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Can Post-Lecture CAD Screencasts Reduce Cognitive Load and Foster Self-directed Learning in First Year Interior Design?

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Abstract

This paper discusses a case study which explores the provision of post-lecture Computer Aided Design (CAD) screencasts, for supporting classroom teaching, for first year students on the BA Honours in Interior Design & Furniture at the Dublin Institute of Technology. When students choose to study interior design they have a perception that the course will be primarily creative and artistic in nature. Art and design students tend to lean towards divergent thinking tasks and have a propensity of not being aware of new learning challenges such as technical drawing, model making, construction studies and AutoCAD, which all require convergent thinking skills. The high workload in first year and the requirement for students to be self-directed in their learning, adds to their challenges. The screencast tutorials aimed to help students to overcome these challenges when learning AutoCAD and facilitate convergent thinking skills. Seventeen students took part in the applied research project, nine first years and eight second years completed a questionnaire, with four of the first years and two second years, from the cohorts, also participated in focus group interviews. The focus of the data collection was on the student learning experience in first year, design thinking styles, and multimedia learning – with specific attention given to the AutoCAD screencasts, aligned with Mayer's cognitive learning theory of multimedia learning.

Findings suggest that the screencast tutorials do help to reduce cognitive load and aid self-directed learning with these students, mainly because they can be used as a revision tool when required by students, ahead of module assignments. Findings showed that students do find technical tasks more challenging in first year, including AutoCAD. Managing workload and becoming a self-directed learner were also difficult for first year students. The two cohorts were compared and findings showed that second year students had developed a more convergent thinking style, with a realization of the need for designers to be both divergent and convergent thinkers in equal measures. While there are limitations to the findings, due to the small scale nature of the study, they recommend that the screencasts are a benefit to students as a revision aid, and to teachers as an alternative or complement to classroom teaching, at third level.

Keywords: CAD[1], Cognitive load, Convergent thinking, Divergent thinking, Interior Design, Screencasts, Self-directed learning

[1] CAD is a generic term for computer aided design software such as AutoCAD, Adobe Photoshop, Google Sketchup and 3D StudioMax.

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Introduction

This case study assesses the provision of AutoCAD screencasts i.e. *"video of a computer screen with real-time audio commentary"* (Green, Pinder-Grover & Mirecki Millunchick, 2012, p.717) as a supplement to classroom teaching in first year Interior Design & Furniture in Dublin Institute of Technology. AutoCAD is a commonly used technical drawing and modelling software in Architecture and Engineering disciplines. AutoCAD screencasts can aid students learning, by allowing them to revisit them when required, thus reducing cognitive load (Seery & Donnelly, 2012, p. 668) and encouraging self-directed learning (Green *et al.,* 2012, p.717). Through *"building on what is already known"* (Carlile & Jordan, 2005, p.21) from weekly face–to-face lectures and provision of screencasts, the teacher *"accepts the autonomy of the student and instead acts as a facilitator or mediator"* (Carlile *et al*., 2005, p.19) while the students complete the AutoCAD activity. Over a three year period, over sixty CAD screencasts were produced to support classroom teaching. It has been proven to be beneficial to learning to be given an opportunity to *"revisit topics to strengthen retention"* by presenting *"material in more than one form to facilitate transfer to long term memory"* (Carlile & Jordan, 2004, p.18); hence the introduction of CAD tutorials in an audio-visual medium, accompanied by written hand-outs, thus having the potential as Sweller (1988) argues, to reduce cognitive load.

Context and Rationale

In first year, most interior design students tend to be confident in manually produced work such as sketching and creating design concepts. However, students tend not to be confident with new learning challenges e.g. technical drawing, model making, and CAD. The majority of students come to the course with little or no experience of

AutoCAD and tend to be unaware of its importance for module assignments in the course. There is a high workload on students in first year, with up to ten modules, all with individual assignments and deadlines. Technical skills, in this case AutoCAD, are important to overcome because they are essential for employment in the design industry.

Aims and Objectives

This research study aimed to explore if provision of screencasts in an AutoCAD module could help to reduce the cognitive load on first year students, due to the heavy workload and introduction to new learning challenges in the discipline. There are four key themes to be researched in this case study. These themes are explored to support the context and rationale of the study, which argues that the themes can have clear connections to each other.

- Cognitive load
- Design thinking
- First year learning experience
- Multimedia learning

The following objectives of the study were set:

- Evaluate the screencasts as a resource in terms of benefits for students' learning of AutoCAD, the user experience, whether they can help to reduce workload and foster self-directed learning in first year.
- Investigate students' design thinking styles.
- Explore students' reflections on the first year learning experience in Interior Design and what students consider to be the most challenging aspects.

