USING BLOGS FOR AUTHENTIC ASSESSMENT OF PROJECT BASED MODULES

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ABSTRACT

Blogs used for education can capture snippets of an engineering project life and arrange information to show progression. Blogs teach students about writing techniques, online publishing and presentation, and proper Internet etiquette, which many students will use in future careers. More importantly, it helps to understand whether students have been able to appreciate a design framework such as CDIO as they progress through an iterative process.

Many project based modules in Singapore Polytechnic have been designed using the CDIO framework. These modules teach students to go through the CDIO process during the project cycle and appreciate the various stages. Facilitators have a requirement to monitor the design process at every stage and possibly at different iterations. Rubrics are designed to assess student teams on the process rather than the end product hence it is important for facilitators to have a snapshot of every stage of the project to assess and give feedback effectively. Using blogs, facilitators are able to carry out authentic assessments and align students to the design framework used as the project develops.

Blogs encourage community building in which both the bloggers and commenters exchange opinions and ideas. It also promotes open dialogue among student teams by encouraging them to comment on each other's posts and give constructive feedback. It also serves as a platform to give students to express their content in their own way and hence boost creativity. Facilitators can also bring together a group of content experts for a given unit of study for students to network with on a blog. Blogs exhibit, organize, and protect student work as digital portfolios. As older entries are archived, developing skills and progress may be analyzed more conveniently. Furthermore, as students recognize their efforts will be publicly published, they are more motivated to produce better writing.

In this paper, the methodology of using blogs as part of project assessments in a module called Engineering and Design is shown. The paper also discusses a structure given to students to help scaffold the blog with posts that consist of appropriate content. The rubrics to assess these blogs will also be shown. Examples of blog entries showcasing the different CDIO stages and how student teams were able to steer their project design though continuous feedback and iterations for a successful completion will be presented.

KEYWORDS

NOTE: Singapore Polytechnic uses the word "courses" to describe its education "programs". A "course" in the Diploma in Electrical and Electronic Engineering consists of many subjects that are termed "modules"; which in the universities contexts are often called "courses".

INTRODUCTION

Engineering education has been evolving to nurture young engineers with a myriad of abilities and skills to satisfy the current industry needs. The industry require engineers to be equipped with communication skills that is not limited to fluency in solution presentations but be able to connect in diverse cultural and philosophical teams leading to complex communication and social skills as described by Samavedham KRL et al. Deeper and meaningful connections are made when student achievements are a product of a design process such as the CDIO framework. Dym, Clive L et al (2005) show that the purpose of engineering education is to graduate engineers who can design but also appreciates that design thinking is complex to teach. One of the effective ways to teach these processes is to immerse the student in real life problems and use design tools to craft a solution while stimulating higher thinking. The use of cognitive educational approaches and teaching while subjected to real-world contexts provides a need for authentic assessments that require students to apply their skills and knowledge to find solutions to real problems as shown in Custer, Rodney L., et al. (2000). Tenopir et al. (2010) show that communication skills, problem solving and interpersonal skills are the necessary soft skills in addition to technical skills for engineering students. It is important to note that communication skill is not limited to confident presentations but writing reports and also convey designs through detailed drawings and arrange information to engage an audience.

Assessment is a fundamental element of tertiary education as well as in industrial training and for most educators and students it is an important aspect of their coursework as detailed by Lamprianou and Athanasou (2009). Hence creating meaningful assessments that students find value is fundamentally a significant aspect for maintaining motivation levels in the classroom and maximizing learning. As more educational institutes move towards project and problem based pedagogies, authentic and sustainable forms of assessment that encourages self-directed learning focusses on assignments and tasks that have applicability to the world outside the classroom as described by Boud (2000). As a facilitator in project based modules, the role involves several and varied tasks to ensure an active learning environment. It is necessary to have forms of assessments that increases their efficiency and accountability through ways that promote quality and don't hamper their other activities as mentioned by Fidler (1993). With affordable technological advancements, blended style of course delivery is becoming a norm for many programs offered by institutes of higher learning. Blended learning provides students with more control over their own study and an access to course material from any location. The self-control and self-regulated traits of blended learning often need to be regulated and monitored to achieve desired learning outcomes as shown in Zhu Y. et al (2016). Hence authentic assessments need to be carefully designed for project based modules that have elements of blended learning required to train the modern engineer.

