Designing and Using Self-Paced Tutorials: Lessons from the Pilot

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CONTEXT

The literature has shown the importance of students developing threshold concepts and undertaking formative assessment. There are also suggestions within the literature that many students will not undertake beneficial activities that display no direct reward in terms of grades. A new electrical engineering common first year subject with 450 students resulted in bottle necks for providing effective feedback. An online self-paced tutorial resource was created that advanced students through core threshold concepts, supplemented with non-assessed activities that guided students through the process of solving problems and understanding class material

PURPOSE

The purpose of this pilot study was to answer the research question 'Will students use this ungraded resource and how would they use it?' Findings from this study will be used to expand the resource and better target the design, implementation and usefulness.

APPROACH

Self-paced tutorials were designed based on recommendations from the literature. They were placed on the subjects Moodle site and promoted as a free resource, having no direct contribution to grades, that would reinforce threshold concepts. Moodle analytics were used to measure student interaction and progress with the tutorials. A survey was completed at the end of the session to gain additional feedback.

RESULTS

The study found that approximately only a third of students in the subject engaged with the self-paced tutorials. The students that did engage found the resource beneficial, but the feedback suggested that dedicated tutorials on more complex exam styled questions were needed. Insufficient feedback was received from students that found no benefit from the resource. At least 91% of students that failed the subject did not fully engage with the self-paced tutorials.

CONCLUSIONS

The initial student usage from the pilot provided enough encouragement to use the feedback to develop more modules to support student learning. The modules once developed can be reused across numerous years and shared with other campuses. The design structure can be considered by other academics attempting to develop similar resources. The biggest challenge moving forward is trying to encourage the students at most risk of failing to engage with the self-paced tutorials. This may be due to no direct reward in terms of grades.

KEYWORDS

Formative assessment; Self-paced learning; Threshold concepts

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Introduction

It is generally well acknowledged that feedback plays an important role in helping students advance their education. Good feedback practice is associated with: clarifying good performance; developing reflection and self-assessment skills; informing students about their learning; increasing motivation and self-esteem; closing the gap between current and desired performance; and providing information to teachers to help shape their teaching (Nicol & Macfarlane-Dick, 2006). There are many forms of feedback both direct and indirect that are being used in the higher education sector. Formative assessment is one form of feedback rising in popularity. The use of formative assessments has been found to allow students to learn from their mistakes leading to an improvement in student performance (Hwang & Chang, 2011; López-Pastor, Pintor, Muros, & Webb, 2013). However, providing good feedback, such as through formative assessments, can lead to workload challenges for the instructor, especially when associated with large class sizes and limited resources (López-Pastor et al., 2013; Poza-Lujan, Calafate, Posadas-Yague, & Cano, 2016).

A new common first year electrical engineering subject (representing ten engineering majors) with approximately 450 students led to the challenging task of providing enough support and feedback to aid learning within resource constraints. The subject was comprised of weekly two-hour lectures, one-hour tutorials and two-hour laboratory sessions. Multiple approaches of support were considered, such as running PASS sessions (Power Ms, 2010). Funding constraints and the desire to provide flexible, any time learning led to the development of several self-paced tutorials that provided students confirmation of the attainment of key threshold concepts. Targeting the resources at threshold concepts was important as it has been found that if students do not reach understanding of the key concepts they can 'get stuck' finding it extremely difficult to move forward in their learning (Meyer & Land, 2006).

The self-paced tutorials were designed as SCROM packages integrated into Moodle that provided alternative instruction to content discussed in lectures and tutorials and provided formative assessment opportunities to help guide students through the process of solving electronics based questions. To allow students autonomy over their learning it was decided that this resource would not be used toward student's grades. However, such ungraded approaches have been found to be mostly ignored by the students that would benefit from them the most (Nikolic, Stirling, & Ros, Online Early Access). Therefore, the purpose of this pilot study was to answer the research question 'Will students use this ungraded resource and how would they use it?' The research question is answered by analysing student usage analytics and through an online survey with the findings to be used to guide the future direction and development of the resource. The findings are of value to academics interested in developing similar resources. This paper will explore the design of the online tutorials and initial student usage.

Design of Self-Paced Tutorials

Moodle is the University of Wollongong's online learning management platform. Built into the platform are many tools that allow for the dissemination of information (for, example links to presentations, videos and websites) and assessment (such as quizzes). Quizzes provide

functionality to provide detailed feedback with each assessment attempt. However, the goal of the self-paced tutorials (SPT) was to integrate both instruction and assessment into the one module, in much the same way a live tutorial would be run. Such functionality is provided by Moodle using uploaded SCROM packages.