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Literature Review

The literature for this study, to investigate the provision of screencasts in an arts based discipline, reviewed the areas discussed below, in order to achieve the aims and objectives.

Cognitive Load Theory

Key researchers on cognitive load theory and problem solving skills, include Sweller (1988), Paas & Van Merrienboer (1994), Paas, Touvinen, Tabbers & Van Gerven (2003a), and Paas, Renkl & Sweller (2003b and 2004). Sweller refers to three types of cognitive load in his research, which are: intrinsic, extraneous and germane load.

- *Intrinsic load:* this is affected by the learner's unfamiliarity or the complexity of learning material.
- *Extraneous load:* this is affected by the organisation and design of the learning material. Unnecessary or inconsequential additions to the material will increase the extraneous load of the learner.
- *Germane load:* this is affected by a combination of the two above. If a learner can draw on previous knowledge of a subject and can release enough working memory to process new knowledge, there is an ability to learn more.

Mayer (2009) took this research further and applied it to multimedia learning design. He tested 12 principles under the three headings, renaming them 'essential processing', 'extraneous processing' and 'generative processing'. These will be discussed further in the 'findings' sections of the research paper.

Design Thinking

The term 'convergent thinking' was coined by Guilford (1967) as the opposite of divergent thinking. It is defined as the ability to give the correct answer to questions which do not require much creativity, such as typical school tests and standardized multiple choice intelligence tests. 'Divergent thinking' is defined as coming up with multiple solutions and ideas. Research into design thinking has shown that divergent thinkers tend to be drawn to the arts, (Hudson, 1966, as cited by Lawson, 2006) whereas convergent thinkers prefer the sciences. Meneely (2010) tested thinking preferences of interior design students, and Carmel-Gilfilen (2012), tested thinking and learning styles with interior design and architecture students, with similar findings. Meneely (2010, p.21) argued they *"prefer conceptual, integrative and expressive modes of thinking, but may overlook or avoid analytical, critical, and logical modes."* Lawson (2006) looked at thinking style research by Guilford (1967) which showed that most tasks require both convergent and divergent thinking. Lawson acknowledged that, for the most part, design is a divergent thinking task, but that there are aspects in the design process which involve convergent thinking. Lawson (2006, p.143) believed that *"good designers …are able to develop and maintain several lines of thought in parallel."* AutoCAD is a predominantly convergent thinking skill, which design students tend to find challenging. This may be due to their thinking styles and may also have a bearing on a learners' ability to juggle several modules at once in first year.

First Year Learning Experience

The first year learning experience has been explored in many disciplines. A common theme in the literature, which is important in this research, is that students "*may come to realise that their expectations are not met by reality"* (Anderson, Peters, Halloran,

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Every, Shuttleworth, Liarokapis, Lane & Richards, 2012, p.1852). This may mean different things in different disciplines, such as believing a games art degree will be practical and skills based, without looking at the critical thinking and scholarship behind the technology (Tinwell, 2013, p.124). There may be assumptions that 'net generation' (Prensky, 2001) students are proficient in the necessary ICT skills at third level, which has been proven to not always be the case (Yang, Catterall, & Davis, 2013, p.640). Studies in higher education in Australia (Krause, Hartley, James & McInnis, 2005) have shown that these issues are recurrent. This current study looks into the first year learning experience in this case and whether unrealistic expectations effect learning challenges.

Screencasting

The term 'screencast' was coined by Jon Udell (2004, 2005, 2006), an analyst at Microsoft, and is defined as *"a digitally recorded playback of a computer screen output which often contains audio narration, to visually present procedural information"* (Sugar, Brown & Luterbach, 2010, p.2). Common strands in the literature on screencasting in education focus on a number of key areas: the technology itself (Sugar *et al.*, 2010; Winterbottom, 2007; Kopel, 2010); research with large lectures groups (Green, Pinder-Grover & Mirecki Millunchick, 2011); assessing student creation of screencasts (Farkas, 2013); student access and perception of screencasts (Rose, 2009); optional usage and subsequent effect (Green *et al*., 2012; Grabe & Christopherson, 2008); talking with students through screencasting (Lee & Thompson, 2012); and implementation to scaffold learning and reduce cognitive load (Dalgarno, Pradhan & Lee, 2008).

In the design field, Hardaker & Rushin (2012) have researched the use of screencasts as a supplement to CAD teaching in fashion and textiles, with use of similar software and research methods. This present study has a different lens on the use of screencasts. It is carried out with a small number of students and focusses more on the user experience of the screencasts, their benefits in reducing cognitive load and fostering self-directed learning in first year interior design.

The aim of researching these four topics is to study the 'knock on' effect each area has on each other to answer the research question. The first year experience has challenges which are affected by the thinking style of the learner, the cognitive load placed on the learner due to heavy workload, and new learning challenges.