Using educational blogs to assess students out of the classroom is one of methods to facilitate blended style of learning. Blogs can be used to document a processes and the milestones in a project cycle. There is a lack of literature that show studies on the effectiveness of students' engagement and learning through blogging or other online communication channels as described by Vu T.T. et al (2016) . A framework developed through an investigation done by Jimoyiannis et al (2012) shows that students, through their blogging assignments achieved higher thinking and cognitive levels. Blogs used in a project based module, facilitate the

process of giving feedback to students at different iterations of their project. Black P. et al (1998) describe that assessments that are designed to support a frequent feedback system helps in substantial learning gains. Blogs also help in practicing reflective writing due to its informal setting which is not a norm for engineering students. Burrows et al (2001) show evidence that students have better understanding of concepts and deepen their rationale of decisions made when they maintain a reflection journal about their project. In addition, it also improves their performance in the other assessments of the same module. The archive of such resources also helps facilitators design engaging activities as Bielefeldt et al (2010) tells us that reflective essays provide us a measurable means to understand evolution in student attitudes over time. Halada et al (2014) see the benefit of creating online journals for students during a course as through reflection on evidence and conclusions made it instigates more questions keeping the cycle of learning and discovery alive.

AN OVERVIEW OF THE MODULE

Engineering & Design is the third of four modules offered in a program called Engineering Academy in Singapore Polytechnic shown in Khan et al (2015). This program was designed to engage and nurture engineering students who are interested in designing and building real solutions. Each module consists of several multi-disciplinary activities which gives students the ability to understand how each discipline fits into more complex problems. The modules offered in this program are all project based and are held in specially designed studios. These studios aid in teamwork interactions, project building and conducting collaborative activity sessions. A workshop furnished with the state of the art equipment ranging from 3D printers, laser cutters, PCB milling machines and lathe machines, adjoins these studios for students to build and test their projects. The teams comprises of students from electrical and mechanical engineering schools who contribute with their wide-ranging expertise and skills. Teams often spend considerable time outside the module's scheduled hours on their project and to facilitate this, they have their own lockers to access materials and are able to use the workshops and meeting rooms anytime during school hours.

In the module, Engineering & Design, students are given real life problems as project statements that they need to solve through their proposed solution. The problem statements given tend to encapsulate a multi –disciplinary issue which allows students to look at it from a different perspective. The solution needs to be mechanically robust to withstand the environment it is designed for and integrated with sensors and actuators. The solution has to incorporate a user centric design which requires user interviews and feedbacks at different stages of the project. The first half of the semester involves hands on activities conducted by facilitators from different disciplines to widen students' perspective and gain understanding of related physical phenomenon. The last two semesters in 2015 and 2016, the theme was building systems that involve water. The hands on activities topics included water parameters sensing, filtration techniques, drag and buoyancy calculations, and hydroelectricity. The second half of the semester is dedicated to project building and students receive feedback at every milestone of their project cycle. This structure assists in establishing an iterative based project development. The module schedule is shown in Figure 1 with project milestones that need to be achieved.

As the module consists of several types of deliverables, assessments also vary in nature every week. The assessments are divided into individual and team components. Peer feedback plays an important role in identifying and awarding better scores for diligent team members. At the end of each hands on activity, a group assignment has to be submitted based on the group's

findings. Some activities are also supplemented with individual assignments that are meant to be challenging. As for the project, at every iteration, every team presents their updates in informal sharing sessions. Feedback and ideas from brainstorming are to be recorded so as to show how they helped to shape their project. At the end of the semester, each group would have delivered a functional prototype of their proposed solution and a blog that journals all hands on activities, project milestones and reflections.

