requiring months of team input. In academic program evaluation, however, a dozen students for each of three levels is minimal. Using 36 dimensions under such conditions would result in an assessment chore of 20 hours or more. There are several ways to solve this problem. One way, illustrated in Table 4, is to organize the dimensions and use the detailed responses to write abstracts for each major category. Table 4 contains abstracted definitions for the four major categories in Table 3. Such large-scale abstracting drastically reduces the assessment time and still results in being able to discriminate 256 types of student performance. Like many simplifying solutions, this one also generates its own problems. First, inevitably, some information is lost. Second, the grouping of dimensions that emerged from the meeting might reflect “group think” rather than the collective thinking of independent members. Third, the organization might bundle strategies within dimensions that do not move together developmentally and thus cause a drop in reliability. Creating a keyword network provides a partial solution to these problems. Such a network provides an index to the interviews and an empirical test of the organization both within and between dimensions. Converging evidence from ratings of student projects will be available soon and should further resolve the issues of simplification.

Table 4. Dimensions with abstracted definitions.

	Beginner	Easy	Practical	Inspiring
	Uncritical	**Uncertain**	**Methodical**	**Risk Taking**
Process: Concept/ Pre-production	Have no conception of research, programming, aesthetics, or design guidelines. Design begin-to-end without awareness of major process steps or industry-standard methods. Make primitive drawings and models and transfer to digital format with little interaction capability. Believe critique is show and tell. Avoid critiquing others or refer only to likes / dislikes.	Forget research or leave to end of process. Know major process steps but misplace several steps. Use one or two development methods. Build larger content with limited styles and without introducing new interactivity. Misunderstand universal design criteria. Believe critiques interfere with their vision. Engage in passive or aggressive critiques.	Use many detailed images and interdisciplinary study for inspiration. Practice several design methods. Explore options to optimize them; include descriptions and concept but miss parts. Presentations are attractive to intended audiences but leave them passive. Critique approaches include understanding design principles, attempting to correct "errors", and giving clear, technical instructions.	Research masters and develop unique sources; seek inspiration from other media. Practice and continuously optimize several ITGM methods. Enhance user experiences by supporting information finding or capturing the essence of the subject or place. Seek critique and respond beyond the suggestions. Clearly describe strengths, aesthetic-design problems, and technical solutions.

Initial Execution	**Unskilled**	**Fragmentary**	**Usable**	**Illustrative**
	Projects do not work or contain multiple errors. Themes are inconsistently applied with conflicting colors and no balance. Important details are neglected. Unrelated items are put together and objects have parts that don't fit. Don't know the relation of forms, scale and proportions to movement."	Projects work but are incomplete, leaving user experiences disrupted. There are many thematic errors. Important design elements or principles are applied inconsistently or attempted but overused. Color and harmony problems exist. Many objects or characters are disproportionate or overly symmetrical.	Projects enable testing user experiences and are mostly unified. Themes are unified through most components. Design principles are applied appropriately to some important characteristics, but some essential elements are misplaced and hierarchical errors exist. Coloring is mostly right. Organic representations have meaningful asymmetrical variations in geometry or texture, but proportionality mistakes still disrupt realism.	Projects show potential beyond the initial experience. Themes are unified through all components. To enhance the user experiences, elements from one component are used in others. Organic representations include deviations from perfect proportions, asymmetry in geometry and texture. Color is flawless color and lighting both refractive and reflective.
Final Execution: Implementation Polish	**Tedious**	**Unpolished**	**Effective**	**Inspiring**
	Fail to consider usage, achieve flow, or create an aesthetic. Create complicated rules and disconnected parts. Don't question composition. Lack historical understanding of architecture. Neither create useful design documents nor know design principles. Can't apply and resist learning software and drawing tools. Miscopy demonstrated steps.	Lack research and beginning aesthetic. Focus tested, but excessive rules restrict user interest and emergent behavior. Create undistinguishable, incomplete, and unorganized objects or settings. Persevere in favorite settings despite limited audience appeal. Design documents fail to inform. See but justify errors. Know software to use but not how. Miss major demo elements.	Start with well-realized aesthetic. Flow achieved but periodically broken. Identify elements creating target emotions and interactions. Yet characters, objects, and settings though distinguishable, evoke weak emotions. Design documents contain needed details. Diligently fix errors. Use tools unreflectively without drawing enough. Understand anatomy and rendering pipelines. Try to replicate new things encountered.	Use many photographs. Realized aesthetic and flawless mechanics sustain flow with emergent behavior. Styles transport users into setting. Interdisciplinary techniques create believable objects and settings plus emotional, motile characters. Rationales for all elements clearly documented. Critique selves, seek critique, and respond effectively. Innovatively use rendering pipeline and other's innovations.
Application of Broader Concepts	**Absent**	**Imitative**	**Questioning**	**Synthesizing**
	Unaware and don't care about disciplinary structure. May know a few designers' names and their key games or websites, but unable to articulate their design vision. Don't understand technology and don't think to learn about trends. Characters fail to elicit emotional responses.	Aware of some individual companies, seminal works and masters, but stick to own time and culture. Need to be told sites or artists to sketch from. Can't articulate their design vision. Interested in technology but not as an artist. Create one-dimensional emotions. Characters must tell viewers their reactions to events.	Aware of big picture without inventing new applications. Understand synergy between graphic, broadcast and interactive design. Know seminal works and masters. Explore beyond their time and cultural. Articulate design visions for masters. Do on-line research, including forums and tutorials, without contributing. Create two-dimensional emotions (multiple scales which never conflict).	Understand interactive media creates unexplored opportunities for communication, life enhancement, and profit. Know most seminal works and masters. Explore beyond their time and culture. Articulate the design vision of many masters. Read trade magazines, attend conferences, and contribute on-line. Create three-dimensional emotions (multiple, occasionally conflicting scales) and characters that grow.

Deconstructing the Keyword Network to Test the Collective Organization of Interview Dimensions

An empirical text analysis was used to test whether the collective organization actually reflected the thinking of individuals and to create an index to the individual dimensions. The basic idea was to search for co-occurrences of keywords within each specific dimension of the interviews. As would be expected from any discipline, the number of co-occurrences produced a network too highly interconnected to provide a test. Network theory shows (c.f., Newman, 2003) that such giant network components form whenever the average number of connections between nodes exceeds one. We used this fact to solve the excessive connectedness by *deconstructing* the network.

Network Deconstruction. (a) Create a keyword network by counting the co-occurrences within a single dimension of each pair of keywords. (b) Subtract one connection from every pair of connected keywords until the average number of connections for the entire network is less than one. (c) The keywords that are still connected form the first component. (d) Remove it from the network. (e) Restore the original connections to the remaining nodes and repeat the (a) to (e) cycle until there are no more connected keywords.

Table 1. Co-occurrences

	Interviewee Dimensions				
Terms	**1**	**2**	**3**	**4**	**5**
apply	0	1	0	0	0
concept	1	1	0	0	0
creat	0	0	1	0	0
design	0	0	0	1	1
develop	0	0	0	1	0
document	0	0	0	1	1

Details and examples of the network deconstruction procedure follow.

1. Find the most frequent keywords (eliminating function words and others with little meaning)
2. Identify the co-occurrences among interviewee dimensions according to the following examples.
   a. In Table 1 *appropriate* and *concept* co-occur once in dimension 2.
   b. In Table 1 *design* and *detail* co-occur twice, in dimensions 4 and 5.
3. Create a co-occurrence matrix like the one in Table 2.
   a. Count all co-occurrences for all dimensions from all interviewees.
   b. Average the number of co-occurrences
4. Deconstruct the matrix by subtracting 1 from each cell until either the cell value is 0 or the average for the whole matrix is less than 1.
5. Re-order the terms beginning with the pair having the highest number of co-occurrences and including all terms with non-zero connections with those above it.
6. Identify the component of included words by the amount subtracted from each cell in step 5.
7. To get the next component, remove the first component cells, restore the original co-occurrences and repeat steps 4 -7.
8. Continue steps 4-8 until all cells have zero values.
9. Draw the network with the width of each

Table 2. Co-occurrence matrix

Term		use	design	visual	detail	work	miss	creat
use			9	6	6	8	5	7
design		9		6	7	5	7	3
visual		6	6		6	3	6	3
detail		6	7	6		3	4	2
work		8	5	3	3		3	2
miss		5	7	6	4	3		3
creat		7	3	3	2	2	3	
Average	4.0	6.8	5.6	4.5	3.0	2.5	3.0	2.9

Table 3. Test of Dimensions Found by Deconstruction

Component	Deconstruct Quantity	Concept	Execution
Form	2	14	19
Apply	2	10	13
Explor	1	13	4
Use & Design	4	46	149
Method	2	8	20
Emotion & Response	2	2	10
Application Layout and Color	0	15	52
Proportion & Scale	2	0	6
Achiev	2	0	25
Experience	1	1	12
Textur	1	0	22

Table 4. Test of dimensions being either concept or execution

		Concept	Execution
Concept		37	36
Mixed		71	231
Execution		1	65
Chi-sq (df, value, probability)	2	45.79	1.1E-10

connection proportional to the value in the original co-occurrence matrix for the pair of words connected (see Figure 5).

10. Test the organization against the theoretical categorization of the discipline, course descriptions or outcomes.
    a. Count total connections in each component that are in each theoretical division.
    b. Estimate expected values from the total (33% are in the Concept category and 67% in the Execution category).
    c. Separate components into groups that have more, equal or less than expected as in Table 3.
    d. Calculate the Chi-sq for the grouped dimensions, as in Table 4. If it is significant, the theory is confirmed. If not, data from student ratings might confirm it, but the interviews did not. The results clearly confirmed the concept-execution distinction.

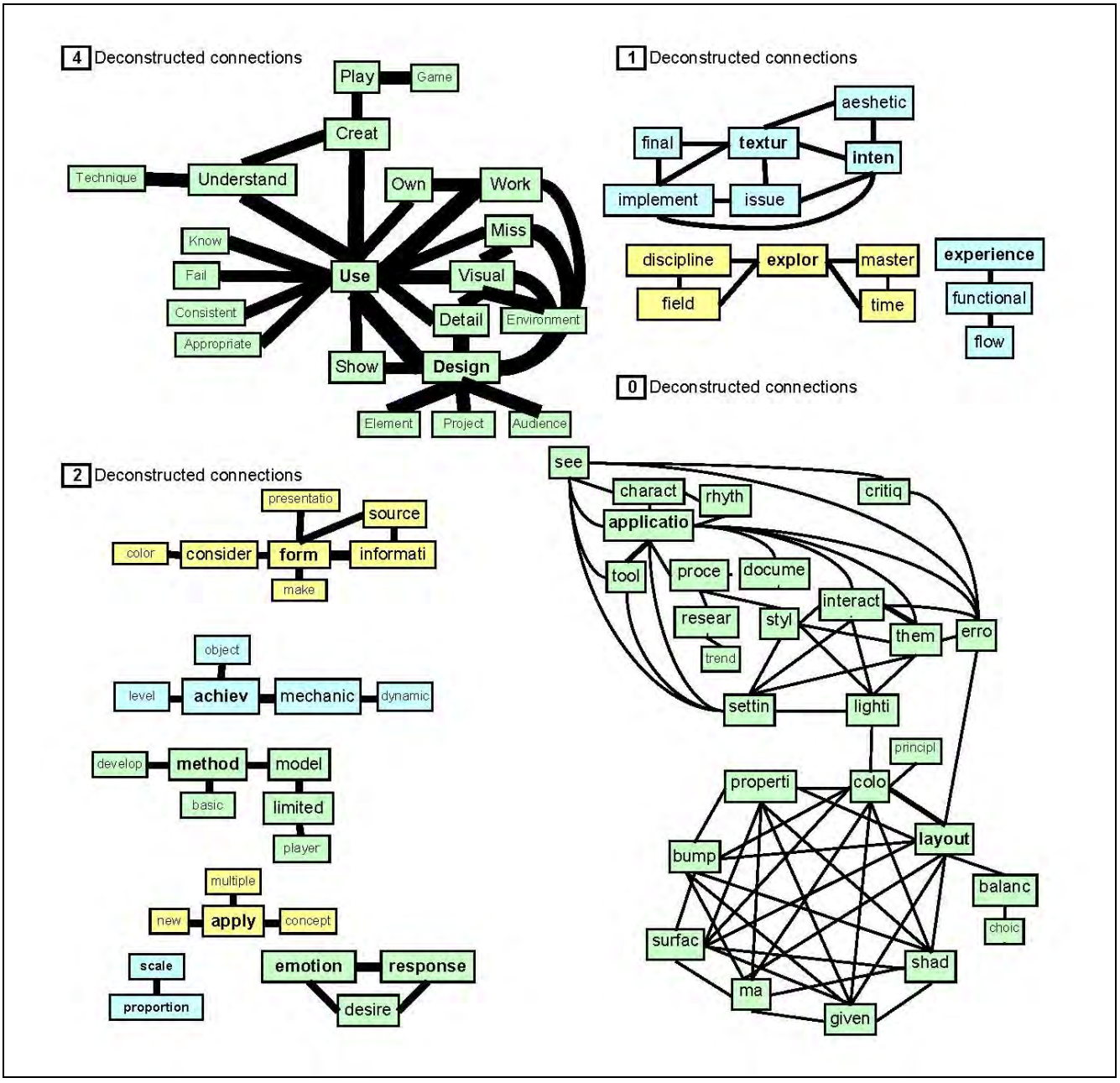


Figure 5. Deconstructed components of keywords used in interviews.

