Using iPad for 3D Scanning, Design and Technical Documentation: A Perspective in Task-based Language Teaching

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INTRODUCTION

The primary research question in this paper revolved around the logistics and feasibility of using iPad to perform the processes related to 3D scanning, design and technical documentation for task-based English language learning in a non-native classroom environment.

The project discussed the use of IPads to scan a physical object using iSense scanners, use CAD software apps to innovate on the design, upload it in Cubify design feed repository, perform rapid prototyping, and then send it off to the Cubify 3D printer.

During this entire process, students are expected to use Google Drive app to write design specifications and short technical reports, use concept-mapping app to draw product design blueprints, and illustrate idea sketches for usability studies using the iPad.

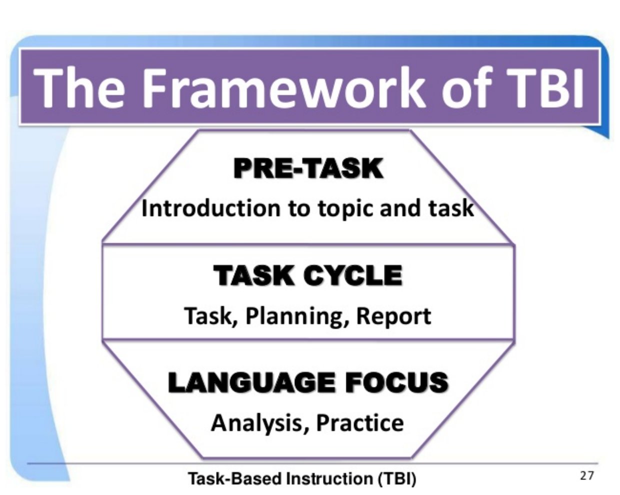
We used a pilot study and experiment to analyze the feasibility and logistics of the proposed course design.

Preliminary observations from this pilot study suggested that iPads could be used effectively and seamlessly to integrate the technology and the technical documentation processes. This pedagogical model is likely to help us teach innovative technical communication courses.

OBJECTIVE & LITERATURE REVIEW

The effective use of the iPad for design education in an English language-learning context is the central focus of this paper. The research explored if 3D scanning techniques and associated apps could be used collaboratively and seamlessly in a project context with iPads when teaching design pedagogy in an English classrooms.

The broad idea and purpose of the paper was to explore if the use of iPads for design education could be used as a tool for task-based language teaching. Task-based language teaching (TBLT) has heavily influenced syllabus design, classroom teaching and learner assessment in a foreign or second language teaching context ([14]); [15]). Skehan [15] has advocated that task characteristics should be divided into strong and weak forms of the TBLT approach. The strong form suggested that tasks should be the unit of language learning, while the weak form suggests that tasks are a vital part of language instructions. In this article, we have adapted the strong form TBLT where the use of the iPad for 3D scanning along with associated design tasks using apps is the unit for language learning. Our study tried to address some of the fundamental research questions that have bothered the researchers on the topic of effective use of iPads for education.



Project goal in classroom: The idea with the proposed course is to help students use iPads extensively to go through the process of customizing a design for direct digital manufacturing, make updates in the middle of the production cycle, without re-tooling the production line. This coordinated activity in a team ranging from 3D design or scanning to 3D printing included multiple processes, stages and iterations. This is expected to help improve communication within a team through back-and-forth design updates (prototyping) and frequent design reconsiderations; through understanding the use of various technologies, and how they work seamlessly with each other; help write collaborative Google-drive based design documents on the iPad about design processes; report on developments and findings, and in the process develop language acquisition skills.

MATERIALS AND METHODS

Sample: Two students at the university took part in this trial. These two students are advanced undergraduate students with above average English and native Japanese language proficiency and ability to understand new software and hardware with a shorter learning curve.

Using IHMC Concept Mapping Software: Students in the lab kick started the entire production process by accessing images online for a specific product design, develop their own ideas on design innovation, and drew up a production plan by drawing a concept map using the IHMC concept mapping software app.

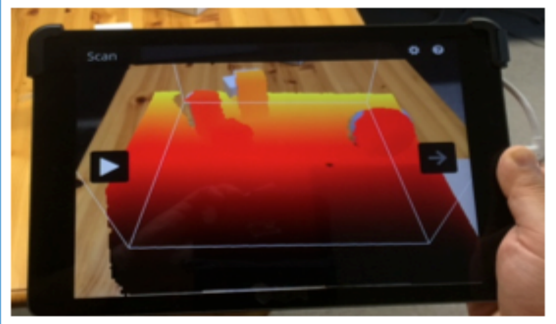
Using the CAD Software and Scanner: During the second stage of production, students were expected to use iPads extensively for prototype design with Autodesk 123D Design apps, and Tinkercad software and with use of 3D scanners fitted to iPads.