A blog is maintained by each group from the beginning of the semester and it is updated almost every week. The main purpose of the blog is to monitor the different stages of the project cycle and observe the changes due to new research and comments from peers and faculty. Blogging guidelines and expectations are set at the first lesson with a structure that has deadlines for each post and the content it should have. As the blog is created for an audience, the quality of the content becomes a concern for the students and therefore it has been seen great efforts are taken to publish each post. To manage blogging and keep it effective as a tool for learning requires some effort from facilitators that they may not be used to in the other modules they teach.
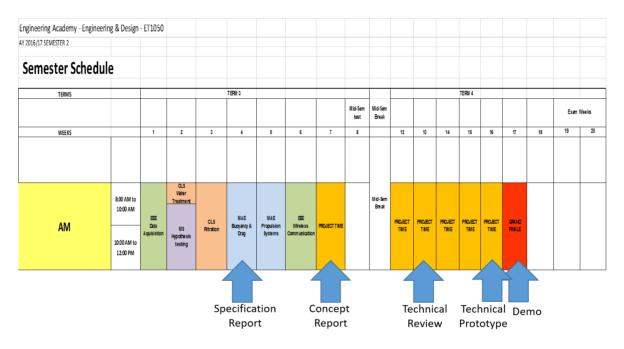

Figure 1. Engineering and Design schedule with project milestones

BLOGS USED AS AN AUTHENTIC ASSESSMENT

Students are briefed on the purpose of the blog on the first day of the module. They are shown clear examples of how current technology companies stay in touch with their customer base using blogs and social media. The scoring system for the blog submission using rubrics are also shown. Links to previous semesters' blogs are also shared as guidelines.

As one of the main learning outcomes of this assignment is to foster collaboration, a closed group on Facebook with all students and facilitators is formed. This group helps facilitators to remind students of deadlines and share interesting reading material. Each team has to post a link of their new post on the group to share with others within the stipulated deadline.

Facilitators comment on the blog post directly as well as copy the same content on the blog link shared by the team in the closed group. This helps to share the facilitator's opinions with everyone in the class. One of the individual tasks for students is to comment on another team's post which is assessed by a separate set of rubrics at the end of the semester. The closed group on Facebook helps facilitators to keep student engagement productive and non-static.

Documenting a design process

Modules that have been designed using the CDIO framework often have assessments that would like to ensure that students have been through each stage and more importantly, see the value of proceeding into a project using a design technique. Often the tangible part of the project cycle are highlighted and grades are reflected based on how successful the end product is. To appreciate a design process, each part of the process must be equally emphasized to students. Verbal feedback to students and written reports submitted to facilitators are usually the form of communication and assessment in the earlier stages of the projects. However, these methods lack exhibiting the entirety of the project cycle. Although all activities for such modules have been prepared to achieve all the stages of the CDIO framework, it is difficult to showcase them explicitly at a defined stage and how it aided in the development of the next one.

In Engineering and Design, the CDIO process is carried over several activities and project milestones. To help students Conceive ideas for their project, a few project statements are given to each group. This gives them a sense of autonomy in choosing their project. After conducting a thorough research about the different project statements given, the first blog post is written. This post describes each statement and the reasoning behind choosing the particular statement. The post also includes what are the state of the art solutions available for the problem at hand. It also details what is lacking in the available solutions and would like to address in their solution. Weekly hands-on activities' reports and reflections on how the knowledge and skill acquired can be used in the project building are posted on the blog. The following project related posts start moving in to the Design stage named as the Specification and Concept report discussed in the next section. All blog posts needs to show detailed mechanical designs and electrical schematics. Facilitators use these posts to give each team technical feedback before they phase into the Implement stage. While building the prototype, each team would blog about their project progress and interesting problems that they faced and what solved it. The final post in the Operate stage, details the user experience of the solution and a video to demo how the solution would work to solve the problem assigned to them. Students at this stage feel proud of their accomplishment and the blog helps them to see the entire process they have been through and take back as a documented learning journey for future projects.