Methodology

A case study approach was taken for this research, more specifically, what Stake (as cited in Cousin, 2005, p.422) refers to as an *"intrinsic"* case study, which focussed on the use of the screencasts for education over the first year of an interior design course. The research question and sub questions are what Stake (as cited in Cousin, 2005, p.423) refers to as "*load bearing issue questions",* aimed at obtaining what Geerz, (as cited in Cousin, 2005, p.424) refers to as a *"thick description"* through the triangulated data collection methods used.

A constructivist viewpoint (Creswell, 2014, pp.5-9) was taken as the question proposed to solve a problem for students. There is *"no one reality"* (Badevi, 2013) to the benefit of the screencasts as the learners' perception has many variables. Grix (2002, p.177) states that *"all research necessarily starts from a person's view of the world, which*

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itself is shaped by the experience one brings to the research process". The epistemological position was therefore, leaning towards interpretivism. Bryman (as cited in Grix, 2002, pp.177-8), states that interpretivism *"is predicated upon the view that a strategy is required that respects the differences between people and the objects of the natural sciences"*. These research methods endeavoured to get an in-depth description of the first year Interior Design student experience, which did respect the differences between people in this specific case.

Study Participants

Two cohorts of students were involved in this case study. They were the first year students, who were receiving the screencasts in the 2014/15 academic year; and the second year students, who received the same screencasts in their first year of the course, which was the 2013/14 academic year. The majority of the screencasts were the same for both cohorts. Most of the students come from secondary school, with some coming from post leaving certificate level 5 or 6 courses. There were no male students in either cohort in this case study. There were 9 first year respondents and 8 second year respondents, with 16 students being under 23 years.

Research Methods

Fruitful results were achieved through a mixed methods approach, adding validity to the research (Creswell, 2014, p.201). The first method was a questionnaire, carried out at the end of the first semester. The survey consisted of 5 themes - 'course choice', 'first year learning experience', 'design thinking', 'traits of a good designer' and 'multimedia learning'. Each part had specific questions, with a total of 16 questions, 6 of which were

in the 'multimedia' learning section. There was a mix of open ended, closed and Likert scale type 'tick box' questions, to give a variety of data for analysis.

The second method was audio recorded focus group interviews, which were carried out with a *"purposeful"* sample (Punch, 2006, pp.54-6) from the two groups, at the end of the first semester. One focus group had four first year participants, and the other had two second years. This resulted in more in-depth descriptions of learners' experiences. It explored key areas for deepening understanding of the themes of this study: the learners' background; the first year learning experience; learners' thinking styles; whether the screencasts were fit for purpose and beneficial to learning, with questions aligned to Mayer's 'Cognitive Learning Theory of Multimedia Learning' (2009); and whether the screencasts do help to reduce cognitive load, and hence, workload in first year in understanding a more technical element of the curriculum.

Screencast Development

> *"If people aren't "getting it", maybe it's time to start telling stories they can't forget or misunderstand"* (Udell, 2005b, p.34).

The screencasts for this study were produced using free downloadable software called 'Hypercam', from Hyperionics.com. It has a simple dialogue box with a series of tabs, (see Figure 1), which can be opened from a shortcut on the computer desktop. It is a process of trial and error to synchronize the audio recording with the image recording. The file produced is in an AVI (audio video interleave) format and opened with 'Windows Media Player' or similar software. The recording varied from two minutes to ten minutes, depending on the depth of topic, and was not scripted, resulting in an informal presentation style. The screencasts, with an example shown in Figure 2, which shows the AutoCAD interface and a typical 3D CAD tutorial, were e-mailed weekly to

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the student cohort and were also accessible in the computer lab through the college server. AutoCAD screencasts are available online, but it was thought that tutorials that related directly to classroom teaching would be more beneficial for learning in first year.

Figure 1: The 'Hypercam' Dialogue Box

Ruffini (2012, p.34) argues that *"seeing, for instance a step-by-step sequence in great detail, or viewing a screencast video directly related to lesson content"* allows students to learn by example. Having screencasts available enabled the teacher to show them in class, then re-cap with the students and provide the screencasts for viewing after class.