The SPTs were designed using Adobe Captivate V7 and exported as SCROM packages to be integrated into Moodle. Adobe Captivate provided a user-friendly interface allowing for both instruction as well as assessed activities within small encapsulated modules. Assessment results and usage statistics were available through Moodle, but a key design decision was made that the assessment results would not be formally used within the subject promoting student freedom to learn without the pressure associated with formal grades. This is because previous attempts to provide graded formative assessment using Moodle quizzes led the students to find ways to overcome Moodle; such as opening the question in multiple tabs, finding the correct answer then entering it into the quiz, with the students focussed on gaining marks and not learning from the experience. The common structure of the SPTs was to blend instruction with assessment, stepping the student through the process of solving electronics based questions. A sample structure is shown in Figure 1 highlighting the blending of instruction and assessment. The figure shows how a threshold concept is translated into a problem. The problem is then broken into a set of quiz based steps asking the learner to answer questions in each step of the solution. Each step is followed by immediate feedback. In this way, a small unit of information is communicated at any one time.

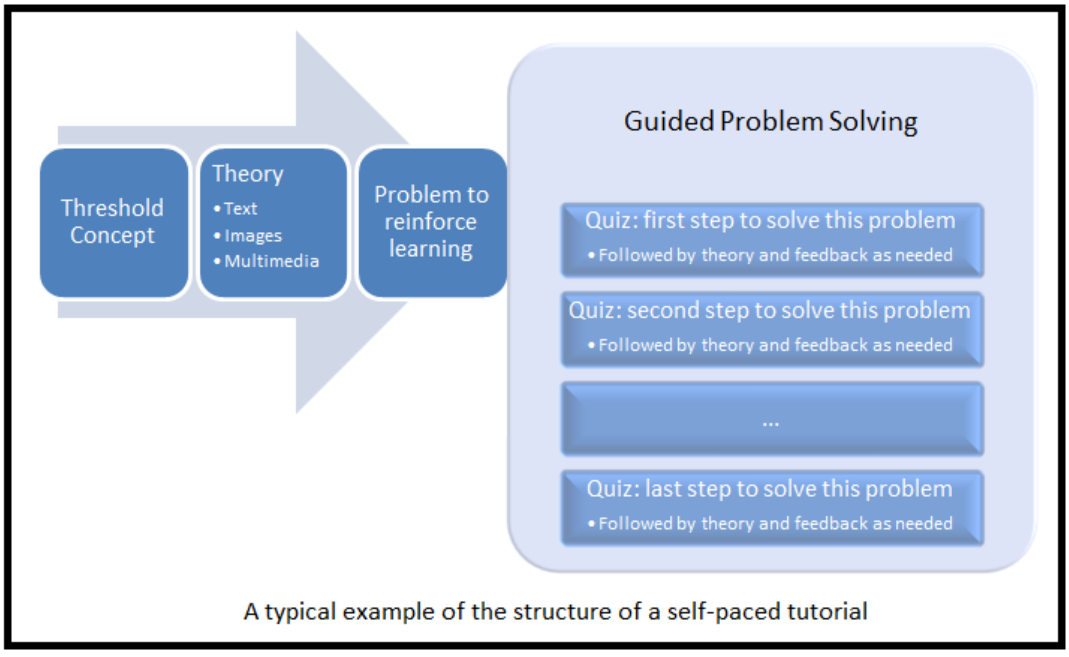

Figure 1: Sample structure of a Self-Paced Tutorial

Figure 2 provides an example of how instruction is provided and then immediately followed with an assessment to check understanding. In this instance students are guided with several slides focussed on developing knowledge of the threshold concept of series circuits, followed by a few activities to check their understanding. Feedback is provided to help the student develop an understanding of where they have gone wrong.

Figure 3 provides an example of how the SPT is used to guide students through the process of undertaking nodal analysis. Nodal analysis is typically found to be challenging by many learners. They require to understand the concept of a node, voltage at a node, current

