MARTIN, K., ZARB, M., MCDERMOTT, R. and YOUNG, T. 2023. Empowering inquiry-based learning in short courses for professional students. *In Chova, L.G., Martínez, C.G. and Lees, J. (eds.) Proceedings of the 17th International technology, education and development conference 2023 (INTED 2023), 6-8 March 2023, Valencia, Spain. Valencia: IATED [online], pages 5404-5409*. Available from: https://doi.org/10.21125/inted.2023.1407

Empowering inquiry-based learning in short courses for professional students.

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2023

EMPOWERING INQUIRY-BASED LEARNING IN SHORT COURSES FOR PROFESSIONAL STUDENTS

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Abstract

This paper presents the pedagogic underpinning for the development of an online postgraduate short course educating participants on multi-modal data science, specifically within the context of the digital health industry. The growing digital health sector in Scotland points to the importance of networking and teamwork components, which will be central to the professional development that should be facilitated within this short course. To that end, this paper will show how the literature has been used to inform the integration of aspects of constructivism (such as encouraging self-efficacy and intrinsic motivation) to improve participants' learning experience and their capability to apply learned skills in their practice.

A key candidate for this approach is inquiry-based learning, typically characterised by events such as hackathons, which are a popular method of self-directed learning in computing education. However, hackathons present challenges for online and postgraduate learners, including lack of physical location and barriers to time investment.

We are therefore motivated to propose an adaptation that draws on theories and research related to inquiry-based learning and hackathons. In this paper we describe the inception of the resulting model and evaluate an initial design against a panel of experts in the field.

Keywords: Computing education, inquiry-based learning, short course development, professional students.

1. INTRODUCTION

There has been increasing research into maintaining engagement through design of novel learning activities, particularly those with mentoring opportunities [1]. One of the motivating factors for this is that some studies indicate that computing education fails to subjectively engage students [2]. These factors can also be seen in the area of ongoing professional development where engagement is key for ongoing professional development [3]. Among these methods, hackathons (events where participants engage in rapid prototyping and development over a condensed timeframe, typically 24 hours) have emerged as a viable way of teaching and assessing skills in realistic environments [4]. Hackathons have previously been linked to a number of pedagogic principles, such as inquiry-based learning [5], which are known to encourage learner engagement.

Though typically held in-person, the COVID-19 pandemic has inspired significant growth in online hackathons for teaching both professional software development skills and soft-skills such as team-working [6]. However online hackathons face a number of challenges which do not impact in-person events. The authors of [7] identified barriers in participation for non-traditional CS students, including women and those transitioning to CS from other fields. Others have identified the challenges of running hackathons online, specifically both intra- and inter- team communication [8].

We were motivated to consider hackathons as a method of assessment for a new short course which is, at the time of writing, recruiting students for the first intake in early 2023 at Robert Gordon University (RGU). The short course is planned to run for 8 weeks, and is worth 7.5 ECTS. The short course teaches data science for digital health, and is aimed at young professionals working in the health industry, or learners with a computer science background transitioning into a data science specialism. All aspects of the short course will be delivered online as a mix of live (i.e. flipped classroom discussions) and asynchronous (i.e. video recorded lectures, practical exercises) elements. Online teaching is known to present challenges for student retention [9]. We contend that hackathons and similar events represent an ideal candidate to promote engagement and retain students, but the aforementioned problems are barriers to integration.

We are motivated by pedagogic theory in work-based learning and intrinsic motivation to propose the Bring Your Own Project (BYOP) method, inspired greatly by hackathons but adapted to include best practice from constructivism and knowledge sharing principles. The result is a group-based online asynchronous learning activity, mixing learners with various levels of expertise in the study domain (in this case, data science). This design has been accepted for adoption as a partial assessment for a short course in RGU following evaluation by a panel of experts.

We structure this paper as follows: in Section 2 we discuss the related work which has inspired our design, while in Section 3 we describe influential contextual factors. In Section 4 we discuss the design of the learning activity and in Section 5 we provide an overview of our evaluation and its outcome. Finally, in Section 6 we discuss our initial conclusions and plans for future work.

2. BACKGROUND

This background considers constructivist perspectives of online learning, to start determining ways of bolstering engagement within the framework of the proposed short course.