Using Online Design Repository: Students were instructed to use iPads frequently for multiple reasons, that included uploading scanned and re-designed design feeds into their personal online repository (*Cubify design shelf*, *Thingiverse*, *Shapeways* etc.), weigh and download design models from online repositories, and eventually order 3D printing wirelessly.

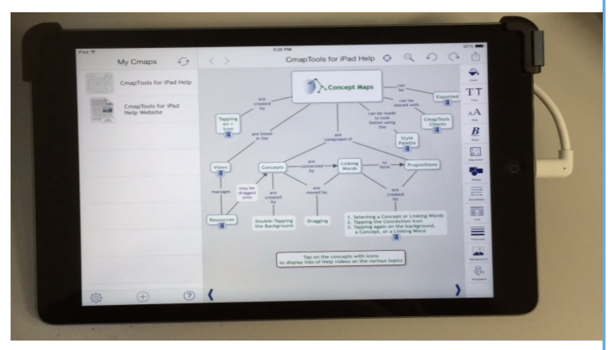
Using Google Drive: Google Drive app was used to write about engineering team-based communication during the design process, including different considerations related to collaborative product development, planning and design, analysis and execution.

iSense scanner fitted to iPad

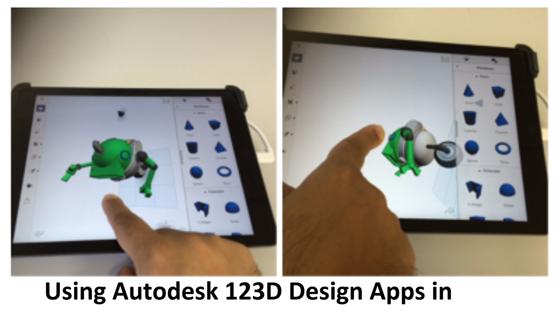
Using iSense scanners fitted to iPads to scan objects of varying shapes



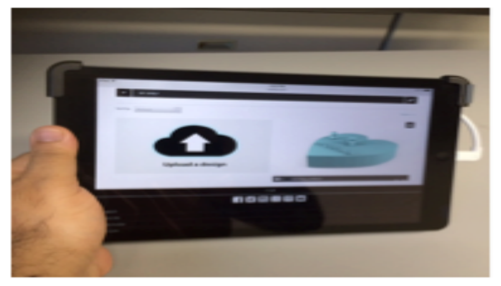
iSense scanning software used on iPad



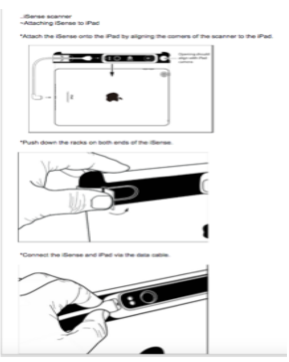
Using IHMC Concept Mapping Software in iPad



Using Autodesk 123D Design Apps in the iPad



Using Cubify Online Design Feed to Upload Customized Design



English User Instructions as entered in Google Drive (Work in Progress)

THE COURSE

During the actual course to be offered, iPads will be used to:

- develop a concept map using IHMC Concept mapping software apps
- fit to iSense scanners to scan physical objects
- install iSense 3D scanning software and prepare an .stl file for 3D printing
- use Autodesk 123D Design software apps to prepare an .stl file
- Export the file for 3D printing
- coordinate the preparation of the image using *Tinkercad* and *BuildwithChrome* in the desktop
- upload the .stl file in *Cubify* online design feed,
- use *Thingiverse* to download image etc.
- Learn how to prepare and upload .stl files for 3D printing using *shapeways.com* etc. and wirelessly order 3D printing.

The above processes include the following technical writing features:

- using iPads to take down notes in Google drive apps
- using iPads to author product specifications guide and user manuals in Google drive (explaining the scanning process)
- using iPads to take pictures of different assembly and subassembly processes

The challenge would be to coordinate the above-mentioned extensive use of iPads seamlessly in the course, such that student groups are able to coordinate different activities successfully.

Cubify 3D Printer

Initial Student Data

- The first and major issue of the iSense scanner seems to be the quality of its scanned images is lower when compared to those of the Sense scanner. This may be due to the fact that the mobility of the iSense scanner is made possible by reducing/compromising the hardware of the scanner itself. Although this doesn't seem to be the case when we read the specifications presented in the website.
- Scanning at an optimal distance (for the Sense scanner which is approximately 35cm to 50cm depending on the object shape and size) proved to be difficult, but resulted in little or no difference at all. Scanning at a slower pace did help smooth out the image of the scanned object. Scanning at a lower angle had no difference.
- The window for the 123D Design app is simple and clean but might be tricky at times if you don't know what functions each icon represents.
- The IHMC Concept mapping app was interesting and relatively easy to manipulate, but typing in the text inside the nodes were a little irritating at times. I will still need to compare the ease of use with the desktop version. But it was good to use the cloud version of the software.
- I am comfortable using both the English and Japanese versions of the apps, but I am not sure whether students in the actual course will be tempted to use the Japanese instead of the English interface to complete their project work. I think students in the course should have very specific guidelines about the use of the English apps interface.

