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Updating Assessment Styles: Website Development Rather Than Report Writing for Project Based Learning Courses

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ABSTRACT

While teaching methods tend to be updated frequently, the implementation of new innovative assessment tools is much slower. For example project based learning has become popular as a teaching technique, however, the assessment tends to be via traditional reports. This paper reports on the implementation and evaluation of using website development as an assessment tool for a project based learning course. A questionnaire was used to gain student feedback in a first year engineering course where the website based assessment tool was introduced. It was found that developing a website rather than writing a report was not an onerous task for the majority of students, it allowed the students to be more creative and the students enjoyed the experience. Initial concerns with potential bias towards those that were studying computing were unfounded and in fact the students not studying computing reported that it was easier than those with a computing background. The website allowed the students to apply their visual communication skills, be more creative and practise communicating with a more general audience. The use of a website as an assessment tool could easily be adapted to a range of courses aimed to enhance communication (both written and visual) and encourage creativity.

Key words: Engineering education; project based learning; website development

INTRODUCTION

Teaching methods are changing over time for multiple reasons but one which often drives change is adapting to new technologies. For example, taking notes during lectures has now largely been replaced by lecture materials being available online for download. When using traditional teaching tools there is a danger that students will 'turn off' and fail to grasp important concepts simply due to

the method of teaching (Mohler, 2001). In response to this teaching styles are evolving. An example of a shift in teaching styles is the incorporation of project based learning into many engineering courses (for example Chandrasekaran et al., 2012; Hsu and Liu, 2005; Steinemann, 2003). However, even though the teaching method has changed the assessment of project based learning courses is often via a traditional written report (for example Martinez, et al., 2011; Palmer et al., 2011; Wong et al., 2005).

With a change in teaching and learning styles comes a change in the role of the teacher and the student. As described by Pachler (2005) the teachers role is changing "from oracle and lecturer to consultant, guide and resource provider. Teachers become expert questioners rather than providers of answers. Teachers become designers of student learning experience rather than just providers of content" (pg 193). The role of students is also changing "from passive receptacles for hand-me-down knowledge to constructors of their own knowledge. Students become complex problem-solvers rather than just memorisers of facts" (Pachler, 2005, pg 193). With this change in roles a review of assessment tools is required to ensure they are appropriate for today's students. While traditional tests, assignments and writing reports still have a place in today's teaching and learning environment, staff should not limit themselves to these tools alone. Although staff might be comfortable changing teaching methods, changing assessment techniques can be more daunting for staff due to the potential consequences on grades if changes prove to be unsuccessful. However, staff should be encouraged to engage with new technologies to ensure that not only our teaching methods stay relevant but also our assessment tools (Erstad, 2008).

To ensure that new teaching and assessment tools are useful, the technologies that students are already familiar with need to be considered in order to try and encourage students to engage with the material and therefore gain greater retention of knowledge (Ali, 2013). For example, most teaching aids currently in use are static (e.g. study guides, copies of powerpoint slides, and textbooks) however a vast potential lies in the application of Information Communication Technologies (ICT) to enhance learning via teaching methods and assessment techniques.

It is important to realise that today's students have grown up in a digital world and that they regularly use the internet. For example it has been reported that 24% of teens are online "almost constantly" with an estimated 92% of teens going online at least once a day (Lenhart, 2015). Students today are 'digital natives' (Prensky, 2001) so even if they are not familiar with a certain technology they are generally able to pick it up and become proficient very quickly. The challenge is that staff are 'digital immigrants' and no matter how well they learn and adapt to the new technological environment they retain an 'accent' (Prensky, 2001). For example, while 'digital natives' tend to be self-taught and learn to use new tools via trial and error 'digital immigrants' struggle to understand this and expect instructions. The argument of 'digital natives' and 'digital immigrants' has been seen

as somewhat simplistic as it has been reported that there is as much variation within these groups as between these groups (Bennett et al., 2008). However, with regards to advances in ICT, students rather than staff are the early adapters (Reijenga and Roeling, 2009) which can be intimidating to staff as the students often understand the new technology at a much higher level than the teachers (Ali, 2013). Teachers have been reported to be resistant to incorporate ICT into their teaching due to a lack of ICT experience, a lack of on-site support and a lack of time to incorporate it into courses (Mumtaz, 2000). Research has shown that for engineering educators to adopt a new practise it must be clear how the innovation offers advantages over current practise and it must not be difficult to adopt which is achieved by ensuring it is based on what is already familiar to the users (Brooks, 2013).