As a theory of learning, constructivism has been shown to be extremely influential in the development of educational theories in which learners actively construct and find meaning with the subject area while engaging with the pedagogical process [10]. A defining feature of constructivism is that learners are actively constructing their own learning: “Learners look for meaning and will try to find regularity and order in the events of the world even in the absence of full or complete information” [11].

Tam [12], for example, draws links between constructivism and online learning, stating that “instructional designers and academics should allow distance learners to be more reflective, to give personal views on topics, to debate and argue their points of view, to question information given by the instructor and textbooks, based on personal observations and knowledge acquired elsewhere [..] two-way, interactive communication and collaboration between the instructor and learners and among the learners themselves” [12]. This level of autonomy is reflected in the constructivist views to encourage active, collaborative and responsible learners.

This focus on autonomy is further seen in inquiry-based learning, prioritizing questions over topics, and therefore pushing students towards engagement [13]. Kienzler and Fontanesi present an adaptation of this, showcasing hackathons as potential pedagogical tools by allowing students to develop “relatively high levels of competency in their newly won skills” [5].

Studies indicate that computing education often fails to address the affective motivation of students and leverage this for course engagement and participation, with some students focusing on getting their qualification rather than engaging with the subject in more meaningful ways [2]. Encouraging this motivation has many academic benefits – McDermott [14] has previously highlighted the correlation between engagement (and its subsequent impact on the students’ ability to persevere in their studies) and academic success. Some methods, such as the use of mentors, are seen as key for the career development of young professionals [1]. Hackathons can also be a viable way of teaching and assessing skills in realistic environments [4], directly impacting engagement.

The COVID-19 pandemic has inspired significant growth in online hackathons for teaching both professional software development skills and soft-skills such as team-working [6]. However, they are not without their challenges. Hardin [7] identified challenges in participation for non-traditional CS students, including women and those transitioning to CS from other fields. Others have identified the challenges of running hackathons online, specifically both intra- and inter- team communication [8].

3. CONTEXT

Robert Gordon University (RGU) is based in Aberdeen, Scotland. This short course will be based within the School of Computing at RGU, and has been validated at Scottish Credits and Qualifications Framework (SCQF) level 11 (which is the equivalent of postgraduate study) for 15 credits (or 7.5 ECTS). All authors are part of the short course development team. The course is motivated by the growth of the digital health sector in Scotland and national goals highlighted in the Digital Health Strategy 2021.

3.1 Overview of Content

The short course will act as an introduction to the theoretical aspects of digital health, before deep diving into individual use cases which exemplify different aspects of data analysis on multi-modal health data. Each topic will explore a domain within the broad topic of digital health (medical imaging, nutrition, and exercise recognition) underpinned by exploration of the relevant data type (images, text and time-series data, respectively). All aspects of the short course will be delivered online as a mix of live (i.e. flipped classroom discussions) and asynchronous (i.e. video recorded lectures, practical exercises) elements. Successful completion of this short course will result in certification for the participants.

3.2 Target Learners

Our target learners are postgraduate learners from two broad demographics: (1) individuals or organisations who are looking to translate their product or move into the digital health business space; and (2) upskilling individuals already working in the health space who aim to learn data science skills. Each group is accompanied by its own set of challenges. Our first demographic will be skilled in other areas of computing (potentially including data science) and, importantly, are looking to grow these skills while remaining in the same business area. As a result, we anticipate they will desire clear and demonstrable benefits of the learning to their learning goals (which will be fundamentally work or business-based). However, they may struggle to absorb domain-specific concepts, as they will not understand the data. The second demographic represent a group with domain expertise, but (potentially) lacking any formal computing education. This demographic will be primarily composed of individuals who are in the process of transitioning from previous employment which was not related to computing science (likely in the health domain), to a career where computing science is central to the role. Their learning goals include reskilling and therefore, they present the challenges associated. On the other hand, they benefit from rich domain knowledge which mean they are likely to be able to identify and explain observable patterns in the data more quickly.

Given the scales of expertise (i.e. low domain, high data science and high domain, low data science respectively) it makes sense to design activities where learners can benefit from one another's previous experience. As learners are looking to enter this business area, team working presents a valuable networking opportunity for participants to grow professional networks.

