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DEVELOPING ASSESSMENT LITERACY THROUGH ACTIVE LEARNING

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Abstract

Postgraduate students studying cyber security for the first time at a new institution can face several challenges. This can include challenges engaging with peers and unfamiliarity with an institution or educational culture. Students are expected to manage this all whilst trying to develop an understanding of cyber security. Consequently, developing confidence, connection with peers and assessment literacy can be demanding. One potential solution to ease this burden is to provide learners an opportunity to develop these skills through an activity early in their course. This can support learners to connect with their peers, develop a sense of what is expected of them (the educational culture) and develop their skills in a low-risk environment. This paper presents an experience report on the design and delivery of a cyber security research-focused active learning practice that affords students the opportunity to connect with peers, develop skills and learn about cyber security using research methods. The practice itself is reported such that other educators could adapt and adopt the practice followed by feedback from learners and a reflection as well as a discussion around the next steps.

Keywords: active learning, assessment literacy, postgraduate study

1 INTRODUCTION

Carroll and Ryan articulate the challenges international students face, noting that often these are not limited to language (for those with a different first language) as one might conjecture, but also cover aspects such as expectations around interaction with peers and lecturers, assessment, academic writing, and teaching methods. Carroll refers to these as the (often unwritten) "rules of the game" [7]. These are elements of a culture of learning and teaching which vary depending on context. For instance, in the UK a strong performance is typically 70% and above which is deemed an ’A’, whilst in the U.S.A. 70% is considered a ’C’. These differences are not limited to assessment alone, for instance questioning a lecturer is unacceptable in some cultures but expected in others. When one adds a complex and varied subject like cyber security to the mix, it could easily become overwhelming for a learner.

Bloxham and West also explored how lack of clarity around the rules of the game can impact student performance in assessment. Bloxham and West completed a study in which students were provided 5 seminars which covered many aspects of the culture around assessment including the institution’s grading system, how academic quality assurance was evaluated and a rubric for the specific assessment. Students were then asked to complete the assessment, provide peer reviews on others’ work and reflect on how the assessment information helped them in completing the work. The research provided some evidence that providing more explicit detail on the expectations of assessment as well as multiple opportunities to apply the marking scheme improved students’ ability to self-evaluate their performance in the assessment.

Designing such an environment for students from various backgrounds presents a particular challenge, especially regarding differing educational cultures. To combat this, one could consider developing an understanding of the different cultures which could result in unhelpful generalisations. Instead, Louie suggests developing a meta-cultural sensitivity and awareness [15]. However, guidance on developing such awareness is limited, particularly in a cyber security context. Consequently, this paper presents a cyber security active learning activity which aims to promote postgraduate student engagement with their peers and social learning, whilst also increasing awareness and sensitivity to a wider variety of backgrounds and experiences.

The contributions of this paper are:

- an overview of the design of a cyber security active learning activity
- feedback from learners on the practice
- reflection on how well the activity supported students' enculturation into the module

2 BACKGROUND

Lectures are the staple teaching method for many higher education institutions [4]. The teaching method emerged from a time when information was difficult to produce and transmit [3]. However, the optimal use of large audiences may not be to receive information but to engage in the collective processing of it [10]. In contrast, active learning, engaging students in the learning process itself [18], is an approach present and growing in many disciplines, including computing science.

Defining active learning is difficult as many would argue that a lecture is not a wholly passive endeavour [2]. Bonwell et al. argues that a good working definition is that active learning is students engaging in the development of higher-order thinking skills rather than simply receiving information [6]. Maher *et al.* argue the flipped classroom is one such learning design, where students prepare in advance of class and then utilise a social constructivist approach to develop and refine knowledge in class [16].

Chickering and Gamson suggest active learning practices can include a range of activities such as structured exercises and team projects amongst others [9]. Inclusion of such activities which are not assessed can provide opportunities to fail. This has the benefit of giving learners the chance to experience and develop skills in relatively low-risk (from a grade perspective) academic environments.

Cooperstein and Kocevar-Weidinger argue that the foundation of active learning from a theoretical perspective is that of constructivist or discovery learning [11]. Similarly, Martín et al. suggests that collective processing and formation of knowledge or social constructivism is fundamental to active learning [17]. Nevertheless, Good and Brophy would argue that the constructivist approach itself is only optimal when ideas are expressed and critiqued in partnership with others [12]. There are many different approaches or learning designs in computing science that attempt to embody these theories.

For instance, the Jigsaw approach broadly expects several class groups to investigate a component and then regroup to consider the whole. The learning design was originally devised to address the challenge of segregation in 1970s US education [1]. Liao, Griswold and Porter report on the use of the learning design in a computing architecture course with students reporting deeper engagement and learning from the use of this design [14].