When reviewing teaching and learning methods it is also important to realise that today's engineering students also require more than just technical skills. They also need to be able to work in teams, manage projects and communicate with a range of audiences. While project based learning is often used to facilitate teamwork and project management skills it also has the potential to enable students to communicate with a general audience. In terms of communication methods formal writing is a critical skill required by engineers but it is also important to ensure students can adapt their writing style to be appropriate for different situations (Moore and Morton, 2015). According to the Washington Accord, engineers need to "Communicate effectively on complex engineering activities with the engineering community and with society at large ..." (International Engineering Alliance, 2013, pg 11).

While redesigning a first year engineering project based learning course the assessments were carefully reviewed and it was decided that the report should be replaced by a more innovative assessment technique. The purpose of the assessment was to allow the students to report on their progress during the course and present their final solution in a creative way where they could practise writing for a general audience. The assessment tool selected was a website which could be developed during the course as a series of assessments.

A range of online assessment tools have been reported in the literature including websites, blogs, wikis and e-Portfolios (Bishop et al., 2014; Carroll et al., 2006; Chao, 2007; Chen et al., 2005; Judd et al., 2010; Miyazoe and Anderson, 2010; Reijenga and Roeling, 2009). These tools are generally used to facilitate collaboration between students, enable self-reflection and in some cases enhance communication. However, one study reported that when student input was tracked the contribution tended to be individuals entering their own information and very little editing by team members occurred (Judd et al., 2010). Chao (2007) reported very positive feedback from students and found that the use of online tools enhanced both collaboration and communication within student teams. Similar findings were reported by Minocha and Thomas, (2007) where wikis were found to stimulate creativity and encourage cooperative learning.

While teaching methods evolve over time often assessment tools remain static and the traditional tools often used (e.g. reports and exams) do not comprehensively evaluate the skills that the students are learning. The aim of this paper was to report on the implementation and then evaluate the use of a website for assessment in a first year engineering project based course. In terms of evaluation the key questions of interest were whether the students would find the website difficult to develop, whether it allowed them to be more creative, whether it took more time than a traditional report and what their preference would be if they had the choice between a website or a report. Due to different majors within the course, some of which study computing and others who do not, it was investigated whether the students with no-computing background found this assessment style more difficult. Finally the students were asked how they felt this assessment approach had influenced the quality of their work.

CONTEXT

At Massey University the Bachelor of Engineering Programme has been redesigned to include a project based spine which consists of a series of project based learning courses throughout the degree. The second project based course that all Bachelor of Engineering and Bachelor of Food Technology students are enrolled in is called Creative Solutions. This is a 14 week course which aims to develop the students creative skills and teach them the basics of engineering design and visual communication. The course is taken by students studying the following majors: Mechatronics, Electronics and Computer Engineering, Product Development, Chemical and Bioprocess Engineering, Food Product Technology and Food Process Engineering.

Previous to the students completing the Creative Solutions course the students have undertaken studies in physics, mathematics and either computing (for the Mechatronics, Electronics and Computer Engineering and Product Development majors) or chemistry (for the Chemical and Bioprocess Engineering, Food Product Technology and Food Process Engineering majors). In addition to these foundation courses the students have undertaken one project based learning course. This initial course is an Engineering Without Borders project where they develop solutions for developing communities. The focus of the Engineering Without Borders course is the importance of context, systems thinking, project management and written communication.

The scenario that the students were given for the Creative Solutions course was that they are a group of consultants who have been given the task of future proofing one of New Zealand's key export industries to ensure that it is a thriving industry in the year 2070. The future focused scenario was to ensure that the students could be creative with their solutions and were not constrained by

what is technically and economically feasible today. The projects allocated were based on export products listed in the Situation and Outlook report by the Ministry for Primary Industries (Ministry for Primary Industries, 2014) and includes industries such as timber, fisheries, meat, wool, etc. The students are placed in teams of 3-5 and were grouped by their major so that the topics allocated can be relevant to the students' interests and knowledge.

DEVELOPMENT OF A WEBSITE BASED ASSESSMENT TOOL

Prior to redesigning the course the assessment was focused on developing a written report which was due at the end of the semester. This report consisted of a group section where the final solution was discussed and an appendix where each individual reported on the process they followed to generate ideas, screen ideas and develop their solution. The findings were then presented at an exhibition where visual communication was the focus.