3D Scanning Data

	Initial Object 1 (Cube = 7.4 cm)		Initial Object 2 (rectangular prism)		Initial Object 3 (cylinder)		Initial Object 4 (sphere)	
	WC*	C**	WC*	C**	WC*	C**	WC*	C**
Procedure	Scanning is conducted upon the partition background. The Scanning is conducted in 10 separate trials. After each trial, the data is then entered upon a table.	Scanning is conducted upon a table without a background. The Scanning is conducted in 10 separate trials. After each trial, the data is then entered upon a table.	Scanning is conducted upon the partition background. The Scanning is conducted in 10 separate trials. After each trial, the data is then entered upon a table.	Scanning is conducted on a table without a background. The Scanning is conducted in 10 separate trials. After each trial, the data is then entered upon a table.	Scanning is conducted upon the partition background. The Scanning is conducted in 10 separate trials. After each trial, the data is then entered upon a table.	Scanning is conducted upon a table without a background. The Scanning is conducted in 10 separate trials. After each trial, the data is then entered upon a table.	Scanning is conducted upon the partition background. The Scanning is conducted in 10 separate trials. After each trial, the data is then entered upon a table.	Scanning is conducted upon a table without a background. The Scanning is conducted in 10 separate trials. After each trial, the data is then entered upon a table.
Findings	The scanning is much smoother compared to the Sense scanner. The loss of tracking still occurs, though not as frequent as was with the Sense scanner. The scanned image of the object is rough, requiring some rendering.	Slightly faster scanning speeds. Smoother image compared to the uncalibrated images.	Scanning is smoother compared to the Sense scanner. The loss of tracking still occurs, though not as frequent as was with the Sense scanner. The scanned image of the object is rough, requiring some rendering.	Slightly faster scanning speeds. Smoother overall image compared to the uncalibrated images. Still needs some refining.	Scanning is smoother compared to the Sense scanner. No loss of tracking occurred. The scanned image is a little rough but can do without any rendering.	Slightly faster scanning speeds. Smoother image compared to the uncalibrated images.	There are no loss of tracking, as was with the Sense scanner. There are some difficulties scanning the object. A full image of the object cannot be obtained.	Slightly faster scanning speeds. Smoother overall image compared to the uncalibrated images. The lower half of the sphere is still impossible for scanning. Although the area of the unscanned part is less compared to the uncalibrated images.

3D Scanning with iSense Scanners with a Random Background

	Cube = 7.4 cm	Rectangular Prism	Cylinder	Sphere
Procedure	Scanning is conducted upon the white Styrofoam background. The Scanning is conducted in 10 separate trials. After each trial, the data is then entered upon a table.	Scanning is conducted upon the white Styrofoam background. The Scanning is conducted in 10 separate trials. After each trial, the data is then entered upon a table.	Scanning is conducted upon the white Styrofoam background. The Scanning is conducted in 10 separate trials. After each trial, the data is then entered upon a table.	Scanning is conducted upon the white Styrofoam background. The Scanning is conducted in 10 separate trials. After each trial, the data is then entered upon a table.
Findings	Scanning upon white background is difficult due to the white background hindering the scanners movements.	Scanning upon white background is difficult with identical issues to iS-OS-IO1.	Scanning upon white background is difficult with identical issues to iS-OS-IO1. No loss of tracking, however the downgrading of the tracking seems to happen to frequently.	Scanning upon white background is difficult with identical issues to iS-OS-IO1. The lower half of the sphere seems to be impossible for scanning. The sphere is slightly rough, identical to the normal background image. No loss of tracking, no frequent downgrading of the tracking.

Scanning with iSense Scanners with a White Background

POTENTIAL & FUTURE STUDY

This study has shown us multiple possible educational outcomes using iPad in a task-based language-teaching classroom.

- The main educational outcome in this non-native language situation is to teach students the fundamentals of English technical writing in a strictly procedural context.
- Design education is the natural outcome of this maker context where students learn to use different software and apps using the iPad, and then write about the use of such applications in a technical writing domain.
- Students learn the fundamentals of project management and public presentations in a maker context, by communicating with their group partners, friends and community in English within the confines of a pre-set framework that involves an extensive use of the iPad and software applications.
- This collaborative and community-based task-based language teaching context help students develop superior analytical thinking skills and public display of the projects and 3D printed products using English.
- The logistics of in-class design and manufacturing processes should be worked out effectively. The major idea should be on identifying a single focus, keeping in mind what realistically students at the level can handle and complete by the assigned project deadline.
- Future research should focus on survey-based perception studies, and usability analysis of how students adapt to such pedagogical structures. Such understanding will help us further explore language teaching within the confines of design education.

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