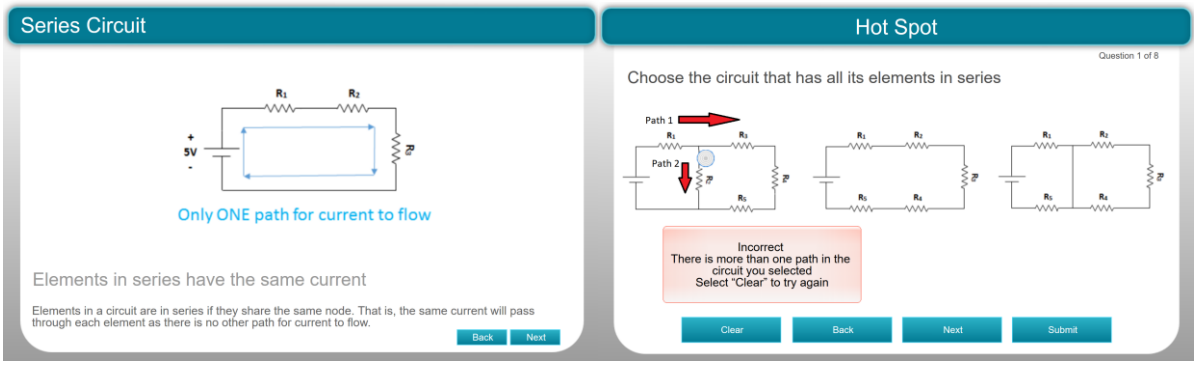

Figure 2: Sample of reinforcing instruction

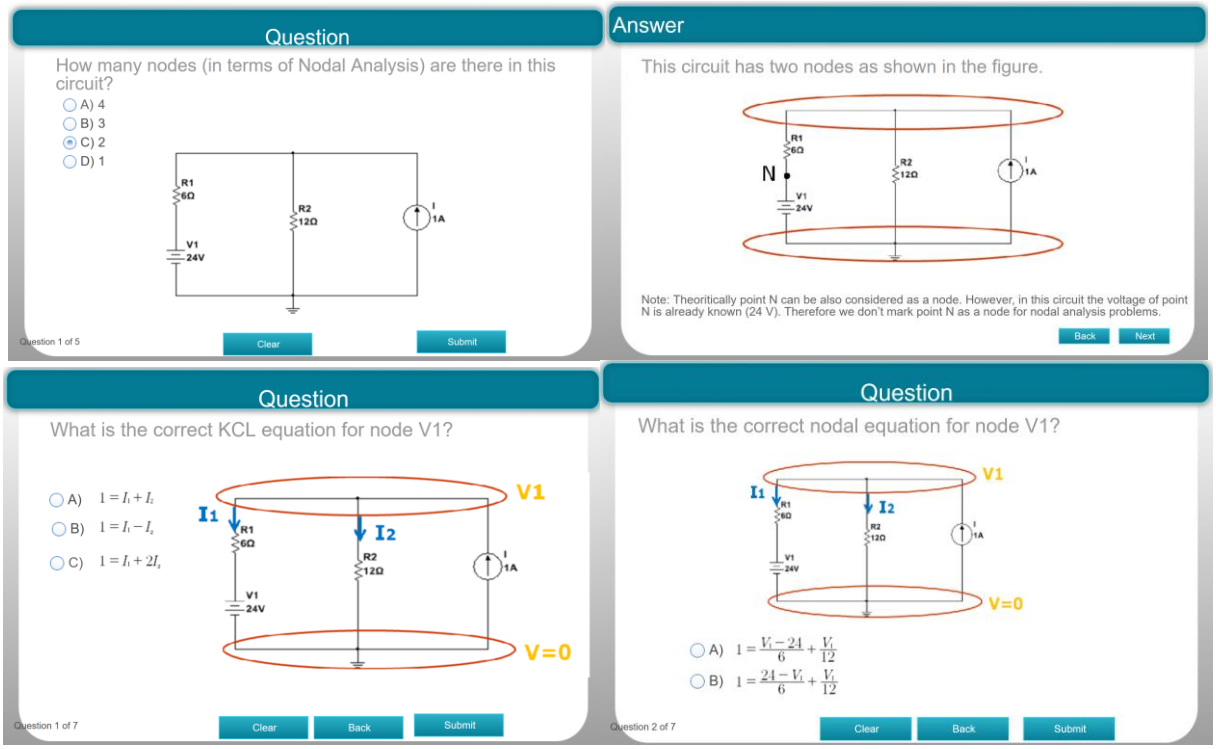

Figure 3: Example of stepping through a problem (selected steps shown)

through a node, Kirchhoff's Current Law (KCL) and solving general simultaneous equations. Learners are stepped through the process of identifying the nodes, determining the KCL equation and then identifying the correct nodal equation. Again, the blending of instruction and assessment is used to provide students with the confidence in overcoming the threshold concept.