Conclusions

The interviews create a *powerful* database for assessing the development of expertise in new media, meaning that the database discriminates an enormous variety of new media performances with a relatively small amount of concept learning and discrimination. The concepts are accessible by all participants and therefore lay the groundwork for transformative relationships between people of different levels of expertise. Innovation occurs when previously independent transformations are connected. This occurs haphazardly or through knowledge of the structure of related disciplines.

A clue to the naturally understood structure of a discipline lies in the network of key words that experts use to describe it. Once the networks have matured to an expert level, deconstructing them is the most transparent way to recover their inherent organization. The resulting keyword networks index the thinking of the experts, so that users can readily link them to course descriptions, student-learning outcomes of courses, and new media design documents. Deconstructed keyword networks also provide a tool for empirically testing theoretical statements made in the process of defining and clarifying expert knowledge. For example, the network in Figure 5 was compared with networks constructed at the Savannah College of Art and Design for Foundations (18 interviews), Architecture (9 interviews) and Industrial Design (4 interviews). The comparison revealed that there are a small number of ways that the knowledge in different disciplines are organized and that these ways differ from one discipline to another.

It is reasonable to hypothesize about keyword networks that the most connected component is the most general while the least connected component is the most specialized. The components in Figure 5 (also see the Deconstruction Quantities in Table 3) suggest that new media expertise is organized in the following way. The highest level includes a set of interrelated basic terms useful for both conception and execution of designs (the *Use and Design* component). It transforms into a group of fragmented sets useful for either conception or execution. Ultimately, it transforms again to an even more integrated set of terms useful for both conception and execution. Interviews from other disciplines did not show the return to integrated terms. This difference was not an artifact of the number of dimensions studied because it was true regardless of whether the other disciplines included a much larger number of dimensions (Foundations with 172) or a comparable number (Industrial Design with 43). It will be fascinating to see if this organization is borne out in the ratings of student work from beginning, midpoint and capstone undergraduate to MA and MFA graduates.

The new media study provides interesting data for reflecting on Integrated Assessment Theory using Cole's criteria for cultural psychology. First, through the interviews it taps deeply the local and disciplinary cultural context of assessment. Eventually changes in the database and in student performance will provide an historical understanding, which we will be able to analyze by a fractal application of IAT's four principles. The methodology of defining assessment instruments and analyzing frequencies according to established laws provides a solid scientific basis. When faculty provide the interview results either in the form of the abstracted definitions (Table 4) or original interviews (Table 3), students as well as faculty can evaluate their work and comment on the instrument. This is an important step toward making the process one where practitioners are both participant and analyst.

Competence as defined here is not a developmental issue and performance becomes developmental only as people integrate it into their transformative decisions. Consequently, IAT becomes fundamentally developmental only within the transformation and integration goals. One of IAT's most important implications is that to get beyond treating students or employees like products or production workers requires attention to the decisions and discoveries that they make. To do so, assessors must have the goals to of assessing transformation or innovation. The interdisciplinary nature of IAT is evident in its ties to industrial design (Kano), psychophysics (Stevens), human factors research (the power law of practice), ecology (law of succession), network theory and creativity research.

Last and most important is IAT's continued contribution to new media programs, through (a) developing, organizing and testing interview databases, (b) developing and using assessment instruments based on it, and (c) ultimately stimulating student and expert innovations in new media practice. Involvement by new media professionals beyond academia will be a short-term measure of the success of this approach. The ultimate measure will be for students and other users to transcend top-down assessment by collaboratively creating and using MODEL rubrics in their social networking, self-created content, and scholarship.

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Procedure for Deconstructing a Keyword Network using MS Excel

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Figure 1. Count occurrences using formula in formula bar. Highlight cells with data from each name to the bottom of the interviews (f2:??##). The cell with the bold box is the focus of each instruction Figure given below.

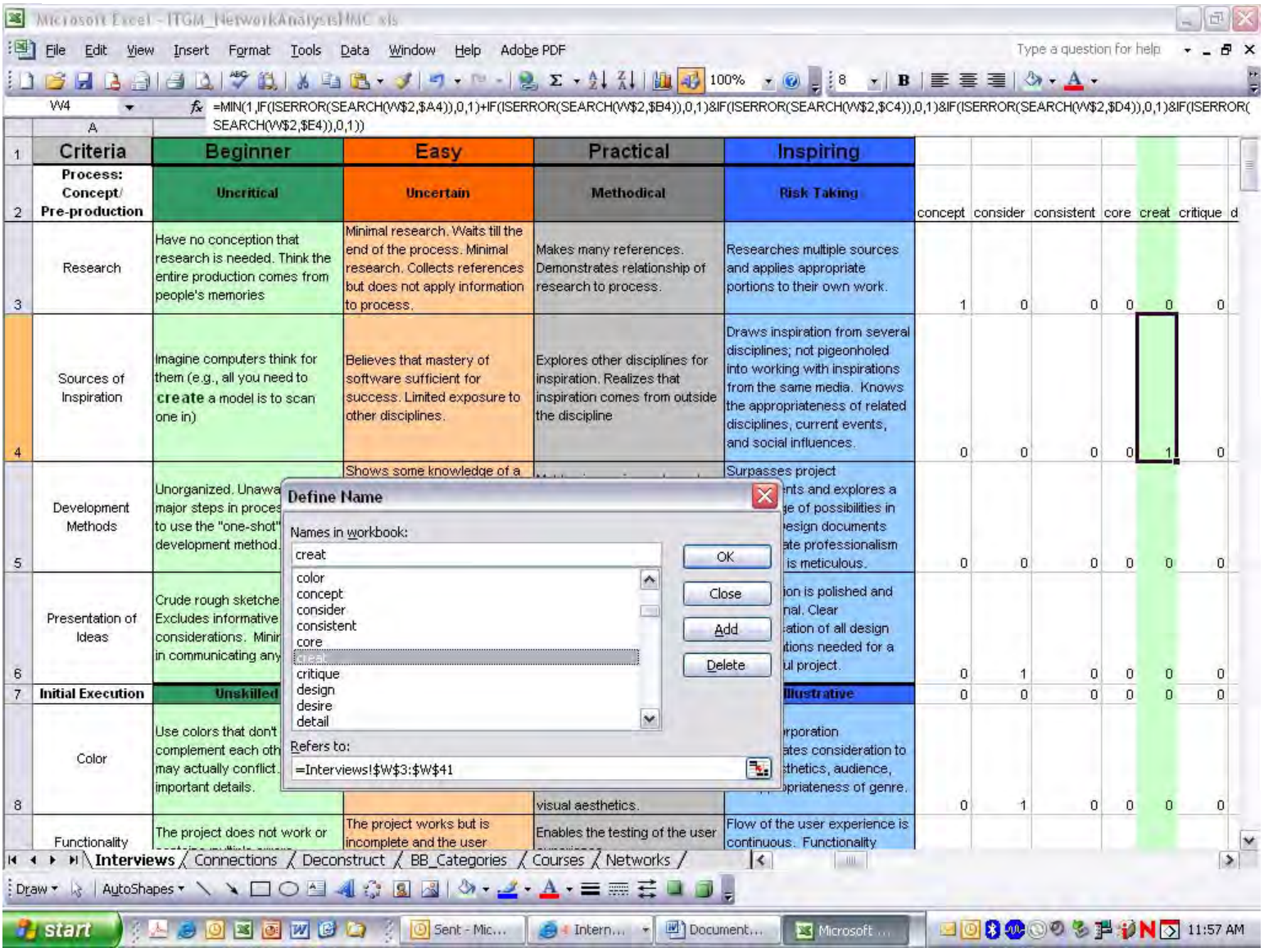
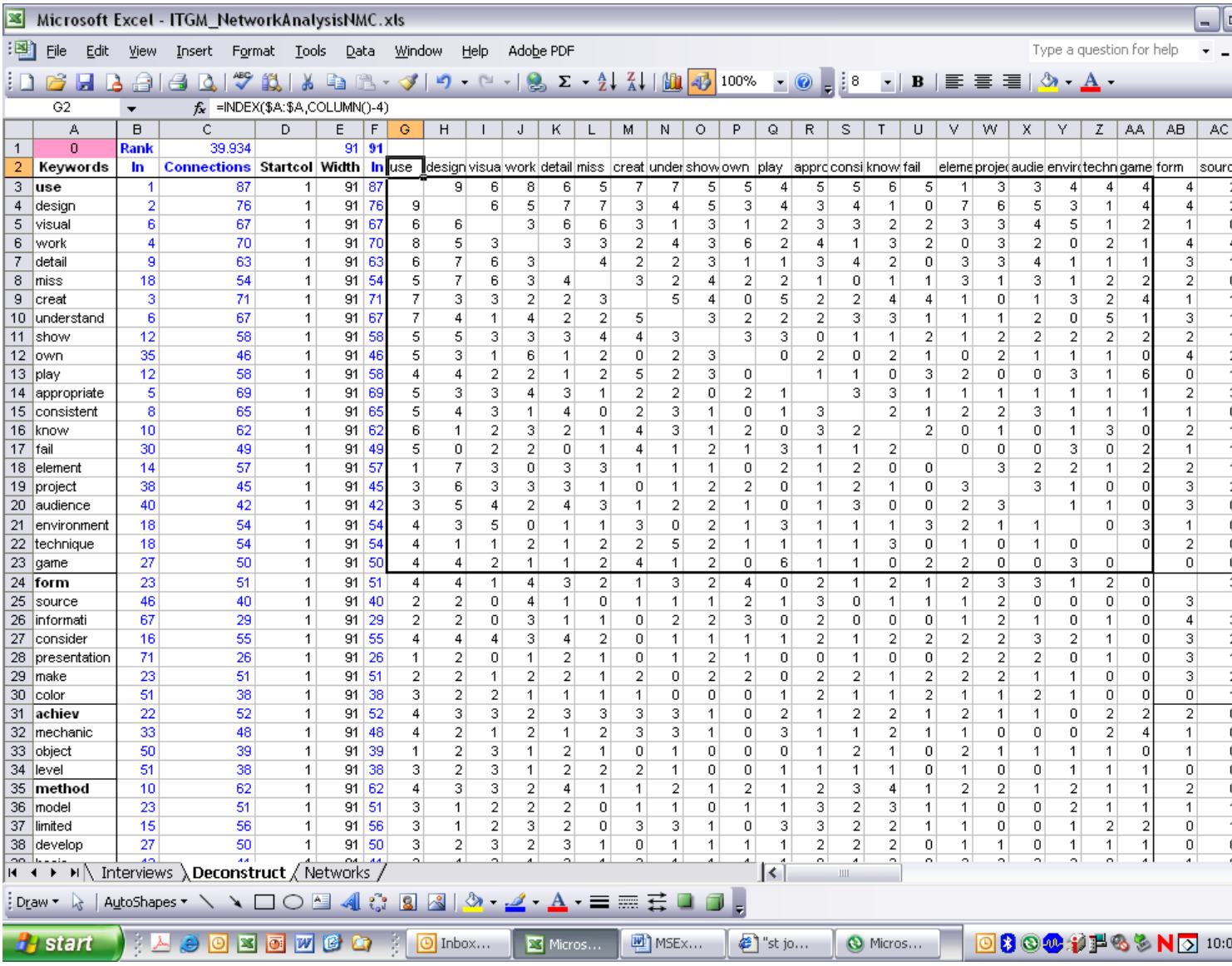
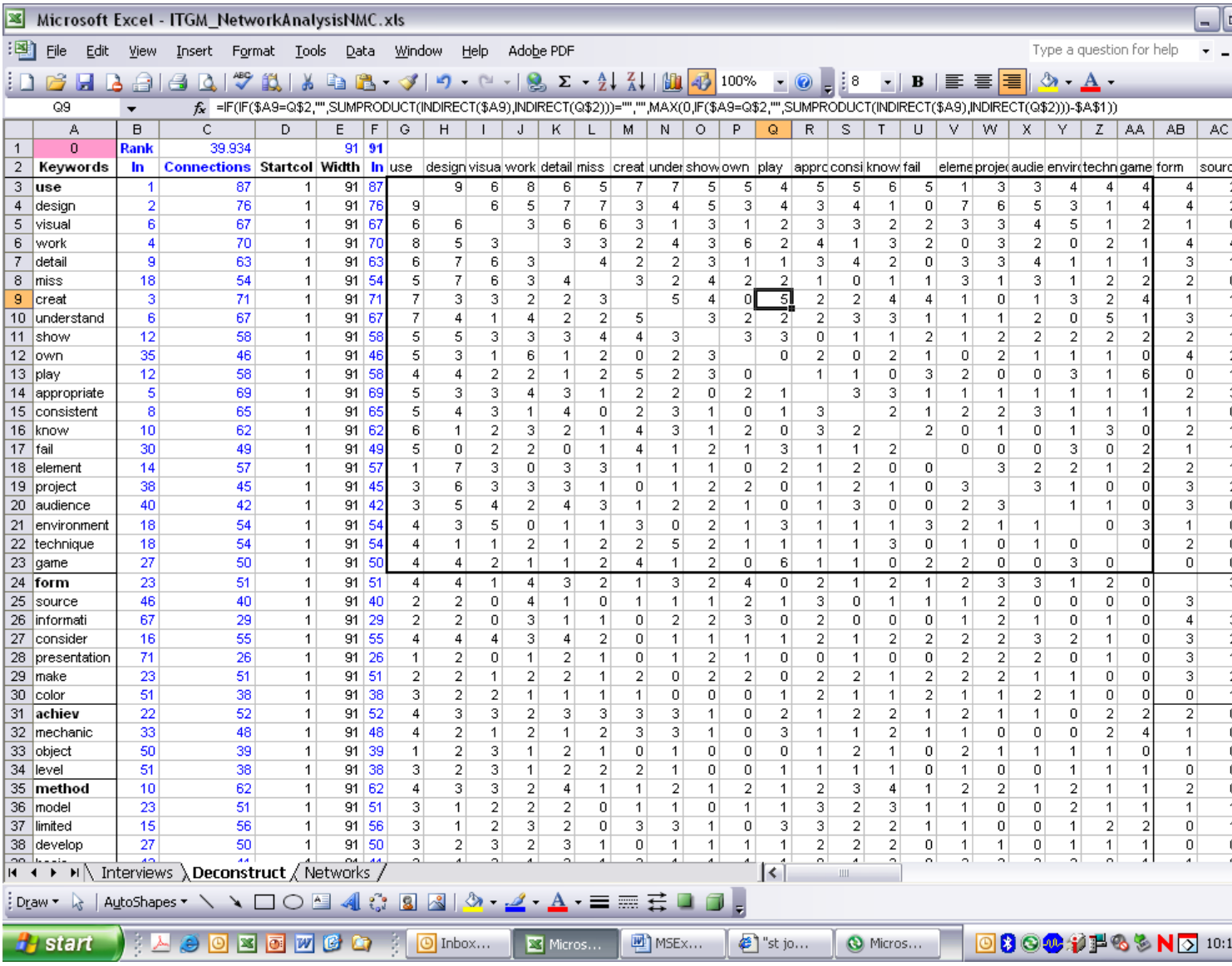


