Using Scrum in an Online Smart Classroom Environment: A Case Study
Ye Wei, Sitalakshmi Venkatraman, Fahri Benli, Fiona Wahr

Abstract—The present digital world poses many challenges to various stakeholders in the education sector. In particular, lecturers of higher education (HE) are faced with the problem of ensuring that students are able to achieve the required learning outcomes despite rapid changes taking place worldwide. Different strategies are adopted to retain student engagement and commitment in classrooms to address the differences in learning habits, preferences and styles of the digital generation of students recently. Further, with the onset of coronavirus disease (COVID-19) pandemic, online classroom has become the most suitable alternate mode of teaching environment to cope with lockdown restrictions. These changes have compounded the problems in the learning engagement and short attention span of HE students. New Agile methodologies that have been successfully employed to manage projects in different fields are gaining prominence in the education domain. In this paper, we present the application of Scrum as an agile methodology to enhance student learning and engagement in an online smart classroom environment. We demonstrate the use of our proposed approach using a case study to teach key topics in information technology that require students to gain technical and business-related data analytics skills.

Keywords—Agile methodology, Scrum, online learning, smart classroom environment, student engagement, active learning.

I. INTRODUCTION

In recent years, there has been a significant surge in the use of online learning environments due to various compelling factors. With rapid advancements in technologies, their effective use in education paves way for the design and delivery of online courses [1], [2]. At the same time, the increasing demand from HE students’ and their desire to learn from anywhere and anytime form the prime motivating factors for the massive popularity of online teaching and course offerings worldwide [3], [4]. HE institutions are using online learning environments for offering courses both in a completely online mode as well as in a dual mode supporting blended learning approaches [5], [6]. In addition, the recent coronavirus disease (COVID-19) pandemic has resulted in online teaching to be mandatory in most countries.

Current learning management systems provide online environments that are designed to support learning activities such as video-based lectures, quizzes, discussion forums, blogs and wikis. Such traditional online learning tools are not sufficient to promote student engagement among the digital native learners of today [7]. HE students adopt skim learning on the Web and their attention span is limited due to distractions with Internet, social media and other mobile technologies that have changed their behaviour patterns having a huge impact on their learning [8]. On the other hand, lecturers designing and managing online teaching activities come from an earlier generation as compared to the learners, which calls for more innovative design of online learning activities to understand the needs and learning approaches of digital native learners [9]. This paper takes a positive step in this direction in the adoption of online smart classroom environments to motivate and support student engagement and collaborative participation in online learning activities. In addition, we propose the use of an agile methodology such as scrum in this context as it is the most popular process frameworks in scientific domain that we adopt in the HE domain. We implement Scrum to engage students in learning key topics in information technology to gain technical and business-related data analytics skills as a case study.

The main contribution of this paper is the use of a relatively new Agile approach such as Scrum in education. Further, our study on improving student engagement, knowledge and skills in business-related data analytics areas of specialisation is not predominant in literature. By adopting Scrum in implementing an online smart classroom environment, we aim to enhance the teaching practices of complex concepts to

• improve student learning and engagement in class, especially in remote learning/blended learning
• enrich collaboration between the educator and students by developing and following an Agile adaptive framework.

The key focus of this contemporary project is to employ several smart software tools in several subjects with an integrated approach towards enhancing student engagement for building their competencies in the Business Analytics domain. Recently, some studies have considered only a single software tool adopted usually for a single subject. this study considers the summative impact on student learning with multiple subjects in a specialised IT field using a combination of smart software tools online [2], [7], [10].

The rest of the paper is organized as follows. Section II presents the commonly applied Agile methodologies in teaching. In Section III we propose the application of Scrum for online teaching that we have experimented as a pilot study. Section IV describes a case study implementing an online smart classroom using collaborative tools for learning activities in teaching key topics in Business Analytics area of specialisation.

II. AGILE METHODOLOGIES FOR TEACHING

Today, changes in our environments take place at an
increasing speed that people participating and managing projects, and individuals are looking at strategies and models to achieve the required outcomes successfully [10]. The education sector is no exception and as educators we need to embrace changes in student circumstances and teaching processes that require agility in the classroom environments. Agile methodologies were developed to address the drawbacks of traditional project management of sequential planning (waterfall models) in an organization [11], [12]. Since Agile is one of the most popular process-based frameworks proved to be successful in managing software projects and teams, it has ignited much interest in the teaching context of education industry [13], [14]. The Agile framework is based on the Agile Manifesto which consists of essential values and principles in which requirements and solutions evolve continuously in an iterative and collaborative approach among stakeholders [15].