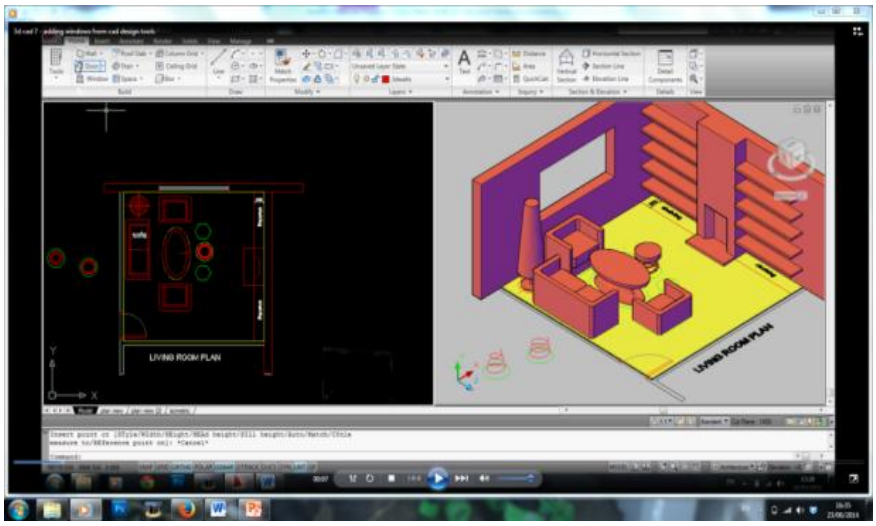

Figure 2: Screenshot of an AutoCAD screencast

Ethical Considerations

Before participating in the questionnaire and focus group interviews, students were furnished with a participant information sheet which outlined in clear terms what the study was about; why participation was required from students; what the questionnaire/focus group interview involved and how much time was involved in participation; an indication that the focus group would be recorded; where the data would be stored; how the researcher would ensure that data was secure; and what the data would be used for. A consent form was provided which stated that participation was voluntary and that the student could withdraw consent at any stage.

Data Analysis

Data gathered from the questionnaire was analysed using a spreadsheet which quantitatively and qualitatively assessed responses from the two learner groups under the headings of 'observation', 'comparison', 'explanation', 'relation to literature', 'implications for theory', and 'implications for practice'. The first three headings were formed as they seemed to be the best method of comparison and contrast between the two cohorts. The last three headings were formed in order to look to existing literature on the topics raised and then assess if any new findings emerged which had implications for existing theory or practice, or not, as the case may be. Visual representations were produced also, as they *"give us an understanding that is difficult if not impossible to get from other ways of presenting the information"* (Battersby, 2010, p.89).

Data gathered from the two focus group interviews were audio recorded and transcribed. Field notes were marked up on the transcriptions, and then a spreadsheet was created under the same headings as the survey spreadsheet. The focus groups

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delved deeper into the research objectives, resulting in much richer descriptions of the student learning experience. The transcriptions were open coded, with field notes initially, using a *"line-by-line technique"* (Noerager Stern & Porr, 2011, p.65) and key themes emerged, which were gathered together on the spreadsheet for analysis. "*Memoing"* (Noerager Stern & Porr, 2011, p.66) was used to analyse the focus group results. Key themes were grouped together and significant findings, relating to the research question, were highlighted.

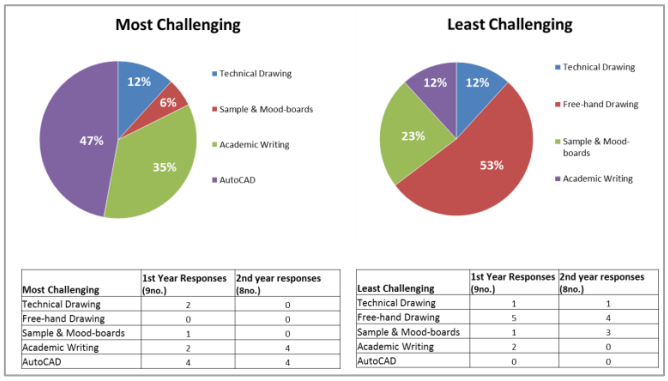
Findings and Discussions

Four main themes emerged from the analysis of the questionnaire and focus group interviews, which are discussed below.

Learning challenges Interior Design students have to overcome in first year

The main issues around new learning challenges in first year, in this study, are 'heavy work load' and having to be a 'self-directed learner'. The questionnaire results showed that 6 of 9 first years listed self-directed study as their biggest challenge. The first years focussed on the learning challenges of coming to college and getting used to a new way of learning, whereas the second years highlighted the learning challenges of key modules they had completed the previous year. When asked to reflect on the first year learning experience, all 8 of the second year students mentioned CAD, whether for positive or negative reasons. Findings may suggest that first years were presently dealing with these challenges, whereas second years, taking a retrospective view, had become accustomed to this way of learning, so it was the difficult modules they remembered. Focus group interview findings show that students in both years found the workload and self-directed study challenging, with comments from first years such as: *"The amount of work that we received, we weren't expecting such a load. It was really*