When redesigning the assessments it was decided that the students needed more feedback during the semester on the aspects that they had been presenting in the final report and that the format of the final report should be changed to allow visual communication to be assessed more comprehensively. Therefore a website based assessment tool was chosen. There were several aspects of using a website as an assessment tool which were taken advantage of. The website itself was developed throughout the course and there were multiple stages where sections of the website were assessed. The students were then given the opportunity to update these sections based on feedback prior to their final assessment. The course assessment was divided into five stages which are explained in Table 1. These are designed to build off each other with the initial stages acting as checks to ensure that the teams are on task and to provide feedback on their work. A rubric was used for each assessment and the key criteria are listed in the individual assessment criteria and group assessment criteria columns of Table 1.

There is a combination of group and individual assessment to ensure that students cannot pass the course based on the efforts of their team members. In Stage 1 a review is conducted with each individual given topics to focus on and the writing is assessed as an individual component. During this stage the website is also developed to contain this information and the website is assessed as a group. The main purpose of this assessment is to ensure the students have an understanding of the industry and to begin the process of developing the website. Stage 2 focuses on the future and is assessed in the same way as Stage 1. In this stage the students gain knowledge of what the future might hold for their industry and by the end of Stage 2 the groups will have a list of problems or opportunities. These are then ranked and the top problems/opportunities are allocated to group

Table 1. Stages of the project and assessments for the course.

Stage	Description	Individual assessment criteria	Group assessment criteria
Stage 1: Current industry review	The students produce a functioning website which presents a brief background on how the industry has developed over time and a detailed description of the product itself, the raw materials and where they come from, the processes used to make the product and the market it is sold into.	Individual piece of writing to be assessed on technical content, ease of understanding and referencing	Peer assessment of website based on visual impact, creativity and functionality.
Stage 2: Future challenges	The website is updated with additional pages which explain the key future challenges which might include changes to market/consumers, availability and cost of raw materials, resource use (eg water and energy), biological threats (eg pathogenic plant pest), etc.	Individual piece of writing to be assessed on the review of the challenge, ease of understanding and referencing	Peer assessment of website based on visual impact, creativity and functionality.
Stage 3: Design of individual solution	Each individual is allocated a future problem identified from Stage 2. The students needed to define their problem, use idea generation methods, screen their ideas, develop sketches of their top 2-3 ideas, decide on the final solution, carry out detailed design, produce drawings to communicate the final solution and develop a timeline for implementation between now and 2070.	Portfolio meeting to assess progress and a design report marked on the solution, process followed, drawings, timeline, application of engineering and written communication.	No group assessment
Stage 4: Final website	A brief description of each of the individual solutions developed is added to the website along with an explanation of how they work together to future proof the industry. The students were encouraged to be creative with how they presented their integrated solution.	No individual assessment	Marked on website organisation, the final solution, timeline, visual impact and weekly updates.
Stage 5: Exhibition	The students present their final integrated solution at an exhibition where they are assessed by a panel of people from industry and within the University.	No individual assessment	Marked on visual impact, the solution and its explanation and teamwork.

members for Stage 3. Stage 2 also involves assessing the website which has been improved based on feedback in Stage 1. Stage 3 is an individual assessment where based on the allocated problem/opportunity ideas are generated, screened and developed. Progress is assessed in a portfolio meeting and an individual report is written. This is where the design process is assessed. The final ideas generated by each group member are then integrated to produce an overall solution for the industry which is presented on the website (Stage 4) and at an exhibition (Stage 5) which are both group assessments. By this time the website contains background information (Stage 1), what the future holds (Stage 2), identification of key problems/opportunities and solutions for these problems/opportunities (Stage 4). The exhibition provides further opportunity to present their solutions and is focussed on visual communication aspects.

The website included weekly updates which provided information on what was achieved during the previous week and what was planned for the current week. The weekly update also allowed groups to use the website as a planning tool and as a record of their meetings but additionally it

allowed staff to gain some insights into how the team was operating and provided evidence if there were any issues regarding team members involvement in the project.