Yet another alternative is think-pair-share where students consider a problem posed privately, then partner with peers to refine their answers before engaging in a class discussion. Kothiyal et al. reports learner engagement with the process in a computing science context but while they report strong engagement generally with the thinking and sharing aspects, it is unclear if students are as engaged when pairing with peers [13].

The challenge with many of the aforementioned active learning designs and many others in computing science is that the term and its effectiveness are often unclear [19]. Chi argues that active learning is poorly defined in general and attempts to provide clarity through a framework that distinguishes interactive, constructive, active and passive learning activities as characterised by learner actions [8].

Passive is when learners are prepared to receive information but not do anything with it, for instance, listening to a lecture but doing no more than paying attention. Active is where learners manipulate the information available such as highlighting key parts of a text. Constructive is where learners move beyond the information available to generate something new, such as creating mind maps or explaining concepts in their own words. Interactive is a dialogue - there is a two-way process between learners or learners and teachers, e.g. debating a given scenario. Chi provides evidence that *active* activities are better than passive, constructive activities are better than active and interactive is most effective for learning [8].

Consequently, an optimal learning design to enculturate students may be to combine active, interactive, and constructive elements. To do so, students formed a team, selected a topic, and then constructed an artefact that was actively presented to the rest of the class. The aspiration is that by supporting students to interact and acknowledge contributions within teams, the lecturer can integrate and build community among disparate students. Additionally, the lecturer can learn from the presentations produced by teams by evaluating the capability of the class and using this to consider how to shape the design and delivery of the module for the given cohort. This active learning approach itself is not novel with many practitioners adopting these types of activities as discussed above however, it does provide an example application within a cyber security context.

This paper outlines the context in which this activity was developed and run in Section 3, then details the design of the activity in Section 4. A reflection on how well the activity ran as well as feedback from learners is provided in Section 5 with a final discussion in Section 6 and conclusions in Section 7.

3 CONTEXT

The primary motivation is to acculturate learners to institutional culture by providing opportunities to fail and demonstrating the value that can be drawn from their peers' experiences. The course itself is delivered in the first semester and for many of the postgraduate students, it will be their first exposure to a research-led institution in the United Kingdom.

Learners in the module must complete a 10-week team research coursework assignment as part of the course. The present practice lasts for only one week but affords the development of relevant skills and course knowledge without the risk of contributing to a mark.

Learners must investigate a topic, extract a salient element and communicate it. In doing so, they learn how to access university resources, how to submit a deliverable via the VLE and how to adhere to the assignment specification. For example, in the activity learners are permitted a single slide. If they submit more than one, then only the first slide is presented to the class. For some teams, this meant a slide of names was presented rather than the intended content slide which was disregarded due to breaching the activity instructions. A reality that sounds harsh but is a valuable learning experience, in that learners should pay attention to specifications.

The second aspect of the activity is that learners present to a large class, thus observing the value of the content generated by their peers and seeing how that content can be drawn from all over the world. Moreover, the activity requires learners to define themes from the multiple presentations, demonstrating to learners the application of the underlying research theory and concepts.

The characteristics of the institution, typical of a research-led institution in the region, are that programmes can have large student cohorts and that learning activities should reflect the research culture and practice of the domain. There is an expectation that learners should be prepared to gather, analyse, assess and communicate.

Nevertheless, many learners will have different expectations. For example, some are keen to connect with lots of students, others expect small cohorts. Similarly, some students expect opportunities to spend time on independent work whereas others expect a more taught experience with the lecturer.

The concern is that learners' expectations only align with the realities of the institution and programme of study after completing assessments and receiving outcomes. Such outcomes are likely to be negative, given that many students will be contending with familiarisation with the institution while also becoming familiar with their present and foreign living environment.

The active learning practice is delivered in Week 1 of a 10-week postgraduate module in cyber security management. The course is designed to target learners at Levels 6 and 7 on the Regulated Qualifications Framework (RQF) and Credit and Qualifications Framework (CQFW) in England and Wales, Levels 10 and 11 on the Scottish Credit and Qualifications Framework (SCQF) and Levels 6 and 7 on European Qualifications Framework (EQF).

The postgraduate course comprises approximately 200 enrolled students. The course is a feature of many undergraduate and postgraduate programmes and as a consequence, the background and culture of students can vary in terms of experience, expectation and knowledge. The unifying element is that all learners are senior having completed roughly three or four years of undergraduate education.

4 ACTIVITY DESIGN

This paper presents a computing education active learning practice that expects teams of learners to:

(1) research cyber security incidents for a specific country
(2) identify a single incident
(3) generate a presentation slide on that incident
(4) submit the presentation in advance of the next class
(5) nominate a single member of the team to present that incident to the class who
(6) presents for two minutes to the class

The activity is designed for teams of learners. In the present context, learners have already been randomly allocated to a team for a coursework assignment by the lecturer. The teams comprise no more than six members and no less than five.