4. The "Bring Your Own Project" (BYOP) Model

Given the contextual factors noted above, we propose to assess the course using an adaptation of the more traditional hackathon method. Modifications are intended to resolve two specific challenges identified in hackathons: i) difficulty in participation for students transitioning to computing science and ii) limitations of the online platform.

The Bring-Your-Own Project (BYOP) model is styled similar to a week-long asynchronous hackathon. As a preliminary step, learners will be encouraged in advance to prepare a problem from their (future or aimed) workplace for discussion during the kick-off session. Throughout the session, learners will form groups around similar problems. Over the course of the next week, learners will plan and design a generalizable data science strategy that can be applied to all of the problems in their group. Individual students will use the strategy as a starting point to perform a more in-depth design to their own specific problem. At the end of the week a presentation session will be held. Groups will share both the general plans and the specific designs for individual problems for feedback by an audience of course tutors and other learner groups on the course. This will ensure that (a) learners get experience planning to solve real problems and (b) individuals on the course benefit from expert feedback on plans to give them a 'starting point' for transitioning into digital health. Furthermore, the open and honest discussion will give learners insight into each other's working domains and support the development of professional networks. Figure 1 presents the initial framework for the BYOP method.

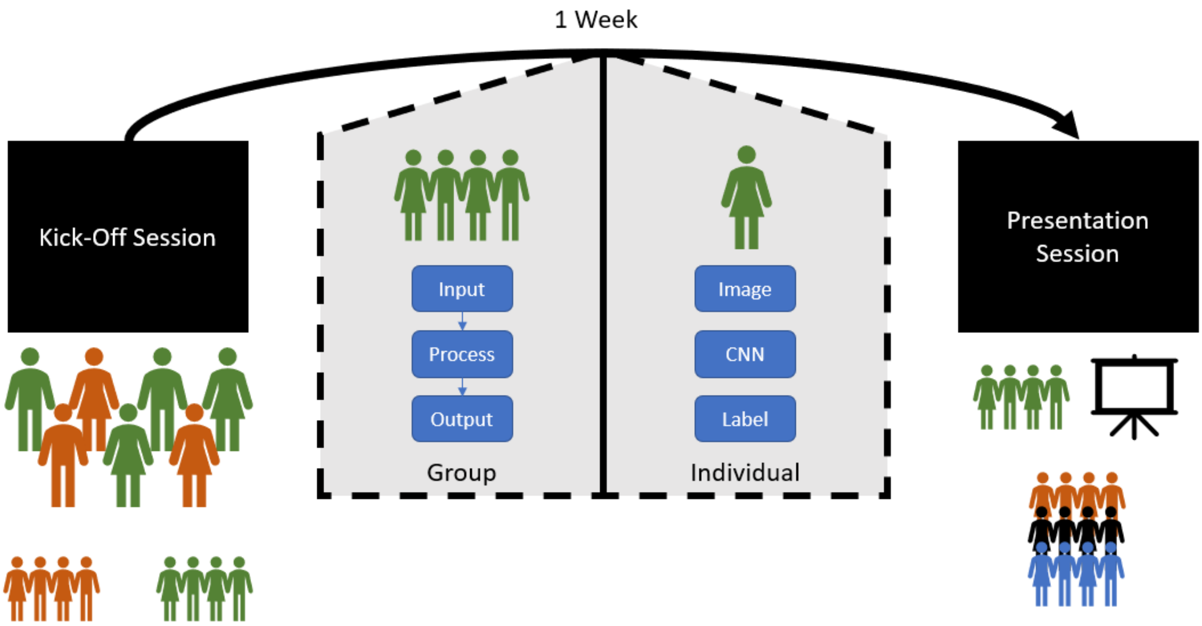

Figure 1: The Bring-Your-Own-Project (BYOP) method. Participants form groups around similar ideas during the kickoff session. In the following week, they work as a team to create a generalizable data science plan, while working individually to design a solution for their own problem.