Figure 2. Make a new page called “Deconstruct.” Copy the keyword names from the page in Figure 1 (from Interviews:G2 across) and paste special these to Deconstruct:A3 down. Key in the formula at Deconstruct:G2 and copy it across to automatically keep the columns in line with the rows. This step is essential for sorting the rows as in Figure 9.



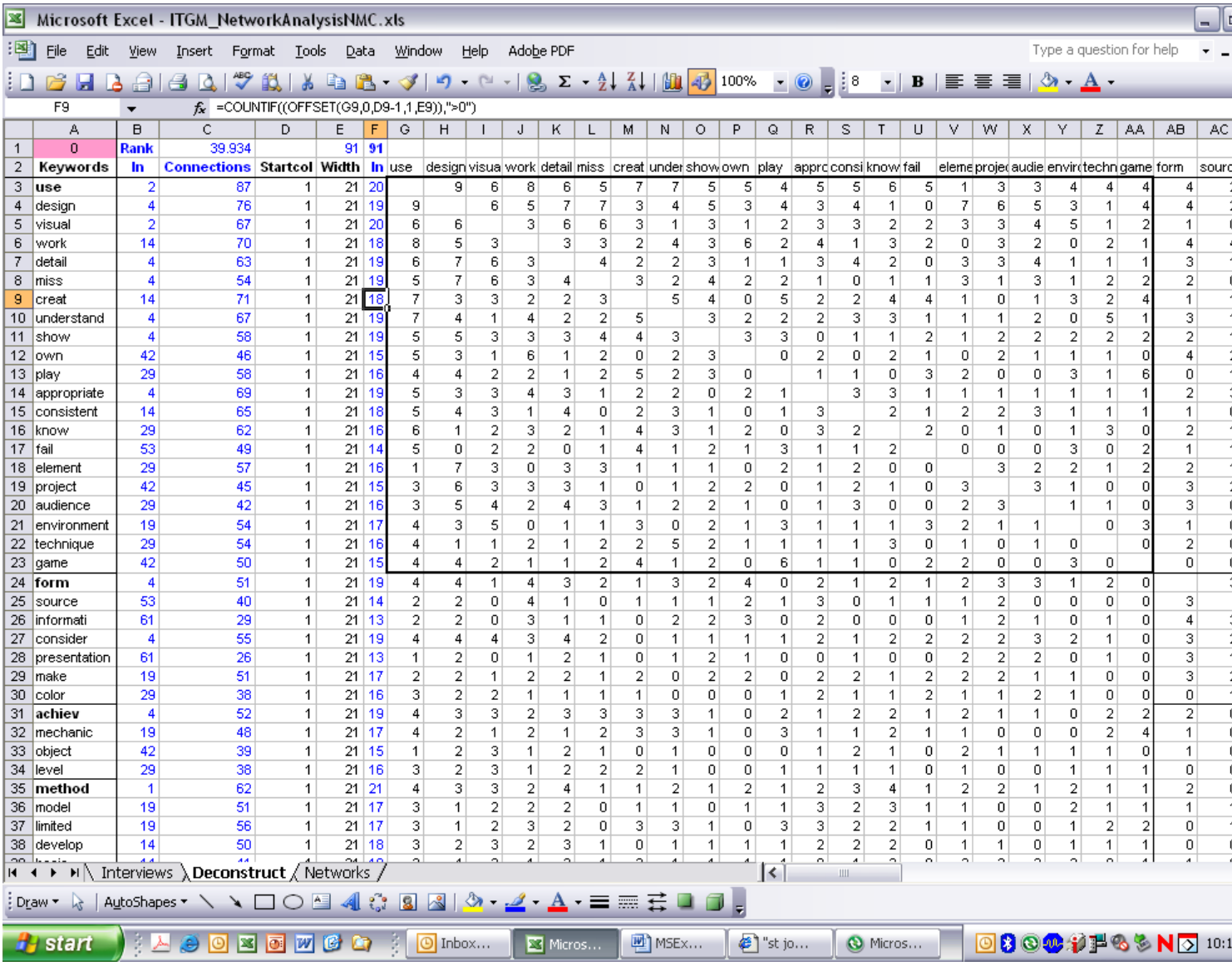
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	0	Rank	39.934		91	91																							
2	Keywords	In	Connections	Startcol	Width	In	use	design	visua	work	detail	miss	creat	under	show	own	play	apprc	consi	know	fail	eleme	proje	audie	envir	techn	game	form	sourc
3	**use**	1	87	1	91	87		9	6	8	6	5	7	7	5	5	4	5	5	6	5	1	3	3	4	4	4	4	
4	design	2	76	1	91	76	9		6	5	7	7	3	4	5	3	4	3	4	1	0	7	6	5	3	1	4	4	
5	visual	6	67	1	91	67	6	6		3	6	6	3	1	3	1	2	3	3	2	2	3	3	4	5	1	2	1	
6	work	4	70	1	91	70	8	5	3		3	3	2	4	3	6	2	4	1	3	2	0	3	2	0	2	1	4	
7	detail	9	63	1	91	63	6	7	6	3		4	2	2	3	1	1	3	4	2	0	3	3	4	1	1	1	3	
8	miss	18	54	1	91	54	5	7	6	3	4		3	2	4	2	2	1	0	1	1	3	1	3	1	2	2	2	
9	creat	3	71	1	91	71	7	3	3	2	2	3		5	4	0	5	2	2	4	4	1	0	1	3	2	4	1	
10	understand	6	67	1	91	67	7	4	1	4	2	2	5		3	2	2	2	3	3	1	1	1	2	0	5	1	3	
11	show	12	58	1	91	58	5	5	3	3	3	4	4	3		3	3	0	1	1	2	1	2	2	2	2	2	2	
12	own	35	46	1	91	46	5	3	1	6	1	2	0	2	3		0	2	0	2	1	0	2	1	1	1	0	4	
13	play	12	58	1	91	58	4	4	2	2	1	2	5	2	3	0		1	1	0	3	2	0	0	3	1	6	0	
14	appropriate	5	69	1	91	69	5	3	3	4	3	1	2	2	0	2	1		3	3	1	1	1	1	1	1	1	2	
15	consistent	8	65	1	91	65	5	4	3	1	4	0	2	3	1	0	1	3		2	1	2	2	3	1	1	1	1	
16	know	10	62	1	91	62	6	1	2	3	2	1	4	3	1	2	0	3	2		2	0	1	0	1	3	0	2	
17	fail	30	49	1	91	49	5	0	2	2	0	1	4	1	2	1	3	1	1	2		0	0	0	3	0	2	1	
18	element	14	57	1	91	57	1	7	3	0	3	3	1	1	1	0	2	1	2	0	0		3	2	2	1	2	2	
19	project	38	45	1	91	45	3	6	3	3	3	1	0	1	2	2	0	1	2	1	0	3		3	1	0	0	3	
20	audience	40	42	1	91	42	3	5	4	2	4	3	1	2	2	1	0	1	3	0	0	2	3		1	1	0	3	
21	environment	18	54	1	91	54	4	3	5	0	1	1	3	0	2	1	3	1	1	1	3	2	1	1		0	3	1	
22	technique	18	54	1	91	54	4	1	1	2	1	2	2	5	2	1	1	1	1	3	0	1	0	1	0		0	2	
23	game	27	50	1	91	50	4	4	2	1	1	2	4	1	2	0	6	1	1	0	2	2	0	0	3	0		0	
24	**form**	23	51	1	91	51	4	4	1	4	3	2	1	3	2	4	0	2	1	2	1	2	3	3	1	2	0		
25	source	46	40	1	91	40	2	2	0	4	1	0	1	1	1	2	1	3	0	1	1	1	2	0	0	0	0	3	
26	informati	67	29	1	91	29	2	2	0	3	1	1	0	2	2	3	0	2	0	0	0	1	2	1	0	1	0	4	
27	consider	16	55	1	91	55	4	4	4	3	4	2	0	1	1	1	1	2	1	2	2	2	2	3	2	1	0	3	
28	presentation	71	26	1	91	26	1	2	0	1	2	1	0	1	2	1	0	0	1	0	0	2	2	2	0	1	0	3	
29	make	23	51	1	91	51	2	2	1	2	2	1	2	0	2	2	0	2	2	1	2	2	2	1	1	0	0	3	
30	color	51	38	1	91	38	3	2	2	1	1	1	1	0	0	0	1	2	1	1	2	1	1	2	1	0	0	0	
31	**achiev**	22	52	1	91	52	4	3	3	2	3	3	3	3	1	0	2	1	2	2	1	2	1	1	0	2	2	2	
32	mechanic	33	48	1	91	48	4	2	1	2	1	2	3	3	1	0	3	1	1	2	1	1	0	0	0	2	4	1	
33	object	50	39	1	91	39	1	2	3	1	2	1	0	1	0	0	0	1	2	1	0	2	1	1	1	1	0	1	
34	level	51	38	1	91	38	3	2	3	1	2	2	2	1	0	0	1	1	1	1	0	1	0	0	1	1	1	0	
35	**method**	10	62	1	91	62	4	3	3	2	4	1	1	2	1	2	1	2	3	4	1	2	2	1	2	1	1	2	
36	model	23	51	1	91	51	3	1	2	2	2	0	1	1	0	1	1	3	2	3	1	1	0	0	2	1	1	1	
37	limited	15	56	1	91	56	3	1	2	3	2	0	3	3	1	0	3	3	2	2	1	1	0	0	1	2	2	0	
38	develop	27	50	1	91	50	3	2	3	2	3	1	0	1	1	1	1	2	2	2	0	1	1	0	1	1	1	0	