Several Agile methodologies that have originated and applied to the real-world include Scrum, eXtreme Programming (XP), Kanban, Crystal, Dynamic Systems Development Method (DSDM) and Feature Driven Development (FDD) [16]-[18]. The Scrum framework developed by Jeff Sutherland and Ken Schwaber for software industry has recently become popular in educational contexts [19]-[21]. Educators are faced with the recent requirement to recognise and respond to constant changes in the new pedagogical methods of blended approaches adopted in education. In developing adaptable and lifelong learners along with their competency and skill development, especially in the IT industry, innovative approaches to support collaborative learning and student engagement are warranted [22], [23]. We believe that Scrum, which supports pedagogical adaptive and iterative development of classroom activities through short continuous cycles of planning, feedback and action would lead to improving student learning outcomes in increments.

Scrum is ideal for empirical process control in classroom environments with self-organizing teams to plan and review the learning activities and outcomes (minimum viable products or MVP) in increments called “sprints”. For each sprint, the lecturer or the product owner plans the next set of MVP called “backlog items” to be delivered through the sprint cycle. It is a collaborative development with students and other educators in a teaching team to coordinate and contribute to work efficiently [24], [25]. Using Scrum, the milestones achieved as student learning outcomes in short iterations and the student learning progress can be more tangible with adjustments to classroom activities possible through the feedback gained in each sprint.

III. APPLICATION OF SCRUM FOR ONLINE TEACHING

Scrum is a framework of Agile. The word Scrum comes from the sport game Rugby. This framework helps the team work together efficiently. It encourages self-managing team, short term delivery, fast feedback loop, and change adaption etc. [26]. According to the Scrum Framework given in Fig. 1, there are several artifacts and ceremonies that we employ for online teaching [27]. We provide a list of artifacts, ceremonies and roles used in this study as explained below.

The following three items form the list of artifacts we have adopted for online teaching:

- **Product Backlog**: An ordered list of items that potentially will be fed into Sprint Backlog in the Sprint meeting
- **Sprint Backlog**: An ordered list of items to be completed in the Sprint. The team should have known why these items are in the Sprint Backlog, what to do and how to complete them
- **Increment**: A concrete steppingstone toward the Product Goal

The following five items form the list of ceremonies we have adopted for online teaching:

- **Sprint Planning**: A cadent ceremony that helps the team to plan what will go into Sprint Backlog from the Product Backlog, also knowing why, what and how
- **Sprint**: A time-boxed development period when the team works together to deliver value to the customer
- **Daily Scrum**: A daily ceremony to inspect the work in the Sprint. Each team member will answer three questions: What have I done since last daily scum meeting? What will I do today? What is my roadblock?
- **Sprint Review**: A ceremony to gather with the team and stakeholders to inspect the work completed in the Sprint. It is a time winder to demonstrate the increment (value) to the stakeholders (e.g., customer)
- **Sprint Retrospective**: A ceremony that will be conducted at the end of the Sprint with the team to discover ways to improve

The following is the list of roles we have adopted for online teaching:

- **Scrum Master**: Master of Scrum, a coach of the team who will help guide the team adopt and practice Scrum in the project
- **Product Owner**: In charge of the product backlog, what goes in and what comes out. Product Owners decide what is the value to the customer.
- **Developers**: In charge of how to deliver value to the customer. They turn the items from the Sprint backlog into Increment

The lecturer plays the role of Product Owner who is responsible for managing the subject topics that are taught and to maximise the value of the learning from the effort of the Scrum classroom. Students are divided into groups (e.g., 4 students in a group). Students take turns to play the role of a Scrum Master who is responsible for helping the group members understand Scrum theory and practice. The other group members will be developers who are working together in the Scrum classroom to deliver maximised value of the “product” which is the learning outcome of the subject.

Product Owner also oversees the Product Backlog which contains the subject topics in the subject outline. Product Owner can decide what goes in or comes out of the Product Backlog.

Sprint Planning meetings take place in the class with an interval of 2-3 weeks depending on how long the teaching period is. This meeting takes roughly 1-2 hours based on how many topics are to be covered in the next Sprint. The Scrum class discusses which topics can be included in the next Sprint, how it can be taught or learned, and why that justifies based on
the feedback gained.