For the first step of the practice, teams are advised to access the activity specification on the course virtual learning environment (VLE). The activity specification comprises an outline of the activity and the salient steps. The steps are framed as questions, for example,

What do teams have to produce? Who presents the slide?, When does the nominated team member present the slide? What do audience members do during the presentations? and will the slides be available after the session?

Teams are allocated a specific country to investigate, see §2 for further discussion on this aspect of the practice. The country list is essentially the Top 100 countries by Gross Domestic Product (GDP). The list is drawn from a relevant and respected source and is pruned in terms of countries that represent some overlap or may be overly challenging to identify relevant incidents. The list can be curtailed or expanded in line with the number of teams that require a country allocation.

For the first and second steps, teams are advised to research cyber security incidents for their specified country. Teams are advised first to gather various cyber security incidents for a given country and identify a single incident for presentation to the class. Teams are given guidance on how to perform the activity step as well as what would make for an interesting incident.

For the third step, teams are required to produce a single presentation slide which is submitted in Portable Document Format (PDF). Teams are restricted to a single content slide to present but can have as many source slides as necessary to list their sources of evidence. If teams submit more than one content slide, then the first slide is selected from the top of the document is selected, see §2 for further discussion on this aspect of the practice.

The fourth and fifth step is for teams to submit the slide(s) via the VLE and decide which member of the team will present the slide. At the next class session, the nominated team member takes the stage and has two-minutes to present the slide to the class.

The sixth and final step of the activity is for the nominated team member to present the content. The class is advised that all teams will present alphabetically by team name. The activity will commence with the first five nominated team members taking the stage and forming a queue. The presentation will start and will automatically proceed through slides on a two-minute timer. A timer counts down in the right-hand corner of the screen. If the counter has not elapsed and the presenter has time, they will take questions from the audience, if not, then they will be clapped-off by the class. Nominated team members are advised to continue joining the 'presentation' queue so that it is always five members. The activity continues until all teams have presented.

The class are provided with all the slides and sources in advance of the session. The class are advised prior to the activity commencing, that they should consider (1) what themes emerge between incidents and (2) why teams may have selected specific incidents. These reflections form the basis of a class-wide discussion at the end of the team presentations.

5 STUDENT FEEDBACK

The practice was deemed successful in that all 33 teams presented at the session. Of those teams, 21 teams did not provide any source slides, 7 teams generated and submitted more than one presentation slide, and 1 team did not generate and submit a presentation slide in advance of the session.

For the team that did not generate a presentation slide in advance of the session and instead provided it at the session itself and asked for it to be added. However, they were advised a blank presentation slide that stated "No slide provided" would be projected for two minutes and they may speak to it or not.

The team initially were reluctant to present without their slide. The team took the stage and apologised to the class for failing to generate the content on time and were aware of the impact it had. This was a positive outcome as the team had failed to follow instructions, but gracefully learned from it and projected a professional approach by apologising to the class, reflecting on how they had to improve and presenting the research they had done.

Similarly, for the seven teams that generated more than one slide, all teams approached the situation professionally. The teams apologised and typically advised the class, they had generated more than one slide but had not appreciated the finer details of the activity specification. In this sense, the practice was effective as it gave learners an opportunity to fail and learn that had no real consequences.

For those 21 teams that did not provide any source slides, some apologised to the class and stated they did have sources but had not documented them. The general observation is this happened as the presentations progressed and suggested that some teams started to appreciate the importance of strengthening remarks with high quality evidence. Again, in this sense, the practice was effective as it gave learners and opportunity to fail and learn that had no real consequences.

Feedback was elicited after the activity was complete and is referred to with an identifier, e.g. “F23”. The learners were asked six questions, which elicited at least one response from 99 students. Here we focus on three questions that centred around the practice itself.

The first question asked learners to reflect and “In one word, what is your main takeaway from the activity? and generated 57 responses. F23 reflected the majority of sentiment from students with the one word: “teamwork”. There were other notable repeated words such as “communication”, “research”, “bonding” and “one slide”. The responses indicate the activity was successful in supporting learners to rapidly connect and practice research.

The second question asked to learners was “What was good about the activity?” and generated 57 responses. F9 represented the vast majority of responses with “I enjoyed the research and teamwork”, F19 stated “I now know how my team mates kind of work” and F13 said “Good icebreaker for the group.” However, many learners simply said “Nothing” but another mentioned “the person with no slide”. The feedback suggests the activity was successful at providing learners an opportunity to get to know their team members and establish expectations.