Figure 3. The formula in Q9 will calculate all the co-occurrences of keywords. Copy it from G3 to cover all the keywords.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	0	Rank	39.934		91	91																							
2	Keywords	In	Connections	Startcol	Width	In	use	design	visua	work	detail	miss	creat	under	show	own	play	appro	consi	know	fail	eleme	proje	audie	envir	techn	game	form	sourc
3	use	1	87	1	91	87		9	6	8	6	5	7	7	5	5	4	5	5	6	5	1	3	3	4	4	4	4	
4	design	2	76	1	91	76	9		6	5	7	7	3	4	5	3	4	3	4	1	0	7	6	5	3	1	4	4	
5	visual	6	67	1	91	67	6	6		3	6	6	3	1	3	1	2	3	3	2	2	3	3	4	5	1	2	1	
6	work	4	70	1	91	70	8	5	3		3	3	2	4	3	6	2	4	1	3	2	0	3	2	0	2	1	4	
7	detail	9	63	1	91	63	6	7	6	3		4	2	2	3	1	1	3	4	2	0	3	3	4	1	1	1	3	
8	miss	18	54	1	91	54	5	7	6	3	4		3	2	4	2	2	1	0	1	1	3	1	3	1	2	2	2	
9	creat	3	71	1	91	71	7	3	3	2	2	3		5	4	0	5	2	2	4	4	1	0	1	3	2	4	1	
10	understand	6	67	1	91	67	7	4	1	4	2	2	5		3	2	2	2	3	3	1	1	1	2	0	5	1	3	
11	show	12	58	1	91	58	5	5	3	3	3	4	4	3		3	3	0	1	1	2	1	2	2	2	2	2	2	
12	own	35	46	1	91	46	5	3	1	6	1	2	0	2	3		0	2	0	2	1	0	2	1	1	1	0	4	
13	play	12	58	1	91	58	4	4	2	2	1	2	5	2	3	0		1	1	0	3	2	0	0	3	1	6	0	
14	appropriate	5	69	1	91	69	5	3	3	4	3	1	2	2	0	2	1		3	3	1	1	1	1	1	1	1	2	
15	consistent	8	65	1	91	65	5	4	3	1	4	0	2	3	1	0	1	3		2	1	2	2	3	1	1	1	1	
16	know	10	62	1	91	62	6	1	2	3	2	1	4	3	1	2	0	3	2		2	0	1	0	1	3	0	2	
17	fail	30	49	1	91	49	5	0	2	2	0	1	4	1	2	1	3	1	1	2		0	0	0	3	0	2	1	
18	element	14	57	1	91	57	1	7	3	0	3	3	1	1	1	0	2	1	2	0	0		3	2	2	1	2	2	
19	project	38	45	1	91	45	3	6	3	3	3	1	0	1	2	2	0	1	2	1	0	3		3	1	0	0	3	
20	audience	40	42	1	91	42	3	5	4	2	4	3	1	2	2	1	0	1	3	0	0	2	3		1	1	0	3	
21	environment	18	54	1	91	54	4	3	5	0	1	1	3	0	2	1	3	1	1	1	3	2	1	1		0	3	1	
22	technique	18	54	1	91	54	4	1	1	2	1	2	2	5	2	1	1	1	1	3	0	1	0	1	0		0	2	
23	game	27	50	1	91	50	4	4	2	1	1	2	4	1	2	0	6	1	1	0	2	2	0	0	3	0		0	
24	form	23	51	1	91	51	4	4	1	4	3	2	1	3	2	4	0	2	1	2	1	2	3	3	1	2	0		
25	source	46	40	1	91	40	2	2	0	4	1	0	1	1	1	2	1	3	0	1	1	1	2	0	0	0	0	3	
26	informati	67	29	1	91	29	2	2	0	3	1	1	0	2	2	3	0	2	0	0	0	1	2	1	0	1	0	4	
27	consider	16	55	1	91	55	4	4	4	3	4	2	0	1	1	1	1	2	1	2	2	2	2	3	2	1	0	3	
28	presentation	71	26	1	91	26	1	2	0	1	2	1	0	1	2	1	0	0	1	0	0	2	2	2	0	1	0	3	
29	make	23	51	1	91	51	2	2	1	2	2	1	2	0	2	2	0	2	2	1	2	2	2	1	1	0	0	3	
30	color	51	38	1	91	38	3	2	2	1	1	1	1	0	0	0	1	2	1	1	2	1	1	2	1	0	0	0	
31	achiev	22	52	1	91	52	4	3	3	2	3	3	3	3	1	0	2	1	2	2	1	2	1	1	0	2	2	2	
32	mechanic	33	48	1	91	48	4	2	1	2	1	2	3	3	1	0	3	1	1	2	1	1	0	0	0	2	4	1	
33	object	50	39	1	91	39	1	2	3	1	2	1	0	1	0	0	0	1	2	1	0	2	1	1	1	1	0	1	
34	level	51	38	1	91	38	3	2	3	1	2	2	2	1	0	0	1	1	1	1	0	1	0	0	1	1	1	0	
35	method	10	62	1	91	62	4	3	3	2	4	1	1	2	1	2	1	2	3	4	1	2	2	1	2	1	1	2	
36	model	23	51	1	91	51	3	1	2	2	2	0	1	1	0	1	1	3	2	3	1	1	0	0	2	1	1	1	
37	limited	15	56	1	91	56	3	1	2	3	2	0	3	3	1	0	3	3	2	2	1	1	0	0	1	2	2	0	
38	develop	27	50	1	91	50	3	2	3	2	3	1	0	1	1	1	1	2	2	2	0	1	1	0	1	1	1	0	

Figure 4. Column F counts the number of values to the right that are in the range specified by Startcol (column D) and Width (column E). The formulas in D and E simply copy the number entered above (the values at the top of each component will be manually entered like the 1 in D3 and 21 in E3).



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
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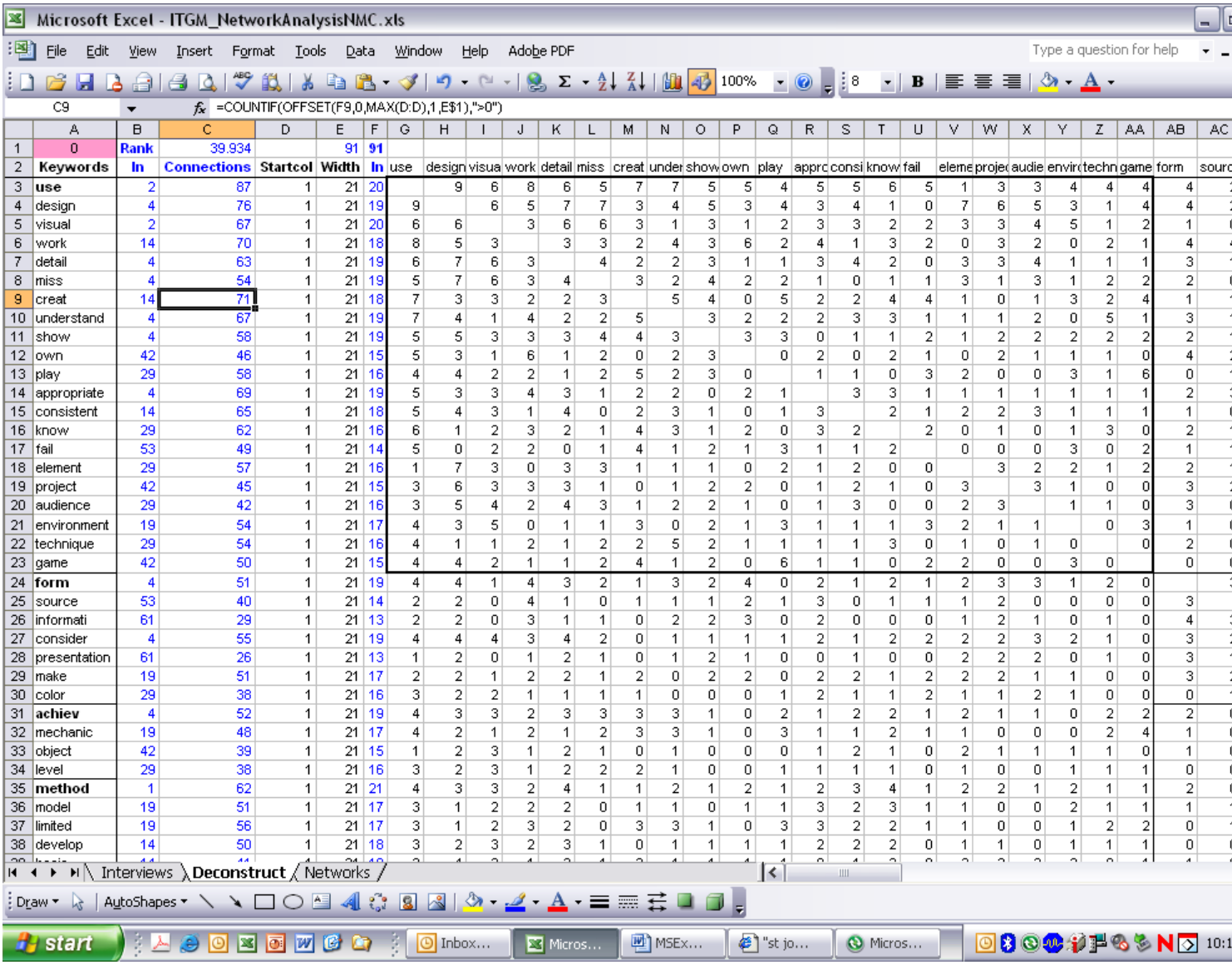
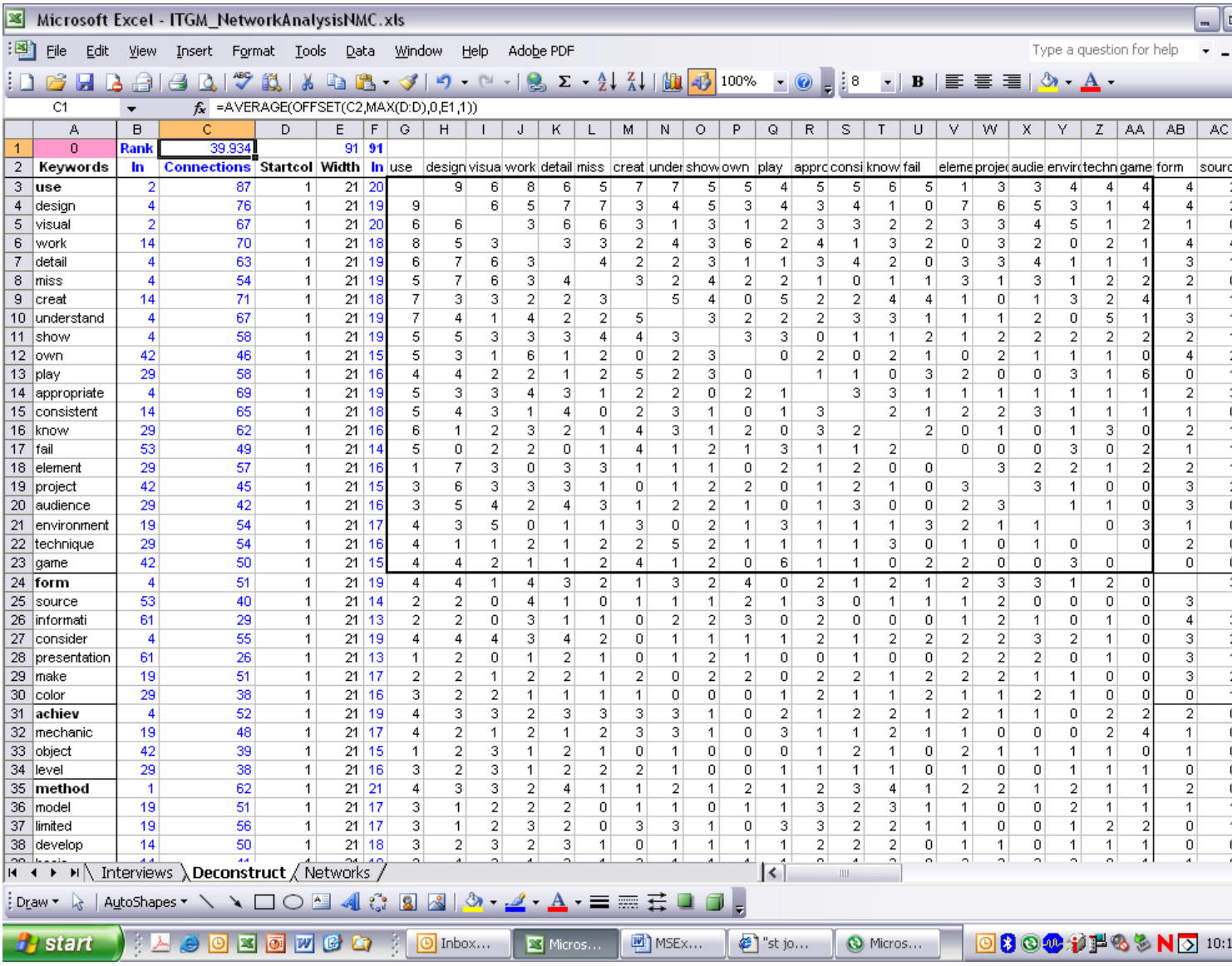
2	Keywords	In	Connections	Startcol	Width	In	use	design	visua	work	detail	miss	creat	under	show	own	play	apprc	consi	know	fail	eleme	proje	audie	envir	techn	game	form	sourc
3	**use**	2	87	1	21	20		9	6	8	6	5	7	7	5	5	4	5	5	6	5	1	3	3	4	4	4	4	
4	design	4	76	1	21	19	9		6	5	7	7	3	4	5	3	4	3	4	1	0	7	6	5	3	1	4	4	
5	visual	2	67	1	21	20	6	6		3	6	6	3	1	3	1	2	3	3	2	2	3	3	4	5	1	2	1	
6	work	14	70	1	21	18	8	5	3		3	3	2	4	3	6	2	4	1	3	2	0	3	2	0	2	1	4	
7	detail	4	63	1	21	19	6	7	6	3		4	2	2	3	1	1	3	4	2	0	3	3	4	1	1	1	3	
8	miss	4	54	1	21	19	5	7	6	3	4		3	2	4	2	2	1	0	1	1	3	1	3	1	2	2	2	
9	creat	14	71	1	21	18	7	3	3	2	2	3		5	4	0	5	2	2	4	4	1	0	1	3	2	4	1	
10	understand	4	67	1	21	19	7	4	1	4	2	2	5		3	2	2	2	3	3	1	1	1	2	0	5	1	3	
11	show	4	58	1	21	19	5	5	3	3	3	4	4	3		3	3	0	1	1	2	1	2	2	2	2	2	2	
12	own	42	46	1	21	15	5	3	1	6	1	2	0	2	3		0	2	0	2	1	0	2	1	1	1	0	4	
13	play	29	58	1	21	16	4	4	2	2	1	2	5	2	3	0		1	1	0	3	2	0	0	3	1	6	0	
14	appropriate	4	69	1	21	19	5	3	3	4	3	1	2	2	0	2	1		3	3	1	1	1	1	1	1	1	2	
15	consistent	14	65	1	21	18	5	4	3	1	4	0	2	3	1	0	1	3		2	1	2	2	3	1	1	1	1	
16	know	29	62	1	21	16	6	1	2	3	2	1	4	3	1	2	0	3	2		2	0	1	0	1	3	0	2	
17	fail	53	49	1	21	14	5	0	2	2	0	1	4	1	2	1	3	1	1	2		0	0	0	3	0	2	1	
18	element	29	57	1	21	16	1	7	3	0	3	3	1	1	1	0	2	1	2	0	0		3	2	2	1	2	2	
19	project	42	45	1	21	15	3	6	3	3	3	1	0	1	2	2	0	1	2	1	0	3		3	1	0	0	3	
20	audience	29	42	1	21	16	3	5	4	2	4	3	1	2	2	1	0	1	3	0	0	2	3		1	1	0	3	
21	environment	19	54	1	21	17	4	3	5	0	1	1	3	0	2	1	3	1	1	1	3	2	1	1		0	3	1	
22	technique	29	54	1	21	16	4	1	1	2	1	2	2	5	2	1	1	1	1	3	0	1	0	1	0		0	2	
23	game	42	50	1	21	15	4	4	2	1	1	2	4	1	2	0	6	1	1	0	2	2	0	0	3	0		0	
24	**form**	4	51	1	21	19	4	4	1	4	3	2	1	3	2	4	0	2	1	2	1	2	3	3	1	2	0		
25	source	53	40	1	21	14	2	2	0	4	1	0	1	1	1	2	1	3	0	1	1	1	2	0	0	0	0	3	
26	informati	61	29	1	21	13	2	2	0	3	1	1	0	2	2	3	0	2	0	0	0	1	2	1	0	1	0	4	
27	consider	4	55	1	21	19	4	4	4	3	4	2	0	1	1	1	1	2	1	2	2	2	2	3	2	1	0	3	
28	presentation	61	26	1	21	13	1	2	0	1	2	1	0	1	2	1	0	0	1	0	0	2	2	2	0	1	0	3	
29	make	19	51	1	21	17	2	2	1	2	2	1	2	0	2	2	0	2	2	1	2	2	2	1	1	0	0	3	
30	color	29	38	1	21	16	3	2	2	1	1	1	1	0	0	0	1	2	1	1	2	1	1	2	1	0	0	0	
31	**achiev**	4	52	1	21	19	4	3	3	2	3	3	3	3	1	0	2	1	2	2	1	2	1	1	0	2	2	2	
32	mechanic	19	48	1	21	17	4	2	1	2	1	2	3	3	1	0	3	1	1	2	1	1	0	0	0	2	4	1	
33	object	42	39	1	21	15	1	2	3	1	2	1	0	1	0	0	0	1	2	1	0	2	1	1	1	1	0	1	
34	level	29	38	1	21	16	3	2	3	1	2	2	2	1	0	0	1	1	1	1	0	1	0	0	1	1	1	0	
35	**method**	1	62	1	21	21	4	3	3	2	4	1	1	2	1	2	1	2	3	4	1	2	2	1	2	1	1	2	
36	model	19	51	1	21	17	3	1	2	2	2	0	1	1	0	1	1	3	2	3	1	1	0	0	2	1	1	1	
37	limited	19	56	1	21	17	3	1	2	3	2	0	3	3	1	0	3	3	2	2	1	1	0	0	1	2	2	0	
38	develop	14	50	1	21	18	3	2	3	2	3	1	0	1	1	1	1	2	2	2	0	1	1	0	1	1	1	0	