Research Method

The pilot study was undertaken in 2016 during the months of July to October (with exams in November and supplementary exams in December) in the subject ENGG104. A total of 448 students were enrolled covering the civil, computer, electrical, environmental, materials, mechanical, mechatronics, mining, telecommunications and flexible (undecided) engineering. A total of ten SPTs were designed for the pilot covering DC circuit basics, series and parallel circuits, solving equations, nodal analysis, capacitors, superposition and Thevenin's theorem. The SPTs were advertised to the students in the lecture and allocated a section within the subjects Moodle site. The SPTs were advertised as a self-help resource that did not count

towards their final grade with the onus on students to determine their suitability. The students could retake any module as many times as required and could undertake them at any time. Due to the research nature of the pilot, students were clearly informed that their interaction with the resource would provide consent to the use of Moodle data analytics associated with the SPTs. This may have prevented some students from engaging with the SPTs and may have some impact on the findings presented in this paper. Eight of the modules were available to the students from the start of the teaching session in July. The last two modules became available from the start of September.

Results & Discussion

Engagement with the SPTs peaked with the first module based on introducing series and parallel circuits. At this peak only 61% of students showed any interest in exploring the resource. From the second module engagement dropped to a third of students with engagement dropping steadily thereafter with the average usage across all ten modules being 28% (noting that the last two modules were released with a two month delay possibly contributing to lower the average). It could be assumed that of those that attempted the first module and did not engage with any further modules either did not find the module of value or did not enjoy the experience of using the SPT. There is also another possibility that given time demands from this subject and other subjects, students may have put off attempts until a later date and simply did not get to it. This possibly suggests the importance of ensuring that the first module provides the best possible experience. Table 1 shows the distribution of student attempts across the modules including the percentage of students successfully completing (100% grade) and those not engaging (0% grade) with the module. The data shows that of the students engaging with the modules, many did not try to ensure full understanding by attaining a 100% grade; the more complex the module, the lower the completion rate. That is, they could see that they had not fully grasped understanding of the threshold concept and for some technical or personal reason did not try the module again to benefit their understanding. This is further analysed by looking at the number of attempts made with each module, seen in Table 2.

Table 2 shows that most students engaging with the SPTs either only needed one attempt or more, but did not undertake more attempts to successfully complete the module. This could have been for several reasons including: technical issues; did not find the module of any benefit; skipped ahead and saw the answers through the guided feedback and believed that a reattempt would be of no value; were overloaded with other commitments; or, simply were not motivated.

Table 3 outlines the monthly statistics as to when the students attempted each module. All but the last two modules were released at the start of the teaching session in late July. As expected, the data shows a loose correlation, with most usage centred around the period the topic is covered in the lecturers as well as the week 7 (in early September) in-class test. Usage in November and December indicates usage prior to final and supplementary examinations. Therefore, the data suggests that for those engaging with the SPTs exam preparation played an important role in their usefulness for students.

At the end of the session an anonymous online survey was conducted. A total of 33 students (7.3%) responded to the survey. All students that responded to the survey found the SPTs as useful to their learning experience. Unfortunately, this provides a limitation in that no data could be analysed to develop an understanding as to why other students found no use with SPTs.

Table 1: Engagement with the Self-Paced Tutorials

Self-Paced Tutorial Module	Attempted	Completed Successfully	Accessed with no engagement with assessment
Series and Parallel Circuits	61%	46%	13%
DC Circuit Basics	36%	82%	2%
Kirchhoff's Law Basics	39%	80%	6%
Identifying Nodes for Nodal Analysis	38%	75%	1%
Writing Nodal Analysis Equations	38%	49%	12%
How to Solve Simultaneous Equations	23%	57%	15%
Superposition	29%	51%	16%
Thevenin's Theorem	31%	38%	22%
Capacitors in DC Circuits 01 (released Sept)	18%	27%	17%
Capacitors in DC Circuits 02 (released Sept)	11%	41%	8%

Table 2: Student Attempts at Completing Each Module

Self-Paced Tutorial Module	Completed Successfully	1 Attempt	2 Attempts	3 Attempts	4 Attempts	5+ Attempts	Total Attempts
Series and Parallel Circuits	46%	274	68	19	5	3	369
DC Circuit Basics	82%	161	18	2	0	0	181
Kirchhoff's Law Basics	80%	174	7	1	0	0	182
Identifying Nodes for Nodal Analysis	75%	169	18	3	0	0	190
Writing Nodal Analysis Equations	49%	169	29	9	2	0	209
How to Solve Simultaneous Equations	57%	101	2	0	0	0	103
Superposition	51%	131	14	0	0	0	145
Thevenin's Theorem	38%	138	11	0	0	0	149
Capacitors in DC Circuits 01	27%	82	7	1	0	0	90
Capacitors in DC Circuits 02	41%	51	4	0	0	0	55