The third question asked to learners was “How could the activity be improved?” and elicited 42 responses. F18 represented a common theme with “more time”, F5 with “more slides” and F2 stated “graded”. There were more interesting comments e.g. F26 stated “No need for all teams to present, it’s too long, choose random ones on the day”. Similarly, F32 stated “Allow teams to select their own event from any country, then compare overlap. These are interesting comments and will be considered in more depth in Section 6.

6 DISCUSSION

The practice is useful in that it has demonstrated the use of an active learning practice in cyber security that has positive feedback and outcomes for learners in acclimatising to new settings. It also hopefully demonstrates that lecturers can attempt to do more with lecture sessions providing an opportunity for learners to appreciate the value of the peers that surround them.

Reporting the experience of the practice will hopefully also support other practitioners in the practical challenges of executing such a practice with a large cohort of students while retaining some of its merits. Reducing the number of presentations and getting learners more invested in it without losing the opportunity to fail would improve the practice.

Lastly, devising active learning practice that is successful with learners is a high risk for educators especially when compared with giving a tried and tested lecture. Educators need to share and exchange such practices more, both those successful and unsuccessful if more are to be adopted.

Feedback from learners and the benefits of active learning would suggest the practice was not only useful but also far more beneficial than just having another lecture with students.

From considering the feedback it is clear that students enjoyed the “icebreaking” aspect of the activity. It afforded learners the opportunity to get to know their team mates, practice research skills as well as consider how to present to a large group.

The activity was also useful in that it provided opportunities for students to fail with no real consequences as the assessment was not graded. Examples where students submitted more than one slide or did not submit a slide at all, demonstrated the impact of not following the specification as well as appreciating the challenge of time management.

What was also impressive was how students responded to the failure, rather than adopting a 'victim stance' or complaining, they responded professionally and communicated a meaningful reflection to the audience. Learners apologised and reflected on how they would perform differently in future.

However, the two feedback comments from F26 and F32, see §5, are compelling and suggest that a refined activity could offer students more time and slides by restricting who can present. The activity could be made more engaging by motivating learners to invest in it more, by asking them to select the country and potentially the type of attack.

The reality is that having 33 teams present, even for 2 minutes, is a considerable amount of time within a schedule. Having the space and time to do that within a course can be a challenge. It may not be necessary for all teams to present to drive the merits of the activity such as team bonding and research skills. Consequently, picking a few teams at random may be an appropriate balance. However, this introduces a concern that teams may not invest as much as they otherwise would as the potential to present would be removed in addition to the activity being ungraded. A way around this is to assess the activity, but this would undermine the "free" opportunities to fail for students as those who made mistakes would result in reduced performance.

7 CONCLUSIONS

The combination of active, interactive and constructive elements into a non-assessed activity has the potential to not only make for a more engaging learning experience for students but also provide an opportunity for students to acculturate within a cohort of peers, a new institution and a new subject such as cyber security. For the educator, devising practice that works with large cohorts, within the course schedule is challenging and requires ongoing sharing and refinement of practice.

Feedback from learners and the benefits of active learning would suggest the practice was not only useful but also more beneficial than simply delivering another lecture with students. This is in line with the work by Chi and Wylie who demonstrated a clear increased value in learning outcomes where activities were generative, interactive, and active [8].

Considering the feedback it is clear that students enjoyed the "icebreaking" aspect of the activity. It afforded learners the opportunity to get to know their teammates, practice research skills, and develop an understanding of cyber security in a given context.

The activity was also useful in that it provided opportunities for students to fail with no real consequences as the assessment was not graded. Examples where students submitted more than one slide or did not submit a slide at all, demonstrated the impact of not following the specification as well as appreciating the challenge of time management, both valuable lessons to learn prior to assessment taking place.

What was also impressive was how students responded to the failure, rather than adopting a 'victim stance' or complaining, they responded professionally and communicated a meaningful reflection to the audience. Learners apologised and reflected on how they would perform differently in future.

However, the two feedback comments from F26 and F32, see §5, are compelling and suggest that a refined activity could offer students more time and slides by restricting who can present. It is clear that the activity could be made more engaging by motivating learners to invest in it more, by asking them to select the country and potentially the type of attack.

The reality is that having 33 teams present, even for 2 minutes, is a considerable amount of time within a schedule. Having the space and time to do that within a course can be a challenge. Similarly, it may not necessarily drive the merits of the activity such as team bonding and research skills. Consequently, picking a few teams at random may be an appropriate balance. The concern is that teams may not invest as much as they may otherwise as not only is it not graded, but it would be unlikely they will present.

Future consideration of how to embed opportunities to enculturate students and their peers, understand more of the cultural expectations around education in a given institution, and develop an understanding of topics in computing would be beneficial for educators to develop and share. In doing so, institutions can potentially help students embed into the new course of study sooner, benefiting both learners and educators alike as learners will be better placed to perform optimally and share their valuable experiences.

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