Figure 5. Column C counts all the connections to the keyword.



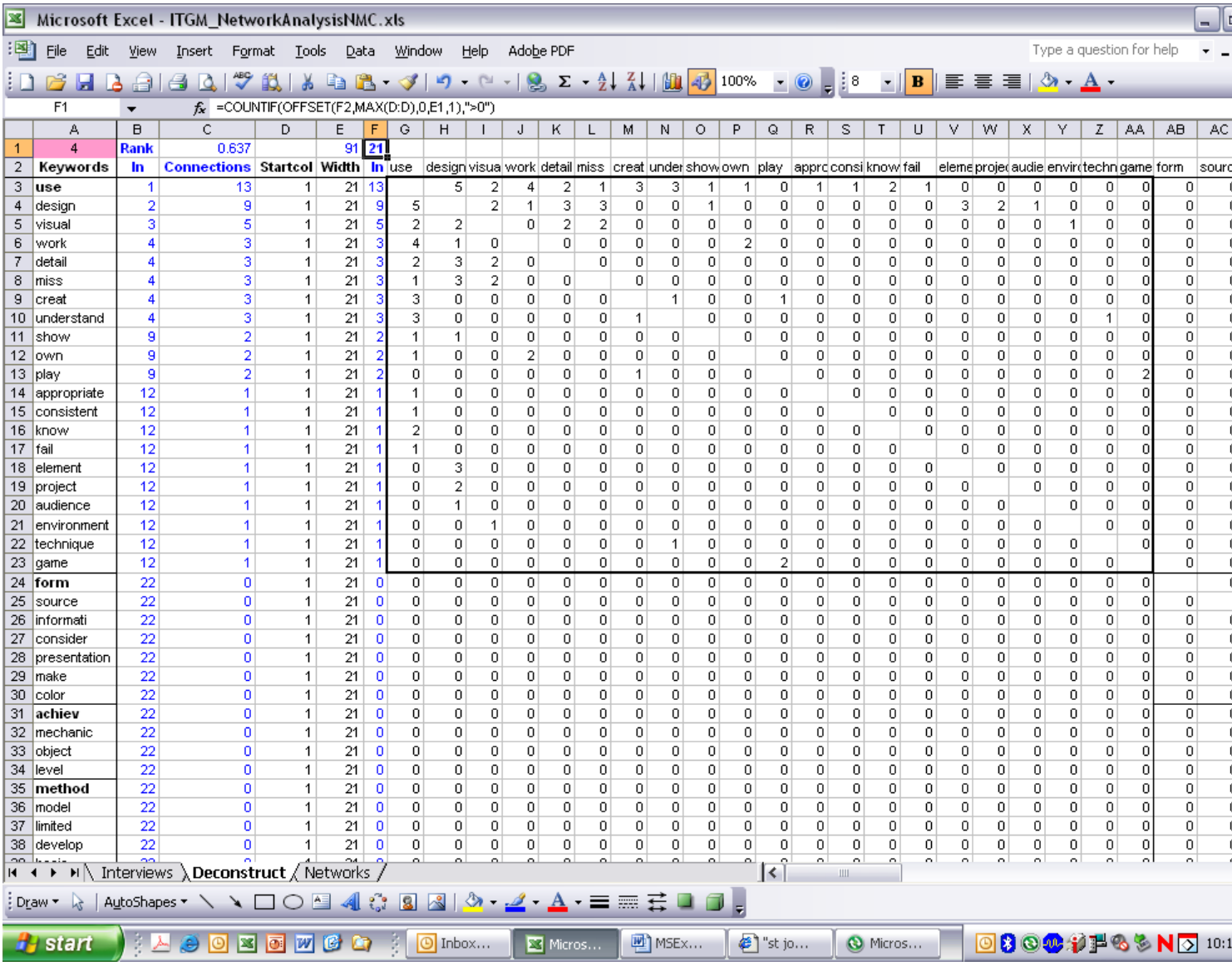
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	0	Rank	39.934		91	91																							
2	Keywords	In	Connections	Startcol	Width	In	use	design	visua	work	detail	miss	creat	under	show	own	play	apprc	consi	know	fail	eleme	proje	audie	envir	techn	game	form	sourc
3	use	2	87	1	21	20		9	6	8	6	5	7	7	5	5	4	5	5	6	5	1	3	3	4	4	4	4	
4	design	4	76	1	21	19	9		6	5	7	7	3	4	5	3	4	3	4	1	0	7	6	5	3	1	4	4	
5	visual	2	67	1	21	20	6	6		3	6	6	3	1	3	1	2	3	3	2	2	3	3	4	5	1	2	1	
6	work	14	70	1	21	18	8	5	3		3	3	2	4	3	6	2	4	1	3	2	0	3	2	0	2	1	4	
7	detail	4	63	1	21	19	6	7	6	3		4	2	2	3	1	1	3	4	2	0	3	3	4	1	1	1	3	
8	miss	4	54	1	21	19	5	7	6	3	4		3	2	4	2	2	1	0	1	1	3	1	3	1	2	2	2	
9	creat	14	71	1	21	18	7	3	3	2	2	3		5	4	0	5	2	2	4	4	1	0	1	3	2	4	1	
10	understand	4	67	1	21	19	7	4	1	4	2	2	5		3	2	2	2	3	3	1	1	1	2	0	5	1	3	
11	show	4	58	1	21	19	5	5	3	3	3	4	4	3		3	3	0	1	1	2	1	2	2	2	2	2	2	
12	own	42	46	1	21	15	5	3	1	6	1	2	0	2	3		0	2	0	2	1	0	2	1	1	1	0	4	
13	play	29	58	1	21	16	4	4	2	2	1	2	5	2	3	0		1	1	0	3	2	0	0	3	1	6	0	
14	appropriate	4	69	1	21	19	5	3	3	4	3	1	2	2	0	2	1		3	3	1	1	1	1	1	1	1	2	
15	consistent	14	65	1	21	18	5	4	3	1	4	0	2	3	1	0	1	3		2	1	2	2	3	1	1	1	1	
16	know	29	62	1	21	16	6	1	2	3	2	1	4	3	1	2	0	3	2		2	0	1	0	1	3	0	2	
17	fail	53	49	1	21	14	5	0	2	2	0	1	4	1	2	1	3	1	1	2		0	0	0	3	0	2	1	
18	element	29	57	1	21	16	1	7	3	0	3	3	1	1	1	0	2	1	2	0	0		3	2	2	1	2	2	
19	project	42	45	1	21	15	3	6	3	3	3	1	0	1	2	2	0	1	2	1	0	3		3	1	0	0	3	
20	audience	29	42	1	21	16	3	5	4	2	4	3	1	2	2	1	0	1	3	0	0	2	3		1	1	0	3	
21	environment	19	54	1	21	17	4	3	5	0	1	1	3	0	2	1	3	1	1	1	3	2	1	1		0	3	1	
22	technique	29	54	1	21	16	4	1	1	2	1	2	2	5	2	1	1	1	1	3	0	1	0	1	0		0	2	
23	game	42	50	1	21	15	4	4	2	1	1	2	4	1	2	0	6	1	1	0	2	2	0	0	3	0		0	
24	form	4	51	1	21	19	4	4	1	4	3	2	1	3	2	4	0	2	1	2	1	2	3	3	1	2	0		
25	source	53	40	1	21	14	2	2	0	4	1	0	1	1	1	2	1	3	0	1	1	1	2	0	0	0	0	3	
26	informati	61	29	1	21	13	2	2	0	3	1	1	0	2	2	3	0	2	0	0	0	1	2	1	0	1	0	4	
27	consider	4	55	1	21	19	4	4	4	3	4	2	0	1	1	1	1	2	1	2	2	2	2	3	2	1	0	3	
28	presentation	61	26	1	21	13	1	2	0	1	2	1	0	1	2	1	0	0	1	0	0	2	2	2	0	1	0	3	
29	make	19	51	1	21	17	2	2	1	2	2	1	2	0	2	2	0	2	2	1	2	2	2	1	1	0	0	3	
30	color	29	38	1	21	16	3	2	2	1	1	1	1	0	0	0	1	2	1	1	2	1	1	2	1	0	0	0	
31	achiev	4	52	1	21	19	4	3	3	2	3	3	3	3	1	0	2	1	2	2	1	2	1	1	0	2	2	2	
32	mechanic	19	48	1	21	17	4	2	1	2	1	2	3	3	1	0	3	1	1	2	1	1	0	0	0	2	4	1	
33	object	42	39	1	21	15	1	2	3	1	2	1	0	1	0	0	0	1	2	1	0	2	1	1	1	1	0	1	
34	level	29	38	1	21	16	3	2	3	1	2	2	2	1	0	0	1	1	1	1	0	1	0	0	1	1	1	0	
35	method	1	62	1	21	21	4	3	3	2	4	1	1	2	1	2	1	2	3	4	1	2	2	1	2	1	1	2	
36	model	19	51	1	21	17	3	1	2	2	2	0	1	1	0	1	1	3	2	3	1	1	0	0	2	1	1	1	
37	limited	19	56	1	21	17	3	1	2	3	2	0	3	3	1	0	3	3	2	2	1	1	0	0	1	2	2	0	
38	develop	14	50	1	21	18	3	2	3	2	3	1	0	1	1	1	1	2	2	2	0	1	1	0	1	1	1	0	

Figure 6. Cell C1 finds the average number of connections for the keywords at and below the top of the component (in this case, all of them).