Improving communication skills

Blogging can be used to improve student writing skills especially that involves analysis and critique. Blog platforms allow students to learn to use various forms of digital multimedia that would convey the idea effectively. The layout of blog posts is suitable for concise reports hence it is important to learn to curate information that would best connect to your audience. Blogs also provide a way for students to clarify concepts learnt in class after their post is assessed by a facilitator. Blogs create spaces where students reflect on decisions made and feedback given through comments. Often many group members are unable to express ideas and

concepts in a social setting and may be marked down for communication skills. Blogs help such students to voice out opinions as well as explain ideas in a non-intimidating setting.

In Singapore Polytechnic, engineering students are subjected to assessments that mostly consist of multiple choice questions and mathematical problem solving. Students often lack technical writing skills particularly that involves analysis. This causes friction for many groups in Engineering & Design to start their blog and often their first post is a landslide of information collected from the web with little effort to connect them and show purpose to the user of the research done. Facilitators' feedback at this stage is very crucial to provide apt remarks about the writing as well as garner interest in students to write better in future posts. Examples of technical blogs is a good resource for students to learn from. It has been observed that every team were able develop clear arguments towards their final posts with strong reasoning and evidence. It encourages students to reflect on how the journaling affected their ideas and knowledge. When students revisit their concepts later in time, they realize the value of their own insights and how they have transformed with justifications.

Promoting collaboration and teamwork

Blogs provides an opportunity for fostering collaboration among group projects and to engage in meaningful discussion. When projects have a similar theme, often teams have the same plaguing problems that hinder progress. When one of the teams can solve this problem, this can help other teams to adopt the same solution and give credit to their peers in their blog. Students are able to learn from each other over the entire semester, especially when the facilitator aids in promoting certain posts and emphasizes what went well in conveying information effectively. Many teams make use of open source material such as Arduino code and 3D designs found on the Internet. Facilitators can use this situation to instill ethics in students to learn to acknowledge others' efforts and include proper referencing in their posts.

Maintaining a group blog helps to bond teams which is unarguably one of the key elements for a successful group project. The team tends to show a sense of ownership over their ideas and this accountability is stronger as their thoughts are on a public stage. Teammates vet their post internally before it is published which helps them to agree on technical details and features of their design. This promotes and in a way compels group members to be aligned to their target design and deadlines. Students are allowed to choose their own platform for hosting their blog and are able to customize it with pictures and multimedia that best represents the team's identity. The module requirement is to use a platform that can accept posts and allow public comments and doesn't reward for elaborate features or design. However, as the semester progresses, students put in impressive efforts that promotes their project and user experience of their blog. Some of them promote their blog on open source technological sites to share their work which shows evidence that many students find value in engaging documentation of the team's efforts.

Project showcase

In Engineering and Design, students spend many hours in school to work on their project. The blog helps to showcase their hard work to various stakeholders. Facilitators can closely observe progress and use as resources to share with other teaching members. It also helps management of the course to review the progress and quality of student work of a particular cohort. Using previous student blog posts as content for the next semester batch can really aid to motivate students to write their first post and manage expectations. The archive can also be used by faculty supervising final year projects that may have similar elements as the

projects in the blogs especially at the beginning when students are conceiving their project scope. Many of the tangible projects are on display at the labs to motivate future students and impress visitors. Tagging these projects with a link with their blogs help to disseminate more information about work done by students in Singapore Polytechnic to various visitors.

A handful of projects in the module are done in collaboration with industry partners. The blog helps the company personnel to track the progress of projects and give their insights and suggestions for improvement at the right time of the project cycle. It also helps these personnel to update their management of project progress. Facilitators teaching this module send out links to fellow colleagues, industry experts and former students. This generates the visibility and readership of student's work and the comments help each team to gather valuable insights. These comments help to gain perspective from potential users and related industry practitioners. Often key design or technical elements that have been missed out have been pinpointed through these comments. This helps students to learn how to deal with varied opinions and whether they are significant enough to pivot changes in their projects' designs. Students also get to exhibit their projects in local engineering shows and Maker Faires and the blog helps them to exhibit with ease as the presentation content is substantial on their posts and videos.