Fig. 1 A Scrum framework suitable for online teaching [27]

### TABLE I

<table>
<thead>
<tr>
<th>Scrum</th>
<th>Classroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Owner</td>
<td>Teacher</td>
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<tr>
<td>Scrum Master</td>
<td>Student lead (in rotation)</td>
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<tr>
<td>Developers</td>
<td>Students in breakout groups</td>
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<tr>
<td>Product Backlog</td>
<td>Subject topics in the subject outline</td>
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<td>Sprint Planning</td>
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<td>Sprint Backlog</td>
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<td>Sprint</td>
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<td>Daily Scrum</td>
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<td>Increment</td>
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<td>Sprint Review</td>
<td>Demonstration of the learning outcome from each group to the whole class</td>
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<tr>
<td>Sprint Retrospective</td>
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Sprint Backlog is the output of the Sprint Planning meeting which contains the topics that will be covered in the Sprint and helps in communicating the details of what, how and why. Then the Scrum class will kick off the sprint and complete the topics in 2 weeks (depending on the length of the sprint in the planning).

Daily Scrum within the student group is optional as it will not be during the class time and it will be led by the group leader (Scrum Master) daily or realistically twice a week.

When the Sprint ends, the topics should be covered with their learning outcomes which the scrum class has achieved as an increment, a shippable product. Followed by Sprint Review, learning outcomes achieved could be demonstrated by the student groups to the whole class by using student-led presentations or collaborative workshops that were successfully completed.

Lastly, a lesson learned session will be held within each student group to answer the following three questions:

- What did we do well?
- What can be improved?
- How can learning outcomes be improved?

Once the Sprint Retrospective ends, the scrum class enters the next sprint cycle starting with Sprint Planning until all the topics in the Product Backlog are covered. Table I summarises how Scrum terms are adapted and mapped onto classroom terms and contextualized with the student learning paradigm.

### IV. ONLINE SMART CLASSROOM-BASED LEARNING ACTIVITIES: A CASE STUDY

In the Scrum class, it is beneficial to utilise smart software tools to support the execution of Scrum and help the students to collaborate online. It has been successfully used to teach software engineering [28], [29]. In our study, a smart collaborative software tool called MIRO was used for classroom-based learning activities. Table II provides the research methods used for collecting and analysing data to assess the student learning through different learning activities.
We present below examples of learning activities undertaken by students using MIRO in an online smart classroom environment:

1. Activity Name: Tell Us a Bit More About Yourself

The introductory activity to share about each other’s interest is a great way to warm up the class and get the students’ interest in using MIRO to develop further collaboration with each other. The outputs from the students shown in Fig. 2 demonstrate how the students’ interests could be shared on a common platform via MIRO for developing future collaboration in their learning journey. Students who hesitate to participate initially get motivated to do so when they see others share their interest on the smart collaborative online environment.

2. Activity Name: Mind Mapping

The mind mapping activity using MIRO enables students to work in a group and share their understanding of a concept such as Business Intelligence planned to be covered within the lesson’s topic of the Sprint. It serves as a smart platform for understanding complex concepts and in developing in-depth learning skills in group environment. As shown in Fig. 3, each student in the group is able to analyse, evaluate and create based on their understanding of the concept and to develop the mind map of the topic progressing in a collaborative way.

3. Activity Name: Dot Voting

The dot voting activity using MIRO helps students learn a brainstorming and negotiation technique. It not only enhanced their learning of the topic concepts but students also learn how to negotiate and get to an agreement within a team. Fig. 4 demonstrated how students collaborate through Dot Voting to learn about the modules of an enterprise resource planning system.

4. Activity Name: Sprint Retrospective

The sprint retrospective activity is used to support the Scrum class ceremony to serve as a retrospective at the end of each Sprint. Students were given time to carry out a lesson learned session within their group to understand what went well, what can be improved and how to improve it for the next Sprint. Fig. 5 shows an example of Sprint retrospective activity completed by the students in an online smart classroom environment.

Overall, HE students are required to acquire life-long skills, knowledge and competencies and be prepared for the future workforce in the ever-changing business world [30], [31]. To facilitate this, we have conducted a pilot study to demonstrate how smart software tools could be adopted using an Agile methodology such as Scrum to engage students in their classroom activities for effectively achieving their learning outcomes.

V. CONCLUSIONS

In this paper, one of the popular Agile methodologies namely Scrum was explored in a HE context. We demonstrated the application of Scrum to online teaching. In particular, we used smart software tools to enhance student engagement and in-depth understanding of complex concepts in a collaborative manner. The reported artifacts collected in a smart classroom environment suggest that Scrum can be effective since active and adaptive learning can be applied incrementally. Scrum
supported learning and teaching transformation from teacher-centric to learner-centric knowledge formation through rich collaboration and activity-based experience.

Fig. 3 A mind mapping activity

Fig. 4 A dot voting activity

Fig. 5 A Sprint retrospective activity
REFERENCES


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