Some of the students in the class were familiar with computer programming while others did not have this background so therefore it was important to select easy to use website development software. It is also important to note that the use of a website was chosen to allow the students to apply their visual communication skills and creativity throughout the assessments and not to assess the students computing skills. Therefore available website development software was reviewed taking into account any unfair advantage that could be given to students studying computing which made up a large portion of the class. After investigating several different forms of software Wix (www.wix.com) was chosen. Essentially if the students can use Powerpoint they can use this software and there were a large range of templates available to get the students started. Wix also does not allow any programming skills to be applied to making the website so there is no advantage for the group of students with computer programming knowledge. At the time that this course assessment was redesigned there were a limited number of freely available website builders however there are an increasing number now available for use (for example WordPress, weebly, site123 and IM Creator).

Feedback on the appearance and function of the website in Stage 1 and 2 (Table 1) were provided by utilising peer assessment with each website being assessed by multiple groups. The websites were assessed based on their *visual impact*, *creativity* and *functionality*. The students were then asked to justify their mark by describing aspects of the website that were done very well and aspects that needed to be worked on for next time. Each website was assessed by four other groups so there was a range of feedback given to the students.

The writing in Stage 1 and 2 (Table 1) which was an individual task was assessed by staff to ensure that the written communication was of a high standard. The writing was assessed on its *technical content*, *ease of understanding* and *referencing*. Detailed feedback on their writing was given to students to allow improvement for the final website assessment.

Design of Website Based Assessment

The use of websites or blogs as assessment tools have been reported previously in the literature (for example Bishop et al., 2014; Reijenga and Roeling, 2009). From these studies it was identified that particular emphasis needs to be placed in certain areas and the assessment criteria are very important. For example, while the students are developing a website there is a risk that the students focus on the visual communication aspects rather than the content (Reijenga and Roeling, 2009). It is however important to ensure the basics are done well, for example, spelling, grammar and punctuation is still important. To ensure the students appreciate the importance of their writing each individual was graded on the ease of understanding and technical content. It was also identified from

the literature that today's students use the internet so often that they tend to solely rely on Google for their information searches and in one study the students rarely went beyond the first page of search results (Combes, 2008). It has also been reported that often students do not reference their information sources correctly particularly when their information sources come from the internet (Reijenga and Roeling, 2009). To ensure the students used appropriate references marks were allocated to ensure complete references were given and that they came from a wide range of sources.

EVALUATION METHODOLOGY

The new website based assessment tool was implemented in the first year engineering Creative Solutions course with a total of 63 students enrolled. At the end of the course a voluntary anonymous questionnaire was given to all students. The questionnaire was distributed and collected by an independent person who was not involved in teaching the course. The collected questionnaires were sealed until all grades were finalised for the course to ensure that there was no way that responses could influence student marks. This research was reviewed and approved by the Massey University Human Ethics Committee Southern B, Application number 14/40. A total of 54 students completed the questionnaire giving a response rate of 86%. Of the respondents 29 had a computing background and 25 had no-computing background.

The following questions/statements were evaluated using a five point Likert scale:

- How difficult was it for you to develop your website for the Creative Solutions paper?
- The website allowed you to be more creative than writing a report would have
- The website took more time to complete compared to writing a report
- The website was more enjoyable to make compared to writing a report

The first question used a Likert scale of very difficult, difficult, neither difficult nor easy, easy, very easy. The final three questions used a Likert scale of strongly agree, agree, neither agree nor disagree, disagree, strongly disagree. This data was analysed using descriptive statistics.

The students were then asked the following open ended questions:

- List the website tools you have used (e.g. still images, video clips, etc) and explain how these tools enhanced your ability to communicate your message.
- Would you prefer to write a report or develop a website?
- During the semester you assessed other teams' websites. Do you think this affected the quality of your teams' website? If yes, please explain how

The open ended questions were analysed to establish common themes by two staff members. The responses were examined by the staff who then established the coding used to group common

statements. The coding was then conducted independently by each of the staff and compared. A very high level of agreement was reached and any differences were discussed and grouped by mutual agreement.