Blog rubrics

As the blogging is part of the assessment, clear rubrics are shown to students at the beginning of the semester to set clear expectations as shown in Table 1. As the assessment of the blog leads to both individual and group scores, the posts related to each component are clearly highlighted to avoid confusion. The blog post rubrics allow the facilitator to grade the post based on whether the objective of the post was met, coherency and organization, creative arrangement of topic, proper citations and quality of writing and proof reading. The commenter on blog posts are assessed by separate rubrics as shown in Table 2.

As the lesson plan shown in an earlier section, the hands-on activities are at the beginning of the semester. For each activity, the post is written by a single author that receives the score. The group posts are at each project milestone with the following requirements:-

• Project selection - This post helps readers understand which project statement was chosen with reasoning and elaboration of the state of the art solutions available for the problem given. The team members are also introduced in this post with a brief description of their skills and expertise.

• Specification report - This post should include the main functions of the proposed solution. Rough sketches, a list of sensors, actuators and building materials should be shown to give form to the project.

• Concept report - This post should include the proposed user experience for the solution with detailed 3D sketches, complete wiring and block diagrams and project timeline.

• Technical report - This post updates readers about implementation progress of the project and any changes in the design with reasoning.

• Final report - This is the final post on the blog which helps readers to understand the need and the functions of the solution. There is also a video attachment that introduces the problem, solution, the design process and demo of the solution.

Table 1. Rubrics for a post on the blog

	Exceptional (20 points each)	Satisfactory (15 points each)	Limited (10 points each)
Content of the blog post	The given topic fully discussed with valid proof based on experiences and research. Viewpoints and comprehensive reflections exhibits deep understanding.	The given topic was discussed with limited depth and proof. Moderate insights and reflections is exhibited.	The given topic was barely discussed with no proof or examples. Did not show any reflective thoughts.
Coherence and Organization	The blog post is coherent and well-organized integrating apt examples and analysis.	The blog post is somewhat difficult to follow with reasonable organization of content.	The blog post is not organized and displays no interest in organizing the content.
Creativity	Blog post was engaging and used several creative elements to effectively engage the reader such as multimedia, web links and pictures.	Blog post exhibited limited creativity using multimedia etc.	Blog post was uncreative with no elements of audience engagement.
Citations	All images, media and text created by others display appropriate copyright permissions and accurate citations.	Most images, media or text created by others display appropriate copyright permissions and accurate, properly formatted citations.	No images, media or text created by others display appropriate copyright permissions and do not include accurate, properly formatted citations.
Quality of writing and proofreading	Written responses contain numerous grammatical, spelling or punctuation errors. The style of writing does not facilitate effective communication.	Written responses are largely free of grammatical, spelling or punctuation errors. The style of writing generally facilitates communication.	Written responses are free of grammatical, spelling or punctuation errors. The style of writing facilitates communication.

Table 2. Rubrics for commenting on a post

	Exceptional (20 points)	Satisfactory (15 points)	Limited (10 points)
Comment's content and quality	The commenter shows there was clear understanding of the post and has given constructive feedback.	The commenter seems confused about the post and questions posed seemed slightly irrelevant.	The commenter made very little effort to give any feedback or pose any questions.

Facilitator's role

A key observation in using blogs for achieving learning outcomes as with any assessment is the role of the facilitator. As the blog in Engineering & Design serves to replace technical reports and achieve greater exposure of the projects, facilitators need to be committed to their feedback and critiques. Prompting students at the right stage of the project cycle to post on their blog is essential in presenting the value of journaling their process. With experience, it is easy to pinpoint students that cut and paste their work onto the blog without any substantial reasoning. Facilitators need to intervene in these situations to suggest what is lacking in the content which leads to creating an engaging space outside of the classroom.