overwhelming. Even the modules we are studying. I didn't expect to get so many, or have so many projects at the same time." (First year student 'G') and *"Being in charge of your own work. Being on top of everything yourself. Organising what you're going to do. Not being told what to do and when to do it."* (First year Student 'B'); and comments from second years such as: *"It was just that we were learning so many new things. Just being introduced to so many different modules."* (Second year student 'M') and *"Well, to be honest, I prefer that (semester long projects), because in first year we had little small ones"….. "and we tried to finish them"…."and we tried to just get them done"* (Second year students 'M' and 'P'). The findings from the focus groups suggested that modules which were found to be challenging for students were 'AutoCAD', 'Proportion' and 'Structure', while questionnaire results (see Figure 3 below) suggested that 'AutoCAD' was the most difficult learning challenge/skill at 47%. Freehand drawing was the least challenging at 53%. Findings also show that none of the students found 'freehand drawing' the *most* difficult learning challenge and none found 'AutoCAD' the *least* challenging learning experience. From the questionnaire results, the main reason students give for 'AutoCAD' being the most challenging is because it is new to them. Other responses show that learning CAD presents various new challenges, relating to the time it takes to learn the software.



Most Challenging	1st Year Responses (9no.)	2nd year responses (8no.)
Technical Drawing	2	0
Free-hand Drawing	0	0
Sample & Mood-boards	1	0
Academic Writing	2	4
AutoCAD	4	4

Least Challenging	1st Year Responses (9no.)	2nd year responses (8no.)
Technical Drawing	1	1
Free-hand Drawing	5	4
Sample & Mood-boards	1	3
Academic Writing	2	0
AutoCAD	0	0

Figure 3: Pie Charts showing the most and the least challenging learning experiences in first year interior design for Question 4 on the questionnaire

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The main reason students give for 'freehand drawing' being the least challenging is because they have done it previously at 2nd level or at PLC level and because they enjoy it. This quote from a first year student shows how she feels about new technical, as opposed to freehand drawing: *"I like the drawing and making the tower and making the bridge. It involved a lot of different ideas. Whereas with 'CAD' – I found that hard, and 'Form and Space' I didn't do as well in that either. It was kind of more strict."* (First year student 'A').

In the focus group, when asked about first impressions of the course and whether anything had turned out differently than they had expected, findings suggest that students were surprised at the amount of self-directed learning and technical research involved. A first year student comments on making a load bearing stick tower: *"We weren't shown how to make them. That was the big challenge. You had to figure it out yourself from all the research that you did, and what to use, and how to do it. Usually we were used to being told – 'this is what you do and this is how you do it."* (Student 'G'). The similarities are that both years had a perception that the course would focus more on art and design elements which were all creative, rather than technical. This relates to Anderson *et al.*'s (2012) findings on the first year learning experience, showing that *"expectations are not met by reality".* The students have a perception from the media as to what interior design is, but there were more technical elements to the learning than they had thought. This is evident in the following quote: *"I didn't expect so much architecture in the course. I thought it was just based on interior design. I thought it was going to be a bit more 'fine arty' as well, if that makes sense. I understand why they're in the course, cos they're both really important, architecture and engineering. We'll have a better understanding of what is going on. It makes*

perfect sense why it's in there. I just never assumed it would be." (First year student 'G').

In the 'Multimedia Learning' section of the questionnaire, students were asked if their opinion had changed towards learning CAD software packages, in general, not just 'AutoCAD'. Findings show that half of the students surveyed in each year say their opinion has changed towards learning CAD software. These findings comply with Yang *et al.*'s (2013) findings on the presumption that school leavers in this digital age possess a high level of ICT skills. In relation to this current case study, findings suggest that CAD is a difficult learning challenge in first year due in part to the heavy workload of many modules, and that methods to alleviate this load would probably be embraced. Findings correlate with Meneely's research on thinking styles (2010), showing that students thought the course content would be more creative than technical and implies that there are challenges for lecturers of technical modules which involve practical skills and convergent thinking.

Thinking styles of first year Interior Design students

As discussed in the literature review, thinking styles of interior design students may have a bearing on which modules they find challenging in first year. This topic was incorporated into the questionnaire and focus group interviews to explain the reasons for the results from the theme above. In the questionnaire, students were given a definition of, and asked to state whether they were a convergent or divergent thinker, or a mixture of both. Questionnaire results (see Table 1 below), state that 10 of 17 students said they were divergent thinkers, 5 claim to be convergent thinkers, whereas 2 claim to be a bit of both. The results for each year were very different, with the majority of first

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years claiming to be divergent, whereas the majority of second years claim to be convergent. The first year results may prove that when students begin the course they are mainly divergent thinkers, whereas when they move to second year they become more convergent, realising the importance of technical skills in the design process. However, this may not be reliable, with such a small group surveyed. The first year results correlate to the literature on design thinking, whereas the second year results may contradict the literature, or prove they are in transition to becoming a mixture of both styles.

Table 1: Survey Q5. (ii) Would you describe yourself as a convergent or divergent thinker?