EVALUATION RESULTS AND DISCUSSION

Difficulty in Developing a Website

One of the main concerns using a website based assessment for the first time was how difficult the students would find using the new software. Therefore in the questionnaire the students were asked to rate how difficult it was to create a website on a Likert scale and the overall results are shown in Figure 1A. The majority of students (41%) gave a neutral response to this question indicating that

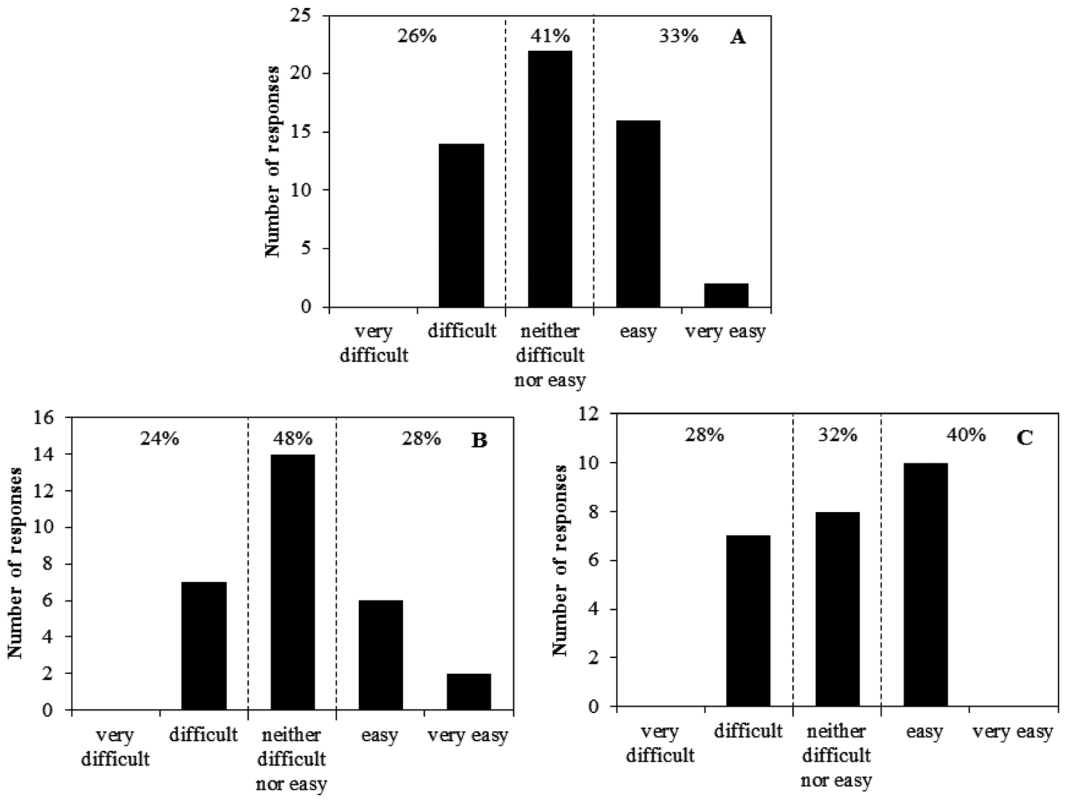

Figure 1. Difficulty of developing a website for students (A: overall student responses (n=54); B: responses from students who were also studying computing (n=29); C: responses from students who were not studying computing (n=25)).

they neither found it easy nor difficult. Of particular interest was the comparison between those students who were studying computing versus those who were not (Figure 1B and C). It is interesting to note that while most of the students studying computing gave a neutral response (48%, Figure 1B), those not studying computing were more likely to find the website development easy (40% compared to 28% for computing students). This means that there was no unfair bias towards those who were studying computing which is probably due to the software chosen and the fact that computer programming could not be used to enhance the website. This may in fact be why the computing students were less likely to rate the website development as easy as they may have preferred to have the ability to use their computer programming skills. These results show that the use of developing a website to encourage creativity and visual communication does not need to be limited to students who have taken computing courses particularly when the software used is carefully chosen.

Developing a Website Versus Writing a Report

The next section of the questionnaire asked the students to compare developing a website to preparing a report in terms of creativity, time taken and how enjoyable it was. These results are shown in Figure 2.

The majority of students agreed that a website allowed them to be more creative than a report with 81% either agreeing or strongly agreeing with this statement (Figure 2A). This is likely to be due to traditional engineering reports having a predefined format whereas the websites allowed the students to use a range of media and to adapt their communication style more than a report allows.

The students gave a neutral response to the question regarding the time that it took to develop a website compared to writing a report (Figure 2B). Only 26 % of students agreed or strongly agreed that the website took more time so this indicates that the development of the website was not an overly time-consuming task for the majority of students.