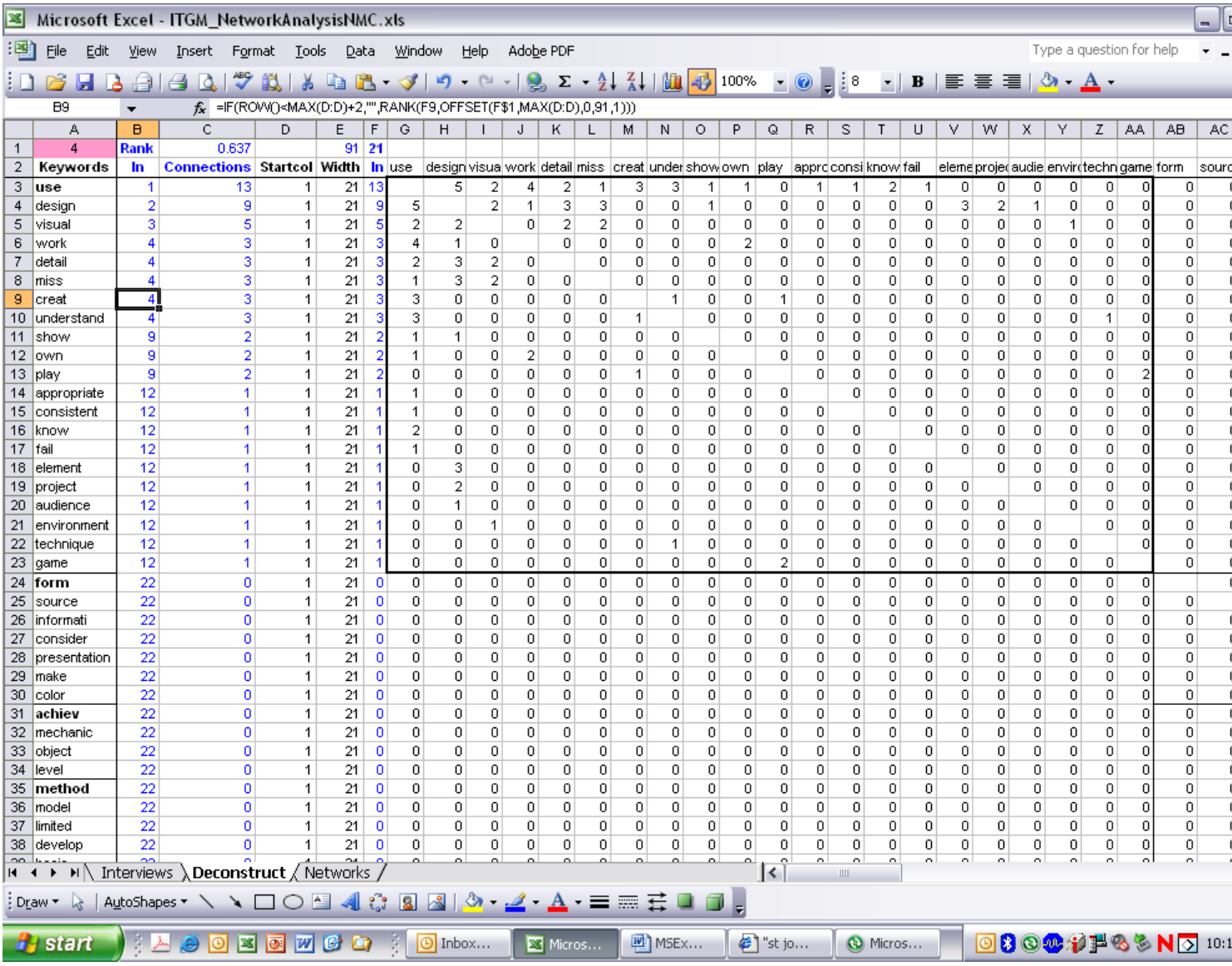
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	0	Rank	39.934		91	91																							
2	Keywords	In	Connections	Startcol	Width	In	use	design	visua	work	detail	miss	creat	under	show	own	play	appro	consi	know	fail	eleme	proje	audie	envir	techn	game	form	sourc
3	**use**	2	87	1	21	20		9	6	8	6	5	7	7	5	5	4	5	5	6	5	1	3	3	4	4	4	4	
4	design	4	76	1	21	19	9		6	5	7	7	3	4	5	3	4	3	4	1	0	7	6	5	3	1	4	4	
5	visual	2	67	1	21	20	6	6		3	6	6	3	1	3	1	2	3	3	2	2	3	3	4	5	1	2	1	
6	work	14	70	1	21	18	8	5	3		3	3	2	4	3	6	2	4	1	3	2	0	3	2	0	2	1	4	
7	detail	4	63	1	21	19	6	7	6	3		4	2	2	3	1	1	3	4	2	0	3	3	4	1	1	1	3	
8	miss	4	54	1	21	19	5	7	6	3	4		3	2	4	2	2	1	0	1	1	3	1	3	1	2	2	2	
9	creat	14	71	1	21	18	7	3	3	2	2	3		5	4	0	5	2	2	4	4	1	0	1	3	2	4	1	
10	understand	4	67	1	21	19	7	4	1	4	2	2	5		3	2	2	2	3	3	1	1	1	2	0	5	1	3	
11	show	4	58	1	21	19	5	5	3	3	3	4	4	3		3	3	0	1	1	2	1	2	2	2	2	2	2	
12	own	42	46	1	21	15	5	3	1	6	1	2	0	2	3		0	2	0	2	1	0	2	1	1	1	0	4	
13	play	29	58	1	21	16	4	4	2	2	1	2	5	2	3	0		1	1	0	3	2	0	0	3	1	6	0	
14	appropriate	4	69	1	21	19	5	3	3	4	3	1	2	2	0	2	1		3	3	1	1	1	1	1	1	1	2	
15	consistent	14	65	1	21	18	5	4	3	1	4	0	2	3	1	0	1	3		2	1	2	2	3	1	1	1	1	
16	know	29	62	1	21	16	6	1	2	3	2	1	4	3	1	2	0	3	2		2	0	1	0	1	3	0	2	
17	fail	53	49	1	21	14	5	0	2	2	0	1	4	1	2	1	3	1	1	2		0	0	0	3	0	2	1	
18	element	29	57	1	21	16	1	7	3	0	3	3	1	1	1	0	2	1	2	0	0		3	2	2	1	2	2	
19	project	42	45	1	21	15	3	6	3	3	3	1	0	1	2	2	0	1	2	1	0	3		3	1	0	0	3	
20	audience	29	42	1	21	16	3	5	4	2	4	3	1	2	2	1	0	1	3	0	0	2	3		1	1	0	3	
21	environment	19	54	1	21	17	4	3	5	0	1	1	3	0	2	1	3	1	1	1	3	2	1	1		0	3	1	
22	technique	29	54	1	21	16	4	1	1	2	1	2	2	5	2	1	1	1	1	3	0	1	0	1	0		0	2	
23	game	42	50	1	21	15	4	4	2	1	1	2	4	1	2	0	6	1	1	0	2	2	0	0	3	0		0	
24	**form**	4	51	1	21	19	4	4	1	4	3	2	1	3	2	4	0	2	1	2	1	2	3	3	1	2	0		
25	source	53	40	1	21	14	2	2	0	4	1	0	1	1	1	2	1	3	0	1	1	1	2	0	0	0	0	3	
26	informati	61	29	1	21	13	2	2	0	3	1	1	0	2	2	3	0	2	0	0	0	1	2	1	0	1	0	4	
27	consider	4	55	1	21	19	4	4	4	3	4	2	0	1	1	1	1	2	1	2	2	2	2	3	2	1	0	3	
28	presentation	61	26	1	21	13	1	2	0	1	2	1	0	1	2	1	0	0	1	0	0	2	2	2	0	1	0	3	
29	make	19	51	1	21	17	2	2	1	2	2	1	2	0	2	2	0	2	2	1	2	2	2	1	1	0	0	3	
30	color	29	38	1	21	16	3	2	2	1	1	1	1	0	0	0	1	2	1	1	2	1	1	2	1	0	0	0	
31	**achiev**	4	52	1	21	19	4	3	3	2	3	3	3	3	1	0	2	1	2	2	1	2	1	1	0	2	2	2	
32	mechanic	19	48	1	21	17	4	2	1	2	1	2	3	3	1	0	3	1	1	2	1	1	0	0	0	2	4	1	
33	object	42	39	1	21	15	1	2	3	1	2	1	0	1	0	0	0	1	2	1	0	2	1	1	1	1	0	1	
34	level	29	38	1	21	16	3	2	3	1	2	2	2	1	0	0	1	1	1	1	0	1	0	0	1	1	1	0	
35	**method**	1	62	1	21	21	4	3	3	2	4	1	1	2	1	2	1	2	3	4	1	2	2	1	2	1	1	2	
36	model	19	51	1	21	17	3	1	2	2	2	0	1	1	0	1	1	3	2	3	1	1	0	0	2	1	1	1	
37	limited	19	56	1	21	17	3	1	2	3	2	0	3	3	1	0	3	3	2	2	1	1	0	0	1	2	2	0	
38	develop	14	50	1	21	18	3	2	3	2	3	1	0	1	1	1	1	2	2	2	0	1	1	0	1	1	1	0	

Figure 7. Cell A1 deconstructs the network. Its value has been incremented one at a time until the value in C1 became less than one. F1 counts the number of keywords that have connections in the specified range (for A2 = 1, this will be starting at column G and including the 21 columns specified in E3 and below).



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	4	Rank	0.637		91	21																							
2	Keywords	In	Connections	Startcol	Width	In	use	design	visua	work	detail	miss	creat	under	show	own	play	apprc	consi	know	fail	eleme	projec	audie	envir	techn	game	form	sourc
3	**use**	1	13	1	21	13		5	2	4	2	1	3	3	1	1	0	1	1	2	1	0	0	0	0	0	0	0	
4	design	2	9	1	21	9	5		2	1	3	3	0	0	1	0	0	0	0	0	0	3	2	1	0	0	0	0	
5	visual	3	5	1	21	5	2	2		0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
6	work	4	3	1	21	3	4	1	0		0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	
7	detail	4	3	1	21	3	2	3	2	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8	miss	4	3	1	21	3	1	3	2	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9	creat	4	3	1	21	3	3	0	0	0	0	0		1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
10	understand	4	3	1	21	3	3	0	0	0	0	0	1		0	0	0	0	0	0	0	0	0	0	0	1	0	0	
11	show	9	2	1	21	2	1	1	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	
12	own	9	2	1	21	2	1	0	0	2	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	
13	play	9	2	1	21	2	0	0	0	0	0	0	1	0	0	0		0	0	0	0	0	0	0	0	0	2	0	
14	appropriate	12	1	1	21	1	1	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	
15	consistent	12	1	1	21	1	1	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	
16	know	12	1	1	21	1	2	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	
17	fail	12	1	1	21	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
18	element	12	1	1	21	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	
19	project	12	1	1	21	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	
20	audience	12	1	1	21	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	
21	environment	12	1	1	21	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	
22	technique	12	1	1	21	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0		0	0	
23	game	12	1	1	21	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0		0	
24	**form**	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
25	source	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
26	informati	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
27	consider	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
28	presentation	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
29	make	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
30	color	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
31	**achiev**	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
32	mechanic	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
33	object	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
34	level	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
35	**method**	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
36	model	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
37	limited	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
38	develop	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Figure 8. Column B now finds the rank of each value in the In column (Column F).