There are facilitators from four different disciplines namely, electronics, mechanical, chemical engineering and mathematics in Engineering and Design. Each of them would leave comments on their respective hands-on activity related posts. These comments may include words of encouragement for good work shown, correction of technical matter and challenge critical thinking with questions. For project related posts, all facilitators would pose their questions and recommendations. This allows facilitators to virtually interact with students meaningfully at their convenience.

Examples

In Semester 2 of 2015, there were 16 teams in the Engineering and Design module. A team named Imp-Bot were tasked to design a vehicle that was able to collect water samples from the swimming pool at two different depths. First, the team conceived to have a floating vehicle that would encompass two sampling containers that would be lowered down using a linkage system. Later, after a few calculations as well as new research done, they thought linkages would difficult to construct and it could be easily replaced with a simple spool system. Figure 2 show a snapshot of the initial design constraints. Figure 2 shows progress a weeks later with detailed features of the proposed design. The blog can be accessed at https://endteamsix.wordpress.com/
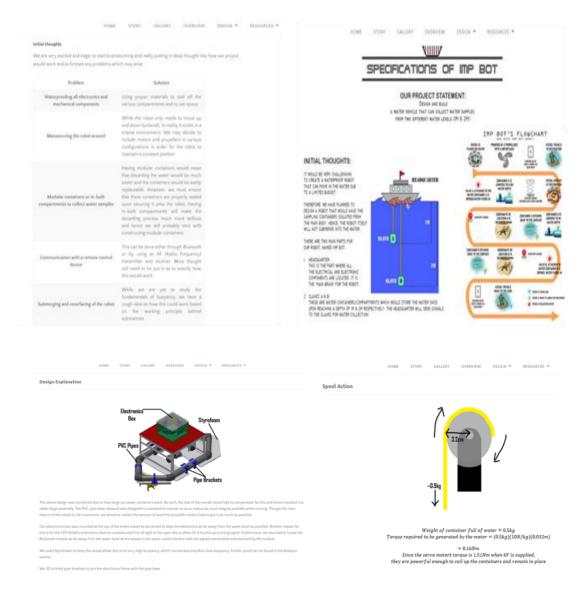

Figure 2. Blog entries from Imp-Bot

Another team who called themselves the Sea Monster, was asked to design an underwater vehicle capable of taking pictures. The team started off with a design that was meant to move around underwater and send pictures to a remote station on land. They quickly realized, the wireless communication methods available to them would not be able to transmit underwater and changed their design to add a tether to transmit data. Figure 3 shows the several iterations the project went through before it successfully was able to take pictures and send back to the user with ease. Sea Monster's blog can be accessed at http://shyanjieteo.wixsite.com/group5end.

Figure 3. Design and specification on Sea Monster's blog

New Age Solutions team was formed in Semester 2 in 2016. This team was supported by Bosch as an industry partner. The project was conceived during a student community trip in Indonesia. The team found out that humidity levels in mushroom farms was an important parameter to control for better yield. The team first went through a learning journey at a local mushroom farm in Singapore. Using a sensor box given by Bosch, they were able to implement the project. The solution was able to send several parameters back to Singapore for analysis over a data network. The on board computer was able to analyze data over a period of time and was able to send an alert SMS to the Indonesian mushroom farmers to make necessary provisions to increase humidity levels or other prescribed form of actions. Figure 4 shows the project cycle of the team. The blog can be accessed at http://newagesolutions.wixsite.com/eagroup1.
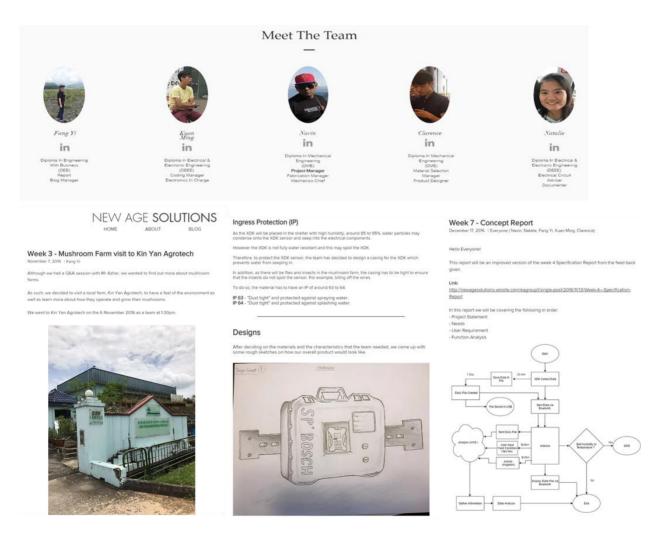