Table 3: Student Attempts by Month

Self-Paced Tutorial Module	July	Aug	Sep	Oct	Nov	Dec
Series and Parallel Circuits	190	80	52	22	21	4
DC Circuit Basics	64	44	41	15	15	2
Kirchhoff's Law Basics	34	61	50	17	18	2
Identifying Nodes for Nodal Analysis	28	54	64	17	25	2
Writing Nodal Analysis Equations	21	46	83	23	33	3
How to Solve Simultaneous Equations	12	22	41	10	16	2
Superposition	10	26	68	16	23	2
Thevenin's Theorem	10	29	63	19	25	3
Capacitors in DC Circuits 01	N/A	N/A	23	43	21	3
Capacitors in DC Circuits 02	N/A	N/A	15	28	12	0

The usage data in Table 3 is supported by the survey response data in Table 4 indicating that the SPTs were mainly used after the content was taught in the lecture and particularly before a quiz or exam. Reasons for using the SPTs were based on helping understand the content, quiz or exam preparation and testing knowledge without the worry of assessment marks as seen in Table 5. This suggests that the ungraded nature of the tutorials was a drawcard for the students that engaged with the SPTs. Additionally, 97% of the respondents stated that the pilot should be expanded with more modules.

Table 4: Use of Self-Paced Tutorials

When did you mainly use the Self-Paced Tutorials?	Response
Before the context was taught in the lectures	6%
After the context was taught in the lectures	27%
Before scheduled tutorial session	3%
After scheduled tutorial session	3%
Before a quiz or exam	45%
Other (please specify)	15%

Table 5: Reasons Students used the Self-Paced Tutorials

Why did you use the Self-Paced Tutorials? (select all that apply)	Response
I was curious as to what they were	48%
I needed help understanding the content	70%
I wanted to test my knowledge of the topics without the worry of assessment marks	70%
Exam or quiz preparation	67%
There was no PASS class assigned for this subject	30%
I thought they were compulsory	3%
Other (please specify)	9%

The survey provided students with an opportunity to express positive and negative comments about the design of the SPTs. Most of the comments expressed that the '*design was good'* and the SPTs are *'very helpful'* and '*I like that I am tested on that very information that is presented*'. However, common across most comments was the need for '*more questions or explanations*' and for '*harder questions*'. Some students also commented on the desire to be able to redo various modules, already possible and suggests better communication of information is required. However, as outlined earlier the respondents were those that found the SPTs useful and therefore feedback on how to improve the resource for those that failed to engage is missing.

As Nikolic et al. (Online Early Access) found that students needing to engage with ungraded formative assessment the most actually didn't, it was important to analyse usage for the 56 students that failed the subject. It was found that 73% did not engage at all with the SPTs, 18% only attempted a few of the easiest modules, 5% engaged but in most cases never achieved full marks and 4% only attempted selected modules. Therefore, at least 91% of students that failed the subject did not take full advantage of the SPT resource providing support to the findings of Nikolic et al. (Online Early Access).

Conclusion

This pilot study attempted to answer the research question 'Will students use this ungraded Self-Paced Tutorial resource and how would they use it?'. The research data indicates that only approximately a third of all students were willing to engage and use the resource on an ongoing basis. Of those that failed the subject at least 91% did not fully engage with the SPTs supporting the work of Nikolic et al. (Online Early Access) that a major problem with ungraded formative assessment is that those that need the feedback the most don't engage. Moving forward incentives need to be found to encourage such engagement.

As this was a pilot, the results and feedback provided some encouragement in continuing to develop more modules and refine the existing modules. Once built, the resources can be reused across many years saving cost and can also easily be shared with our other campuses. In the future, it would also be of benefit to compare the participation rate with that of PASS. The authors hypothesize that the participation rates would be similar. It was found that the main way the SPTs were used was for preparation of a quiz or exam, followed as a supporting resource after the lecture.

Common in the feedback was the need for more and harder questions. As a result, the next iteration will contain two different modules for every threshold concept. The first will be labelled as 'basic' targeted at understanding the fundamentals of the concept. The second will be labelled as 'advanced' targeted at working through examination level questions. Unfortunately, no feedback was provided by students that found no benefit from the SPTs providing it difficult to enhance the modules to better engage these students. The authors will try and undertake a focus group to gather this understanding.

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