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	4	Rank	0.637		91	21																							
2	Keywords	In	Connections	Startcol	Width	In	use	design	visua	work	detail	miss	creat	under	show	own	play	appro	consi	know	fail	eleme	proje	audie	envir	techn	game	form	sourc
3	**use**	1	13	1	21	13		5	2	4	2	1	3	3	1	1	0	1	1	2	1	0	0	0	0	0	0	0	
4	design	2	9	1	21	9	5		2	1	3	3	0	0	1	0	0	0	0	0	0	3	2	1	0	0	0	0	
5	visual	3	5	1	21	5	2	2		0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
6	work	4	3	1	21	3	4	1	0		0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	
7	detail	4	3	1	21	3	2	3	2	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8	miss	4	3	1	21	3	1	3	2	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9	creat	4	3	1	21	3	3	0	0	0	0	0		1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
10	understand	4	3	1	21	3	3	0	0	0	0	0	1		0	0	0	0	0	0	0	0	0	0	0	1	0	0	
11	show	9	2	1	21	2	1	1	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	
12	own	9	2	1	21	2	1	0	0	2	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	
13	play	9	2	1	21	2	0	0	0	0	0	0	1	0	0	0		0	0	0	0	0	0	0	0	0	2	0	
14	appropriate	12	1	1	21	1	1	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	
15	consistent	12	1	1	21	1	1	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	
16	know	12	1	1	21	1	2	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	
17	fail	12	1	1	21	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	
18	element	12	1	1	21	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	
19	project	12	1	1	21	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	
20	audience	12	1	1	21	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	
21	environment	12	1	1	21	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	
22	technique	12	1	1	21	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0		0	0	
23	game	12	1	1	21	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0		0	
24	**form**	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
25	source	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
26	informati	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
27	consider	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
28	presentation	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
29	make	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
30	color	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
31	**achiev**	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
32	mechanic	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
33	object	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
34	level	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
35	**method**	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
36	model	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
37	limited	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
38	develop	22	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Figure 9. Freeze panes at B3 to automatically sort on Rank. Highlight the box (G3 to AA23 in the example) and copy it to the Networks sheet along with its keywords. Then, hide the component by holding the Alt key down and typing OCHORH (Format Column Hide Format Row Hide).

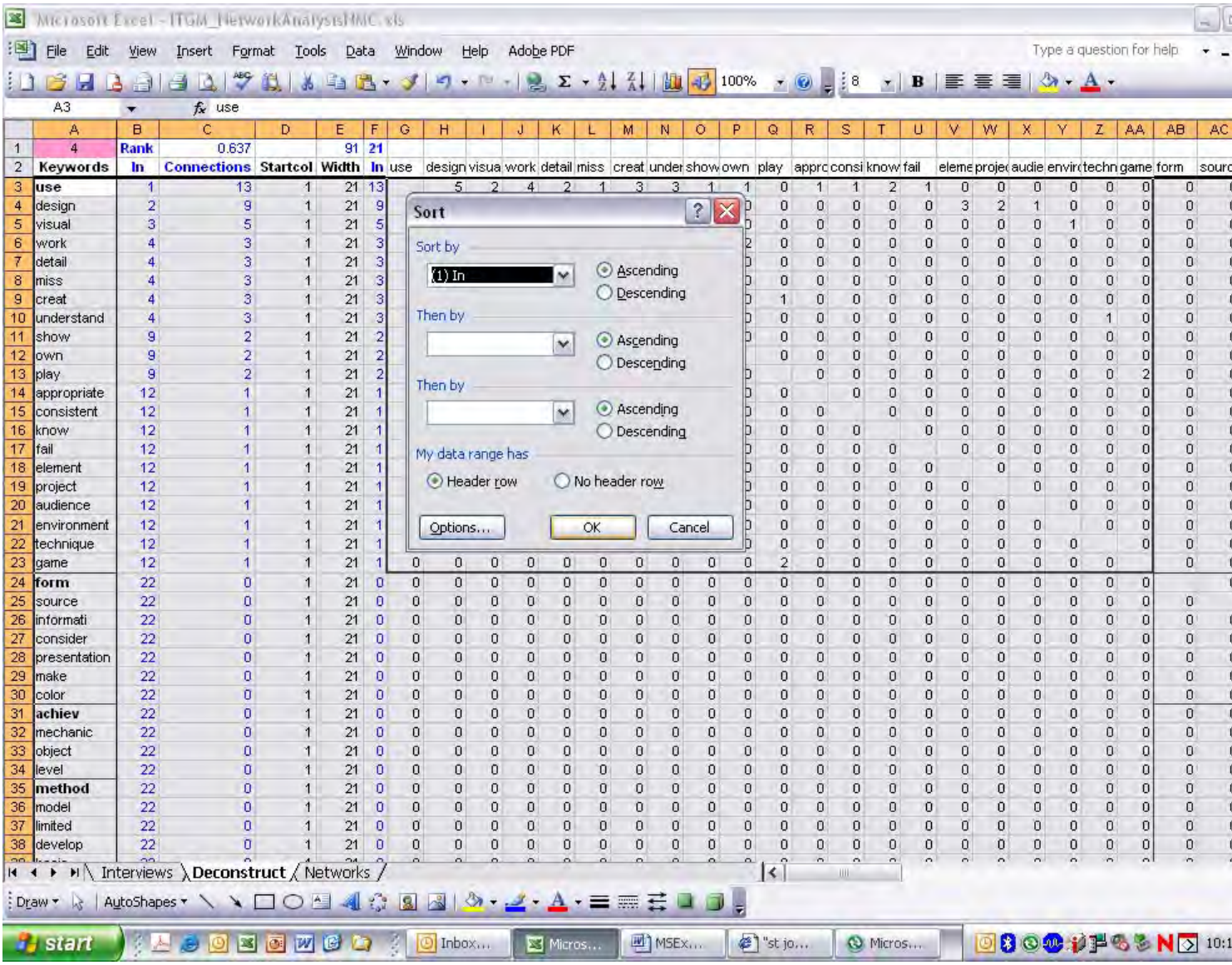


Figure 60. With the first component hidden, prepare to find the second component as follows. Set A1 (the deconstruct number) back to zero, D24 (the new start column) to 22 (which subtracts the 2 calculation rows from the top remaining keyword row) and the width to 70 (the remaining number of keywords calculated by the formula in E1).

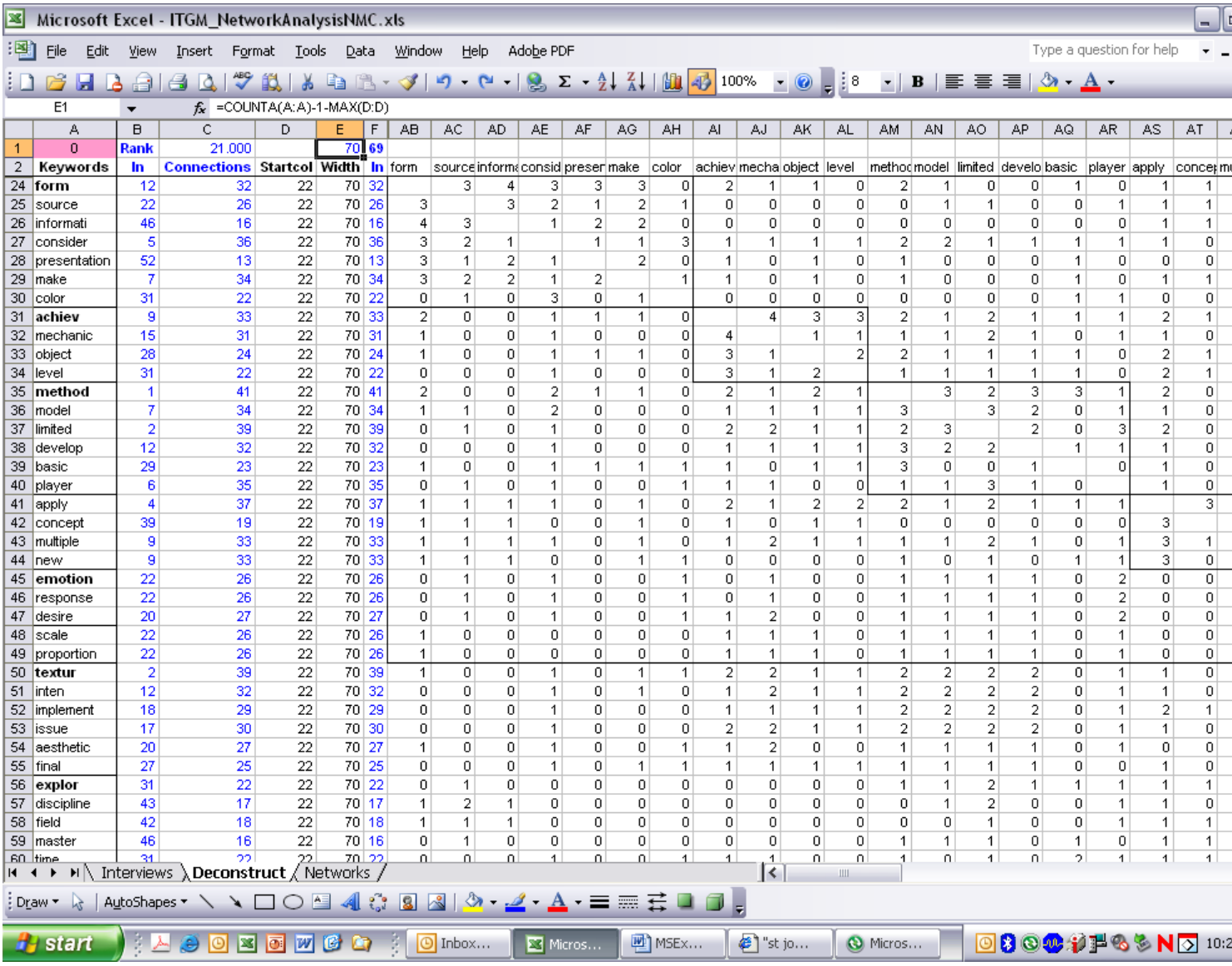
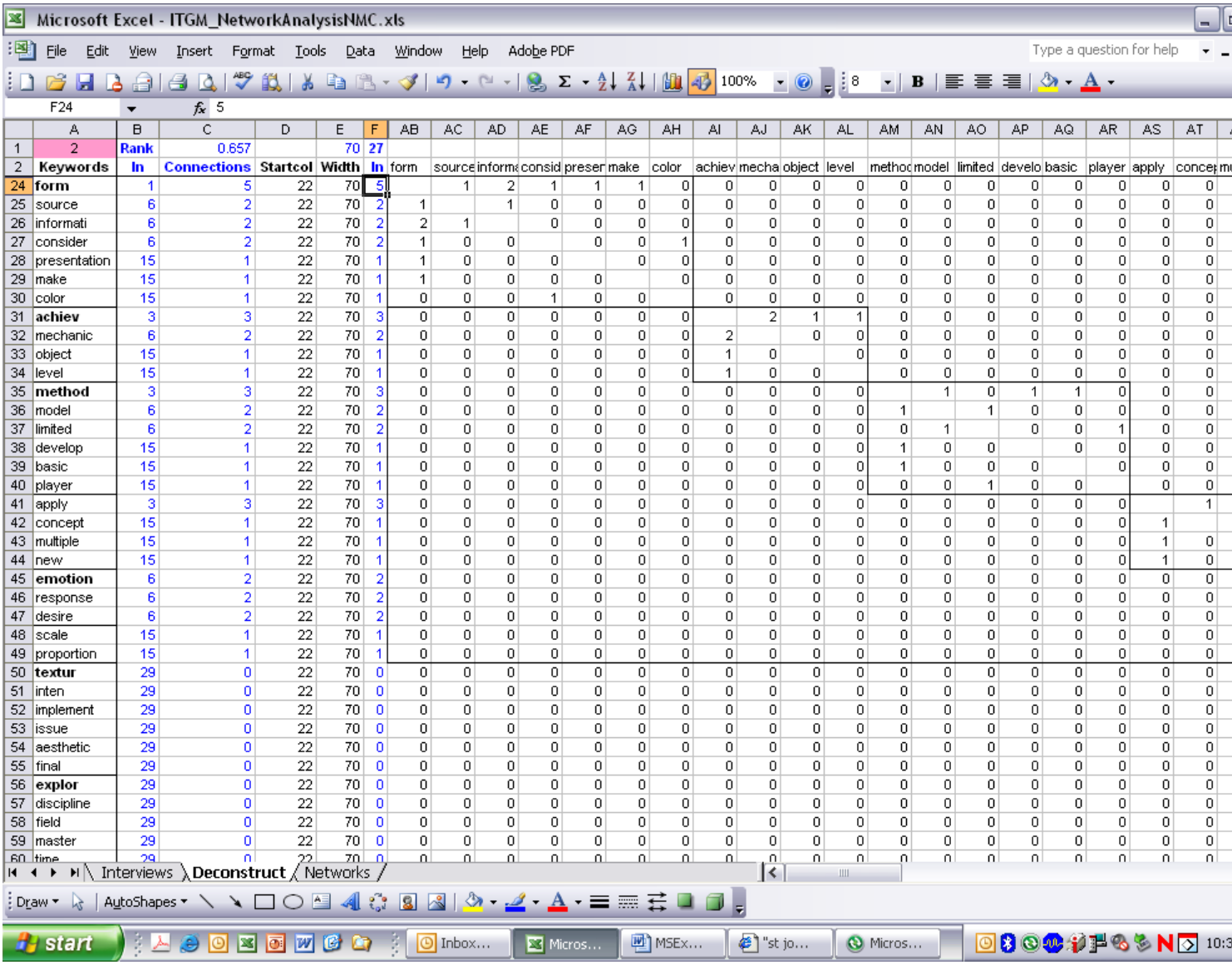
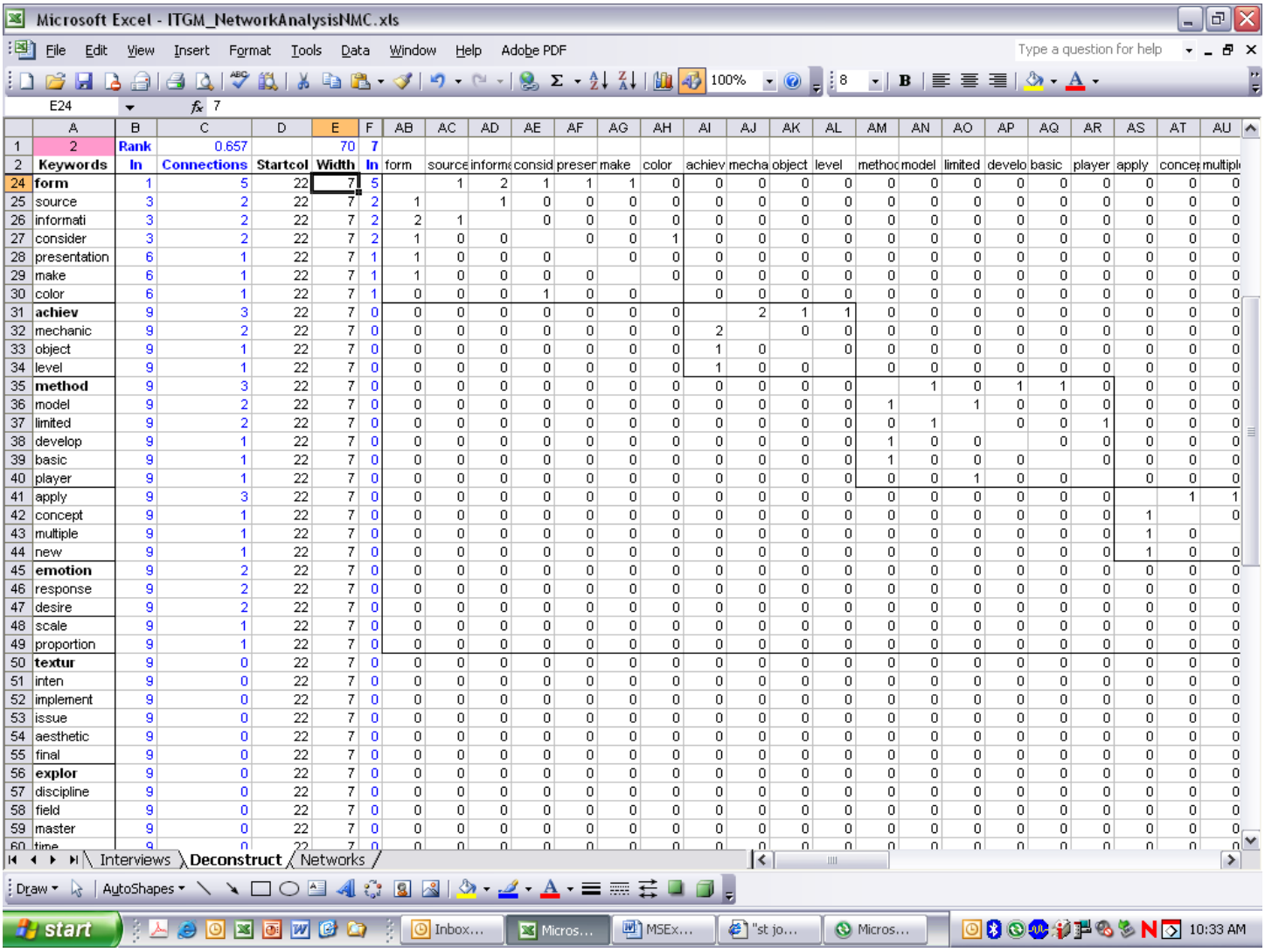