Thinking Type	1st Year Responses (9no.)	2nd year responses (8no.)
Convergent	0	5
Divergent	7	3
Both	2	0

Focus group results show that four of the six students involved in the two focus group interviews claim to be 'a bit of both', whereas two students claim to be divergent thinkers. One second year student stated that she had said she was a convergent thinker in the questionnaire, but believed she was a bit of both. Students may not have been aware that they could state that they were both types of thinker. No student in the two focus groups claimed to be a convergent thinker. One first year explained why she feels she is 'a bit of both': *"I'm able to handle practical tasks, the likes of CAD – like 'black and white', but I can go creative with stuff as well. So I think I fit in to both."* (Student 'B') One first year explained why she feels she is a divergent thinker: "*Divergent, because I'm more creative. I don't really think there is one answer to all of those things."* (Student 'A') Second years showed awareness that 'CAD' is a convergent thinking module and stated *"It's mathematical. It's all precise."* They used the 'Furniture and Storage' module in second year as an example of a module that requires

both types of thinking, stating: *"I think probably with 'furniture and storage'. It needs to work. It needs to function. Also you have to be creative as well, but you don't want to be too creative or the thing doesn't work."* (Student 'M').

In terms of this case study, findings mainly correlate with existing literature on design thinking by Lawson (2006), Meneely (2010) and Carmel-Gilfilen (2012), of interior design and architecture students. The results show that there are challenges for a lecturer in teaching the more practical, convergent thinking modules in first year, as most design students claim to be divergent thinkers. It is an ongoing learning process for students to become both types of thinker. The focus group results suggest that students are aware of this, as they changed their response from what they had written on the survey. It cannot be proven in this study, that screencasts can help to change the thinking styles of interior design students, to become both types of thinker, but CAD screencasts can help the student to make the transition an easier one, by being a memory aid when tackling convergent thinking tasks.

Students' Perceptions of Multimedia Learning

In the 'Multimedia learning' section of the questionnaire, findings suggest that the most common reasons to use the post-lecture CAD screencasts are 'to solve a problem' and to 'remember' or 'refer back on' them if revision is required. Results are similar from both years, with some individual responses which tie in to the main themes mentioned above, such as 'revise', 'practise commands', 'complete activities' and 'watch after class' or 'missed a class'. Only one student stated that they had not used them. These results reflect the main purposes of the screencasts which are to help reduce cognitive load when the students are learning so many new topics and skills in first year, and to

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encourage self-directed learning. When asked how often the students refer to the screencasts the majority use them sometimes, with only one using them often, one never using them, and two have not used them yet in second year (See Table 2 below). The results are positive and support the use and the benefits of the screencasts for students' learning of CAD, promoting self-efficacy (Green *et al.*, 2012) and reduction of cognitive load (Mayer, 2009).

Table 2: Results for Q.7 (ii) on how often students refer to the screencasts (often being weekly)

Frequency	1st Year Responses (9no.)	2nd year responses (8no.)
Often	1	0
Sometimes	7	6
Never	1	0
Not yet	0	2

CAD Screencast Evaluation

The focus group interviews aimed to delve further into the students' perceptions of the use of screencasts for their learning. The findings reiterate that they are fit for the purpose of revision of CAD tools. In second year they are not used as much because students *"know the basics"*. In both focus groups, students state that they do not need to be improved, with comments such as, *"I think they work fine"*, *"they're useful"* and *"they were to the point"*. Subsequent questions in the focus group aligned the evaluation of the screencasts to Mayer's (2009) 'Principles of Multimedia Learning' focussing on eight of twelve principles, which were most applicable in the context of teaching AutoCAD through screencasts (see Table 3 and Figure 4 below). Some of the twelve principles are more related to printed graphics and text in hard copy, which is not relevant to the screencasts. It should be noted that students were made aware of Mayer's Principles in advance, but questions were phrased in simpler terms to be more easily understood.