The students enjoyed developing a website more than writing a report with 74% agreeing or strongly agreeing with this statement (Figure 2C). This may simply be due to the number of reports they have written in the past and this opportunity to do something different was seen as a positive change.

Website Tools

In the questionnaire the students were asked to list the tools they had used as part of their website. Students listed between one and four tools with the majority of students listing two tools. Common answers and the percentage of occurrence are listed in Table 2.

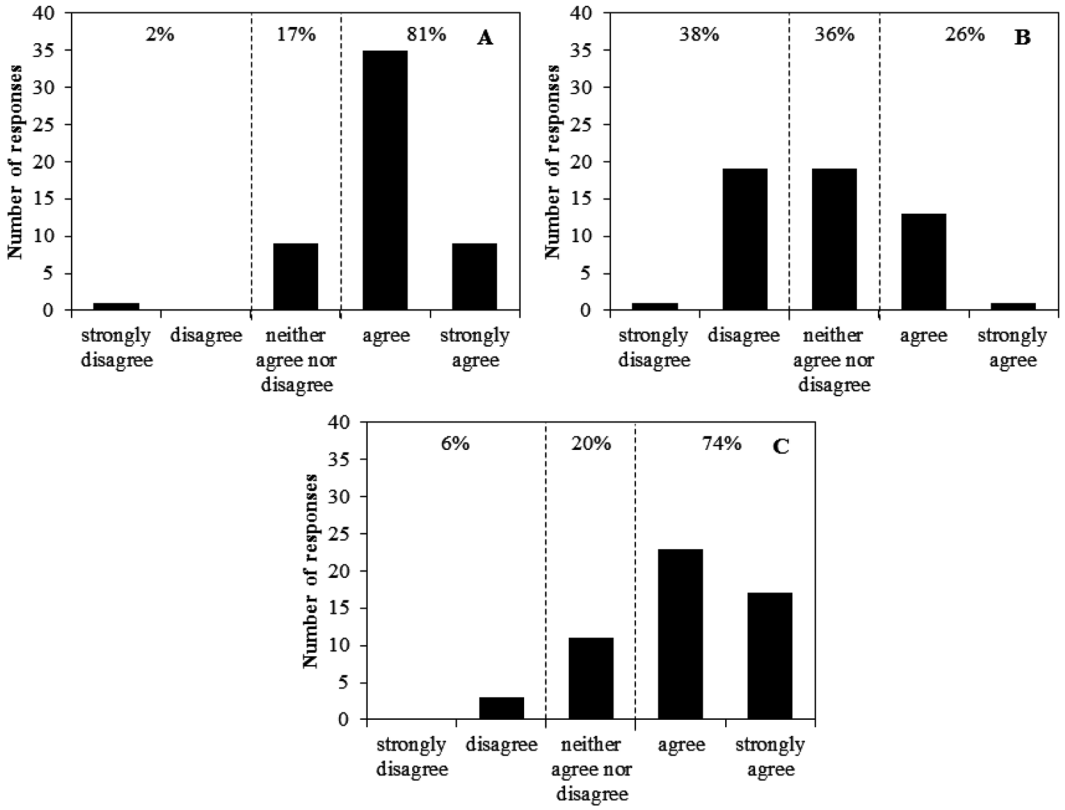

Figure 2. Responses comparing developing a website to writing a report. A: Website was more creative (n=54); B: Website took more time (n=53); C: Website was more enjoyable (n=54).

Nearly all students used images of some kind with many going beyond simple still images and using slideshows and video clips or moving images. It was encouraging to know that many students attempted to use tools which are not possible to use in a report format.

When asked how these tools had enhanced their ability to communicate with the audience the responses were grouped in the categories shown below. Examples of the statements given by the students are also shown.

- More useful communication tool (53% of respondents)

  "The use of pictures and video helps provide viewers with a better feel/understanding of future solutions and provide a more engaging method of conveying information than written text"
- More visually appealing (27% of respondents)

  "It made it more visually appealing and simplified a complicated process"

Table 2. Website tools used and their occurrence.