Figure 4. Iterations of the project cycle shown by New Age Solutions on their blog

DISCUSSIONS AND RESULTS

The facilitators teaching the module Engineering and Design used blogging as a form of documentation for two semesters. Each semester there are eight teams comprising of 6 students in each group. Each group needs to maintain a blog for the entire length of the semester. Prior to blogging, students had to hand in technical reports. These reports were marked with comments and returned to the group for review. The review helped them to write better for the next report and refer to designs when required as they were documented in detail. However, with reports it lacked a methodology to keep all stages of the project together for anyone to review at any time. Reports also lacked the component of deep reflection of the design process.

Although the module lacks traditional technical writing which is a one of the skills required in engineering students, blogging has helped in arranging ideas and designs to productive outcomes. Engineering students in Singapore Polytechnic are exposed to technical writing in communication, writing and engineering modules as well as for their thesis in the final year. Hence, blogging introduces an alternative avenue to communicate which is a current trend many engineers adopt in the technopreneurial world. The content of the blog for the module is extensive in terms of technicality and reasoning for the design embraced. It has been observed that providing a proper scaffolding for the blog contents along with rubrics maintains expectations and quality of posts produced.

The project quality and learning outcomes have greatly benefitted through maintaining a record of the design stages. Each team was able to see their hard work evolve at every stage and lessons learnt were documented that helped them to not repeat them again at a later stage. This also helped the entire class benefit from each other's solutions to problems faced and reduce time in debugging. It has helped facilitators review the entire process and assess the design process effectively resulting in constructive feedback for students. The projects produced were detailed, functional and addressed the critical needs of the users. In earlier semesters when blogging was not used, there was about thirty percent of projects that failed to reach the demo stage to show basic functions. Blogging has helped facilitators intervene at the right timing of the project stage and help each team steer the project deliverables that are achievable and within scope. This had led to all groups producing functional prototypes.

As the blogs took up a twenty percent of the total grade for the module, it was important to understand if students found value in this form assessment. Some qualitative feedback from students are shown below:-

Having to write a blog seems more interesting and I get to see the journey along the way. If I ever want to look back or show a project I worked on, I could just access it on the web instead of stressing to find reports that are somewhere in the computer memory.

The blog helped me to reflect on the decisions I made through the semester. When I go through my team's blog, I can see how my decisions have matured from day one and the result is a functional vehicle due to all the feedback we received and actions made.

As I hope to participate in Maker Faire and engineering shows, it is often difficult to showcase my project and how I came up with the idea and what are the hurdles I went through to get to my final stage. The blog helped me to articulate the process and share solutions to common problems faced by many of my peers during the semester.

CONCLUSION

This paper presented on how using a platform such as blogging that is familiar to our students can be used as a form of documentation for a project based module. This helps students, facilitators and external organizations create an environment that is an active learning space which promotes networking and collaboration. It is critical to set expectations using proper guidelines for the nature of each post on the blog to make it a meaningful assessment. Facilitators need to be active to monitor the progress of each group and give feedback when required as well as share applicable resources.

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BIOGRAPHICAL INFORMATION

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