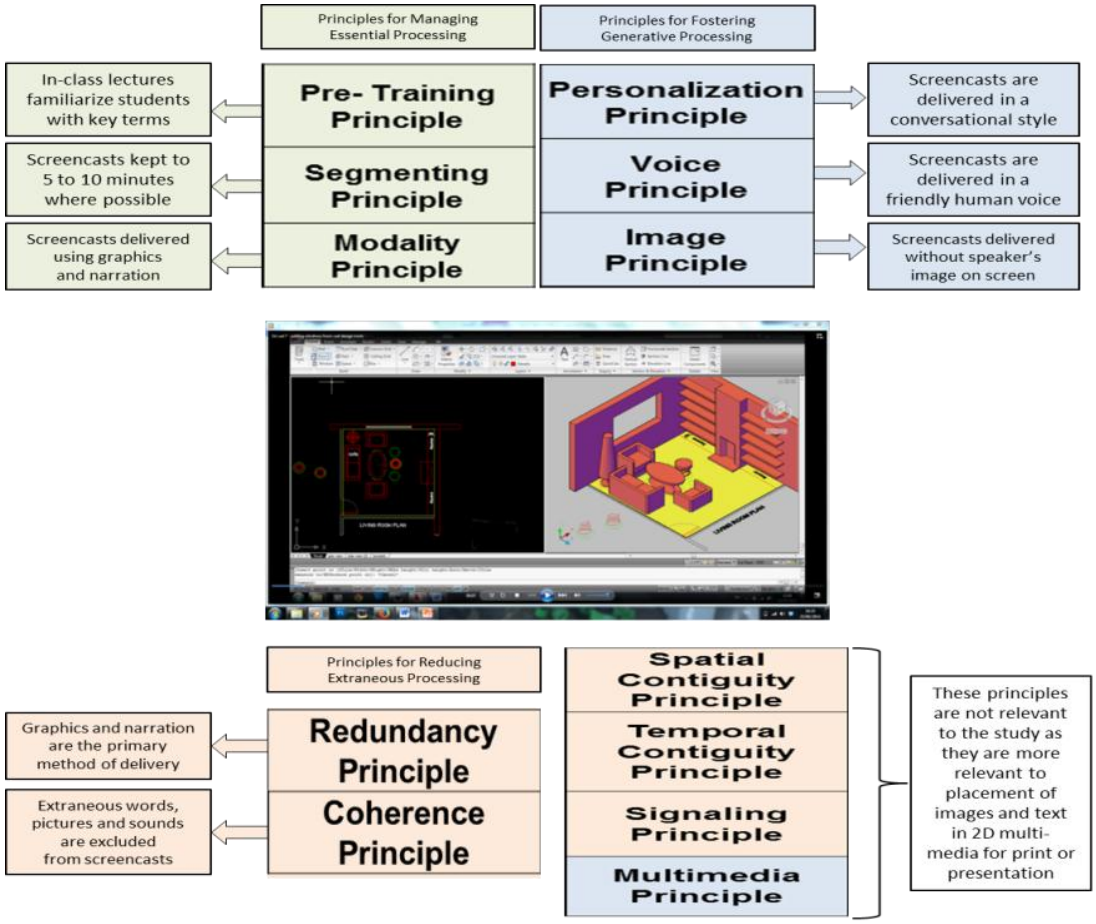

Figure 4: Diagram (showing a screencast screenshot for reference) relating 8 of Mayer's Principles relevant to the context of the study (Refer to Table 3 for definitions)

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Table 3: Mayer's Principles of Multimedia Learning (2009, Ch.12, pp. 265-280) are defined in column 2, with focus group findings shown in Column 3, and implications for practice in Column 4

Mayer's Principles of Multimedia Learning	Definition	Focus Group Findings	Implications for Practice
Redundancy Principle (Principle for Reducing Extraneous Processing)	People learn better from graphics and narration than from graphics, narration and on-screen text.	The students feel that they don't need any pop-up text. The cursor moving on screen and the narration is enough to learn CAD with, unless the student is hearing impaired.	Complies with Mayer's Redundancy Principle. The students response implies that the screencasts are fit for purpose as they are.
Segmenting Principle (Principle for Managing Essential Processing)	People learn better from a multimedia lesson which is presented in user-paced segments, rather than as a continuous unit.	Findings suggest that students find the length of the screencasts adequate. They feel it is dependent on the task in hand. 5 to 10 minutes is ideal. Some said they would watch something longer if they really wanted to learn something. Others said they could be segmented if too long, and that if they were too long you wouldn't watch them all.	Complies with Mayer's 'Segmenting Principle'. It is best to make sure that screencasts are 5 to 10 minutes long unless it is necessary to make them longer.
Modality Principle (Principle for Managing Essential Processing)	People learn better from graphics and narrations than from animation and on-screen text.	Students prefer to learn from videos / screencasts than from written notes with pictures. This would suggest that people learn better from watching the 'doing' of a task than reading about it in notes with images.	Does not relate directly to Mayer's Modality principle, but does show that multimedia learning is preferable. This response encourages a lecturer to use multimedia learning as part of their teaching.
Personalization Principle (Principle for Fostering Generative Processing)	People learn better from multimedia lessons when words are in conversational style rather than formal style.	The students feel that they do learn better from an informal conversational narrator. Reasons given are: it feels like the teacher is on their level, teacher is not patronizing and the teacher can give personal experience and advice.	Complies with Mayer's 'Personalization Principle'. This response indicates that the informal, unscripted narration on CAD screencasts is fit for purpose.
Voice Principle (Principle for Fostering Generative Processing)	People learn better when the narration in multimedia lessons is spoken in a friendly human voice rather than a machine voice.	Students were not directly asked this question, but the answers above show that it could be said to comply.	Complies with Mayer's 'Voice Principle'
Image Principle (Principle for Fostering Generative Processing)	People do not necessarily learn better from a multimedia lesson when the speaker's image is added to the screen.	Students responses show that students feel they would not learn better if they could see the narrator on the screen, as it could be distracting. With CAD screencasts only a cursor and a voice is required. The exception is for hearing impaired students.	Complies with Mayer's 'Image Principle'. There would be no advantage to adding the lecturer's image on a CAD screencast.