Tool used on website	Occurrence
Still images	93%
Slideshow of images	48%
Video clips or moving images	14%
Diagrams	9%

- Easier/more enjoyable to read (12% of respondents)

  "It helped to give the viewers an idea of what was being described and helped to break up the mass writing involved making the website look more visually appealing"
- More interactive (4% of respondents)

  "Laying out a website is easier than laying out a report in terms of navigation and readability. It makes it possible to use visual and digital cues to link/refer to other concepts in the idea/solution"
- More modern (4% of respondents)

  "A modern way of presenting your work and can be explored anytime and anywhere"

These findings indicate that the students did use the tools available to them and appreciated the way these tools enhanced their ability to communicate their ideas generated during the project.

Overall Preference

The final question asked the students if they would prefer to develop a website or write a report. The website was preferred by 76% of the students compared to only 24% who would choose to complete a report.

Impact on Quality of Work

This approach to assessment had the potential to positively impact on the students work in two key ways. There were multiple opportunities to give detailed feedback to the students on their writing and potential for them to make improvements for their final assessment. The other positive impact was via the use of peer assessment. During the evaluation the students were asked how assessing other teams' websites had affected the quality of their own website. These responses were grouped together and fell into the categories shown below. Examples of their comments are also provided below.

- It encouraged a healthy level of competition throughout the class (37% of respondents)

  "It made our group put more effort in to match other groups"

- It helped the students reflect on the quality of their own work (35% of respondents)
  "Critiquing others ideas caused me to critique our website more"
- It helped inspire groups and enhanced the quality of their work (35% of respondents)
  "It helped seeing the standard of other websites and getting feedback as it gave us ideas and inspiration to improve our own website"

Instructor Reflection

The instructor for this course did not have a particularly strong computing background so was slightly hesitant at the beginning of the course. During the course there were some technical issues that some students faced; however, it was observed that the groups worked together to overcome these issues. This encouraged interaction between groups which was seen as a positive outcome.

The most significant change as a result of using a website based assessment tool was the students' attitude. Previously, when the course was assessed via a report, the students tended to delay the writing of their report as to them it did not seem to be an enjoyable part of the course. After the change to the website based assessment the instructor noted that the class was far more eager to make additions to the website. Writing was seen as a positive experience as they completed different pages on their website. The quality of writing was one concern at the start of the course, as the literature had suggested that this could be an issue; however, due to the staged assessment and multiple points of feedback, writing was greatly improved by the end of the course. This is probably more to do with the amount of feedback given rather than the type of assessment.

Another advantage of the website was the ability of staff to monitor students' progress on a continuous basis via the website itself and the weekly update page. The websites were published so that staff could access them throughout the course, but they were not searchable on the internet.

The aim of the course was to develop the students' creative skills and teach them the basics of engineering design and visual communication. It was observed that the use of a website allowed far more creativity than a traditional report. The students were able to use multiple visual tools to present their ideas in interactive ways, which was seen as a key advantage of using a website. In terms of engineering design, it was not felt that using a website had any significant advantages compared to a report, but at the same time it did not make this aspect any less effective. Finally, visual communication was far more effective using a website. Visual communication was previously only assessed in the exhibition but the website allowed it to be incorporated and assessed throughout the course.

As a result of these findings the use of website development has been continued in this course with one small adjustment. After each group has assessed the other groups' websites they then assess their own. This provides a unique opportunity for them to reflect on their own work as they have other websites to compare against. After they have evaluated someone else's work they are in

a better position to evaluate their own. While the students do provide a mark for their own website this is not used when generating the final grade, it is simply a way to encourage them to critically assess and reflect.

CONCLUSIONS

While there were some initial concerns that an assessment based on developing a website might be a challenge for students it was found that the majority of students did not feel that this task was overly difficult and most students felt that it did not take any more time than writing a report. Students reported that the use of a website allowed them to display their information in a more visually appealing way which was easier to read and more interactive than a traditional report.

Initial concerns with bias towards students who were studying computing were also unfounded and in fact the students not studying computing reported that it was easier than those with a computing background. This shows that with the selection of appropriate software this type of assessment could be applied to many different courses irrespective of the students computing background.

Overall the students found the exercise enjoyable and the majority of students would prefer to develop a website rather than write a report if they were given the choice. While traditional style reports are still vital this work has shown that they can be supplemented with other forms of assessment such as websites which allow the students to refine their visual communication skills and practise communicating with a more general audience. While this research is only based on the implementation of website based assessment in one course and there are limitations to this study as it is based on student and staff perceptions, the findings suggest that websites are a useful assessment tool which could be applied to many courses targeting communication skills and wanting to encourage creativity.

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