Figure 11. Increment the deconstruct number (pink) until the average at C1 is less than one. Then write over the value in F that has the rank of one to keep it at the top of the sort in the following steps.



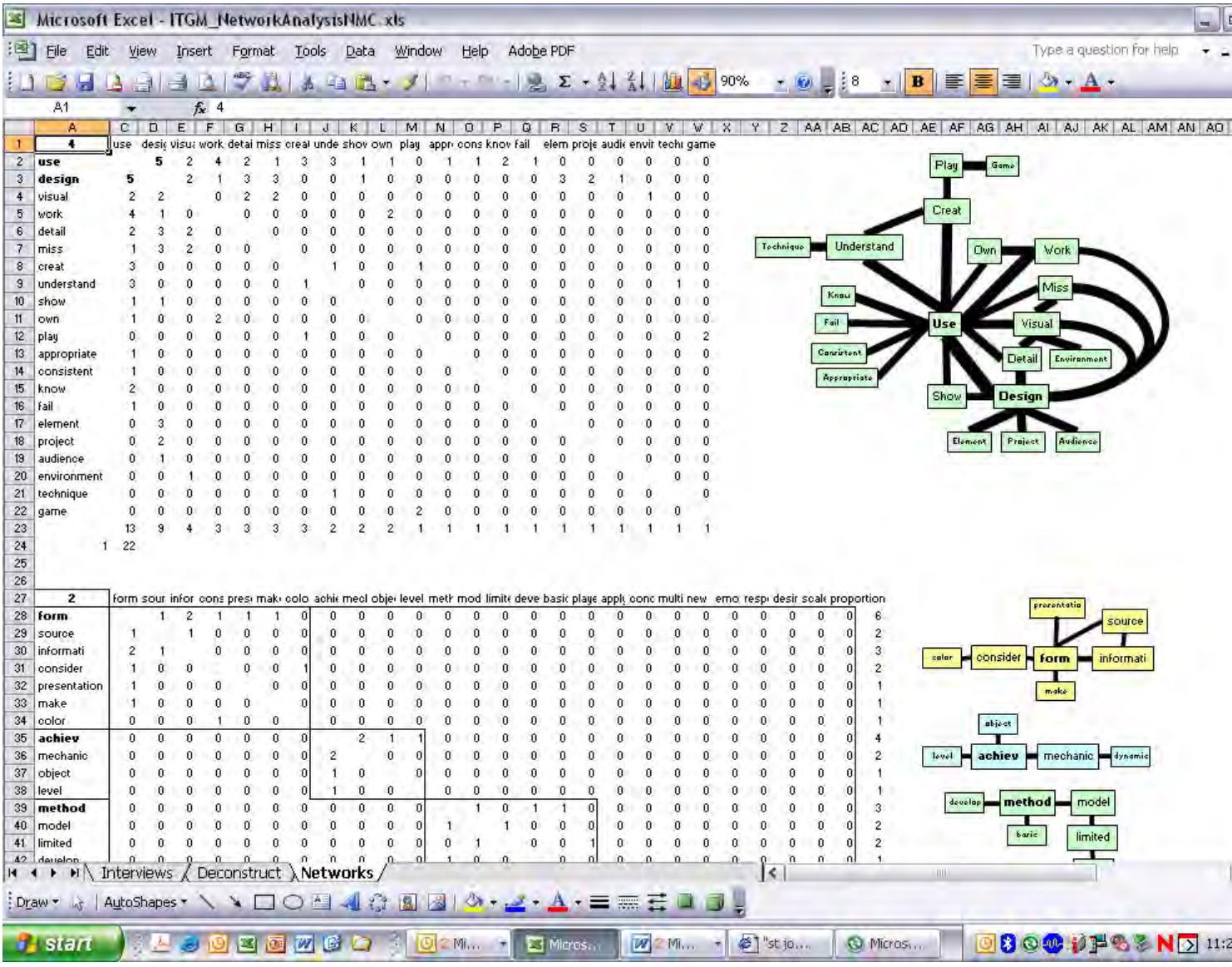
	A	B	C	D	E	F	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT
1	2	Rank	0.657		70	27																			
2	Keywords	In	Connections	Startcol	Width	In	form	source	informa	consid	preser	make	color	achiev	mecha	object	level	methoc	model	limited	develo	basic	player	apply	concep
24	**form**	1	5	22	70	5		1	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
25	source	6	2	22	70	2	1		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	informati	6	2	22	70	2	2	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	consider	6	2	22	70	2	1	0	0		0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
28	presentation	15	1	22	70	1	1	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	make	15	1	22	70	1	1	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
30	color	15	1	22	70	1	0	0	0	1	0	0		0	0	0	0	0	0	0	0	0	0	0	0
31	**achiev**	3	3	22	70	3	0	0	0	0	0	0	0		2	1	1	0	0	0	0	0	0	0	0
32	mechanic	6	2	22	70	2	0	0	0	0	0	0	0	2		0	0	0	0	0	0	0	0	0	0
33	object	15	1	22	70	1	0	0	0	0	0	0	0	1	0		0	0	0	0	0	0	0	0	0
34	level	15	1	22	70	1	0	0	0	0	0	0	0	1	0	0		0	0	0	0	0	0	0	0
35	**method**	3	3	22	70	3	0	0	0	0	0	0	0	0	0	0	0		1	0	1	1	0	0	0
36	model	6	2	22	70	2	0	0	0	0	0	0	0	0	0	0	0	1		1	0	0	0	0	0
37	limited	6	2	22	70	2	0	0	0	0	0	0	0	0	0	0	0	0	1		0	0	1	0	0
38	develop	15	1	22	70	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0		0	0	0	0
39	basic	15	1	22	70	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0		0	0	0
40	player	15	1	22	70	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0		0	0
41	apply	3	3	22	70	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		1
42	concept	15	1	22	70	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
43	multiple	15	1	22	70	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
44	new	15	1	22	70	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
45	**emotion**	6	2	22	70	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	response	6	2	22	70	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	desire	6	2	22	70	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	scale	15	1	22	70	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	proportion	15	1	22	70	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	**textur**	29	0	22	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	inten	29	0	22	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	implement	29	0	22	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	issue	29	0	22	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	aesthetic	29	0	22	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	final	29	0	22	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	**explor**	29	0	22	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	discipline	29	0	22	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	field	29	0	22	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	master	29	0	22	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	time	29	0	22	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 17. Set the width value (column E) next to the Rank 1 word equal to 1 and do the sort. You have now found all the values that connect with the Rank 1 keyword. To complete the component, reset the width to the value in F1 (the number connected to it) and sort again (if terms are connected to other terms in the component but not the Rank 1 word, this step needs to be done more than once). Once the width equals the value in F1 after a sort, the component is finished. To find the next component reiterate the cycle beginning at Figure 9.



	A	B	C	D	E	F	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU
1	2	Rank	0.657		70	7																				
2	Keywords	In	Connections	Startcol	Width	In	form	source	informa	consid	preser	make	color	achiev	mecha	object	level	methoc	model	limited	develo	basic	player	apply	concep	multipl
24	**form**	1	5	22	7	5		1	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	source	3	2	22	7	2	1		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	informati	3	2	22	7	2	2	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	consider	3	2	22	7	2	1	0	0		0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
28	presentation	6	1	22	7	1	1	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	make	6	1	22	7	1	1	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	color	6	1	22	7	1	0	0	0	1	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
31	**achiev**	9	3	22	7	0	0	0	0	0	0	0	0		2	1	1	0	0	0	0	0	0	0	0	0
32	mechanic	9	2	22	7	0	0	0	0	0	0	0	0	2		0	0	0	0	0	0	0	0	0	0	0
33	object	9	1	22	7	0	0	0	0	0	0	0	0	1	0		0	0	0	0	0	0	0	0	0	0
34	level	9	1	22	7	0	0	0	0	0	0	0	0	1	0	0		0	0	0	0	0	0	0	0	0
35	**method**	9	3	22	7	0	0	0	0	0	0	0	0	0	0	0	0		1	0	1	1	0	0	0	0
36	model	9	2	22	7	0	0	0	0	0	0	0	0	0	0	0	0	1		1	0	0	0	0	0	0
37	limited	9	2	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	1		0	0	1	0	0	0
38	develop	9	1	22	7	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0		0	0	0	0	0
39	basic	9	1	22	7	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0		0	0	0	0
40	player	9	1	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0		0	0	0
41	apply	9	3	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		1	1
42	concept	9	1	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		0
43	multiple	9	1	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
44	new	9	1	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
45	**emotion**	9	2	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	response	9	2	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	desire	9	2	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	scale	9	1	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	proportion	9	1	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	**textur**	9	0	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	inten	9	0	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	implement	9	0	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	issue	9	0	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	aesthetic	9	0	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	final	9	0	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	**explor**	9	0	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	discipline	9	0	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	field	9	0	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	master	9	0	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	time	9	0	22	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 13. Label each group by its dominant member(s) and connect with lines representing the width. Show the level of the component by adding the deconstruction number back into the pair being connected (e.g., making the use-design connection 9 units wide). Use the resulting components to generate or test ideas for organizing the dimensions.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Technique
Understand
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Work
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Know
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Use
Visual
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Appropriate
Show
Design
Element
Project
Audience
presentatio
source
color
consider
form
informati
make
object
level
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mechanic
dynamic
develop
method
model
basic
limited
Interviews
Deconstruct
Networks
Draw
AutoShapes
start