Analysis of the screencasts, based on eight of Mayer's principles, reiterates the fact that students feel that the screencasts are fit for purpose in this case. Expanding on the 'Modality Principle', students were asked if they require written notes in addition to the screencasts. Findings suggest that students are divided on this issue. These 'net generation' (Prensky, 2001) students do prefer to use technology to learn and also prefer digital notes rather than printed versions. This response encourages a lecturer to use screencasts as part of teaching, but also provide written notes, preferably in a digital format, which is the way they are delivered presently.

Expanding on the 'Personalization Principle' and 'Image Principle', students were asked if they needed to know and be familiar with the teacher on a screencast. The students' response is that they don't need to know the narrator personally in order to better learn the content of the screencast. Some reasons given are *"if the teacher is good at teaching that's all that counts"*, *"if they are engaging"*, and *"if they can understand them"*. Findings suggest that the narrator in the screencast does not necessarily need to be the lecturer in face-to-face teaching, so tutorials from other sources could be used by lecturers if appropriate.

Conclusions

The purpose of this study was to explore the benefits of provision of post-lecture screencasts on a CAD module for first year Interior Design and Furniture students at Dublin School of Creative Arts. The screencasts were provided to reduce cognitive load for students in a course with a heavy workload in first year. Two cohorts, who had used the screencasts, were involved in the study – 9 first years and 8 second year students. The context and rationale of the case study argued that design students tend to find the

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more technical, convergent aspects of the course, including CAD, more challenging in first year, due to the fact that research has shown that designers tend to be more divergent thinkers. However, a good designer needs to be a divergent and convergent thinker in equal measures (Lawson, 1997).

Four themes emerged in the study: learning challenges in first year; thinking styles of design students; uses of multimedia learning; and evaluation of the 'fit for purpose' nature of the screencasts, using Mayer's (2009) Cognitive Load Theory of Multimedia learning. Findings suggested that theories put forward on learning challenges and thinking styles were correct in the context of this study, although most second years claimed to be convergent thinkers, which may imply they are in a period of transition, but cannot be substantiated in a case study with small numbers.

Evaluation of CAD screencasts by students showed that they were fit for purpose, as they were used *"to refer back on"* and were *"to the point"*. Eight of Mayer's twelve principles of Multimedia learning for reduction of cognitive load, which applied to screencasts, were advocated by student's responses.

Findings suggest that a blended learning approach, introducing multimedia formats of teaching, in tandem with face-to-face teaching, are welcome in a design course in first year to reduce cognitive load and allow students to refer back on classroom teaching. Findings suggest that students become more self-directed learners, teaching themselves new skills, through screencasts. This relates to research by Paas, Renkl & Sweller (2003, p.4), that *"as levels of expertise increase, it is appropriate to decrease instructor controls and increase learner control."*

Third level Interior Design students may perceive themselves to have full knowledge of skills they have previously learned in second level, but there is potential for building on their inherent knowledge, even if the screencast is not created personally by the classroom teacher.

Future development on issues explored in this research could include:

- Further research on how the design thinking styles of first year students affect their learning experience.
- Similarities/differences in design thinking styles within various art and design disciplines could be explored further.
- Exploration on how eLearning technologies support the current drive to promote design thinking and creativity in education and industry, for a better society.

The following recommendations are offered as pedagogical and practical guidance for lecturers embarking on the use of screencasts:

- It has been shown in this research that it would be beneficial to align screencast production with Mayer's theory of Multimedia Learning.
- Pedagogical, practical and technical aspects of screencast design are advocated by many third level institutions, with excellent advice available, for example, from University of Colorado's website at: http://assett.colorado.edu/learn/pedagogical-topic-resources/effective-screencasting-faq/
- Screencasts can be made at little or no cost, and the time spent on creating them is relatively minimal, which is financially beneficial for third level institutions.
- The provision of screencasts, in this case, has been proven to promote self-efficacy (Green *et al.*, 2012) over time, which is an important attribute on a

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design course at third level, where many modules are project based and continually assessed. This is also an important attribute to prepare students for employment in the design industry.

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