We note that the proposed method is appropriate for several reasons. It supports the constructivist ideology and inquiry-based learning due to its links to the conventional hackathon. However, a key difference in our methodology is to encourage students to propose their own projects. Being linked to the participants' own work goals incorporates elements of intrinsic motivation and work-based learning [15], making it easier to justify the time spent on the exercise. Similarly, the separation of work between group targets and individual targets facilitates asynchronous learning and reduces the pressure for in-person meetings (which we found hackathons are traditionally reliant upon). The mixing of two learner groups with differing specialties encourages inclusion (reducing the obstacles faced by transitioning learners), while forming groups around commonality of ideas promotes the growth of personal networks.

5. EVALUATION

A panel (16 individuals) consisting of industry members and academics (both within and outside the host university) was assembled to give feedback on the proposed BYOP method. The framework and relevant context were presented, and feedback sought regarding its efficacy and subsequent implementation. Panel discussions lasted circa 60 minutes. We then analysed the feedback to recognise any barriers to success for the model and identified three recurring themes which will be discussed below.

5.1 Design vs Implementation

Multiple members of the panel (31%) noted that the assessment did not require demonstration of practical capability to implement a data science pipeline. The main concern that it was unsuitable to provide certification when practical skills were not explicitly assessed. Based on this discussion, we amended the assessment to consider the weekly practical exercises (see Section 3). Coding exercises would now form 50% of the assessment, demonstrating students' practical ability, while the BYOP method would form the remaining 50% of the assessment and demonstrate their understanding of applying theory in a business context. This amendment was accepted unanimously by the panel.

5.2 Uniformity for Assessment vs Generalisability for Student Engagement

Another main discussion point was the potential variability of projects that students could present for BYOP. This threatened the validity of the assessment, as there was no means to ensure uniformity for the basis on which students would be evaluated. Several members of the panel (19%) highlighted that this could mean some students select a very simplistic problem, while others may choose a very complex problem. Furthermore, one additional member of the panel was concerned that some transitioning students would not be able to provision any problems for the exercises (and therefore could not be assessed).

In answer to this, we highlighted that the students will explore business use cases in depth as part of the short course, so selecting a suitable use case was in essence part of the assessment. We also added that course tutors will be present during the kick off to provide immediate feedback on project scope. Additionally, in answer to this last concern we updated the design of BYOP such that students unable to produce a project would be provided one by the course tutor. The panel accepted these changes and no further concerns were raised on this topic.

5.3 Challenges in Student Retention

The final concern raised was mentioned by a small number of the panel (13%). They highlighted that traditionally, short courses struggle with student retention over time. We responded that, as the assessment, the BYOP exercise would be near the conclusion of the course and therefore should be unaffected by any initial student drop off. Building a more robust answer to this is something we plan after a pilot of the activity. The panel therefore maintained this as a concern, but accepted it would be resolved at a later date.

6. CONCLUSIONS

This paper proposes an adapted hackathon-style event focusing on bespoke problem solving, in order to act as a proposed assessment model for a new digital health data science short course. The primary contribution of the paper is the BYOP model, which outlines an instructional design for a (short-)course, taking advantage of the natural interest that learners have for problems associated with their own projects. This has two advantages which speak directly to some of the main problems with engagement in such courses: firstly, the fact that they will bring relevant industry-based problems to the course immediately enhances the authenticity of the learning (as it directly produces problems with a real-world application, grounded in the activities that the student is already doing); secondly, the fact that the problems are personalised (chosen by the learner from their own work-specific contexts) has the potential to enhance motivation by focusing on aspects of learning that the students themselves have prioritised as important.

Initial evaluations on the pedagogical model are promising, with a panel of experts providing valuable insight and suggested changes to the model. The main barrier to the adoption of the proposed BYOP model, is the potential for selecting problems which, while relevant to individuals, may be too diverse to form a coherent narrative for assessment. To resolve this, we have built upon the recommendations from a panel of experts. In particular, completion of practical exercises will form 50% of the assessment (meaning that practical skill will form a component of the earning the credentials the course offers) and business use cases will be taught as part of the course material (helping them to scope the problem selection component)

Future work will consider the implementation of the model within the short course, using metrics such as student achievement and student engagement. An abstract version of the model is being considered for use elsewhere in the School, and the results of this abstraction may be written up for further consideration.

ACKNOWLEDGEMENTS

We would like to thank the DataLab for financially supporting this work and development of the short course.

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