Relax, It's a Game: Utilising Gamification in Learning Agile Scrum Software Development

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***Abstract*—Agile software development is a collective term for collaborative working based on a set values and principles, which has become the de facto approach for the software industry, resulting in it being an essential part of the Software Engineering (SE) curricula for many computing degree courses. One of the most popular Agile software development approaches is Scrum which is widely adopted by the software industry and university curricula. Learning Agile Scrum is imperative for students not just as the part of the SE module but for use in the development of their final software project during the course. Teaching the Agile Scrum approach in a way that students can effectively employ in their final project requires the use of some additional practical aid, which is always a challenging task for teaching staff. Employing commercial tools may not be suitable due to additional financial cost, time and learning curve for students. This paper proposes an easy and effective Game-Based Learning (GBL) approach for Agile Scrum using Trello. Trello is a web-based app with no learning curve used to design any project in a collaborative environment. It is not a Scrum tool, nevertheless its features can be transmuted into a Scrum tool to be used to develop projects. Using this Trello-based gaming activity, students can learn the Agile Scrum approach as a game not as a complex methodology. This proposed GBL approach has been used for two undergraduate courses for the last four years, demonstrating constant improvement for both courses in their learning and assessment whilst comparing it with the traditional teaching approach for Agile Scrum.**

I. Introduction

Software Engineering (SE) has been an essential part of computing degree courses at universities. In the last two decades, Agile has emerged as the most successful software development approach [1]; consequently, it led to changes in SE curricula that included several Agile approaches Scrum, eXtreme Programming (XP), Crystal and Dynamic Systems Development Method (DSDM) as a major component of the degree [2], [3]. Amongst all, Scrum is the most popular Agile methodology, which is widely adopted as a de facto methodology for most software development projects [4], [5]. Learning Agile Scrum is imperative for students not just as the part of the SE module but for use in the development of their final year software project during the course. Software project development is a demanding, precise and challenging phase for students who are undertaking their courses at university. Moreover, they are always time constrained with limited time, from design of their projects to completing their reports. Teaching Agile Scrum in a way that students can effectively employ in their final project requires some additional creativity, fun and practical aids, which is always a challenging task for teaching staff [6], [7], [8]. Employing commercial tools may not be suitable due to many reasons such as adaptability, additional financial cost, time and learning curve for the student [9], [10].

This paper proposes an easy and effective Game-Based Learning (GBL) approach for Agile Scrum using Trello. Trello is a low-cost web-based app with no learning curve, used to design any project in a collaborative environment [11]. It is not a Scrum tool, nevertheless its features can be transmuted into a Scrum tool and used to develop an Agile Scrum project and its components such as Product Backlog, Release Backlog, Sprint and Burndown Chart [12]. Using this Trello-based gaming activity, students first learn the Agile Scrum approach through Trello, next students are divided into teams and make a game plan to design a Trello Project Board for a given case study, then they present their Trello Boards in a game competition to compete for the rewards. Finally, they use the overall knowledge and experience of this GBL into the development of a real project. This proposed GBL approach has been used for two undergraduate courses for the last four years, demonstrating continuous improvement for both courses in their learning and assessment compared to traditional teaching approaches for Agile Scrum.

The rest of the paper is organised as follows: Section II explains the Agile Scrum methodology and Trello; Section III presents the stages of the proposed Trello-based GBL approach for Agile Scrum development; Section IV presents an Agile Scrum project template in Trello; Section V presents the results and analysis of this Trello-based GBL approach; Section VI concludes the paper and suggests some future work.

II. Background Information

A. Agile Scrum Methodology

Scrum is one of the Agile software development methodologies proposed by Jeff Sutherland and Ken Schwaber [13]. It is a complete process from design through to the development of a product, based upon a set of guidelines for managing that development. It combines the iterative and incremental process models to overcome issues with traditional models [14]. It focusses on the process adaptability and customer satisfaction by rapid delivery of a working software product [13]. This is achieved by dividing the product into a number of small incremental builds [1]. These builds are provided in

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iterations. Each iteration has an elapsed time of typically 3-30 days, with iterations involving cross functional teams working simultaneously on various topics such as planning, requirements, analysis, design, coding, and testing. Each iteration ends in a Sprint, where a working product is presented to the customer and key stakeholders. A significant issue in any software development project is changing requirements, Agile Scrum accepts these changes as reality versus the desire for complete, rigid specifications [5].

B. Trello® - An Effortless Web App for Team Working

Trello is one of the easiest and popular project management tools to use when teams are involved in projects. It is a collaborative teamworking tool designed to ensure that teams work effectively. The features available in Trello such as boards, lists, and cards enable the organization and prioritisation of projects in an engaging, flexible, and rewarding way [11]. Trello utilises the concept of boards (which corresponds to projects) and within boards, there are lists (group of tasks) and cards (which represent tasks). The cards within lists can be used to track the progress of a project or to simply categorize events [15]. It allows integration of apps that the development team already uses directly into the workflow. This power of Trello converts its boards into living applications to meet the team's unique business needs [11]. Furthermore, it permits synchronisation across all devices and sites. Offering real-time updates meaning everyone is able to share the same perspective. In terms of devices, it is available on a desktop browser and mobile devices whether online or offline. Some of the important features of Trello are given in Table I [15]. Trello® is a registered trademark.

TABLE I: Trello® Features

No.	Features	No.	Features
1	Easy to learn and simple GUI	11	SSL encryption of data
2	Mobile functionality to access boards on the go	12	Easy uploading of files and attachments
3	Free or zero pricing for the basic service	13	Archiving of card records (e.g. comments and changes)
4	Customisable boards for easy design	14	Information retrieval and back-up
5	Native notifications	15	Voting feature and search function
6	Quick overview on front and back of cards	16	Deadline reminders and email notifications
7	Checklists, with progress meter	17	Task assignment and activity log
8	Visibility Scope	18	Power-ups features
9	Easy organization with features such as tags, labels and categories	19	Easy move, swap, drag and drop functionality
10	In-line editing and data filtering	20	Developer API

III. Stages of the Proposed Trello-Based GBL Approach for Agile Scrum Development

A. Learning Agile Scrum Based Project Development using Trello

Firstly, students are taught a range of systems design methodologies including Agile Scrum on their Software Engineering module; subsequently, a web-based tool Trello is employed to include all the design aspects of Agile Scrum within it. It is used to design Agile Scrum components such as the Product Backlog, Release Backlog, Sprint and Burndown Chart. Students are taught the Scrum methodology through elicitation of requirements and their presentation as user stories (subsequently split into tasks), which form the product backlog. From the product backlog, the team selects which tasks they wish to develop and these are loaded into sprints. Sprints are of 1-4 weeks duration and their progress is strictly monitored using a burndown chart. During this phase of their learning, the students are given examples and reinforcement exercises in the individual components of the methodology, so that they are familiar with the method and its design in Trello.

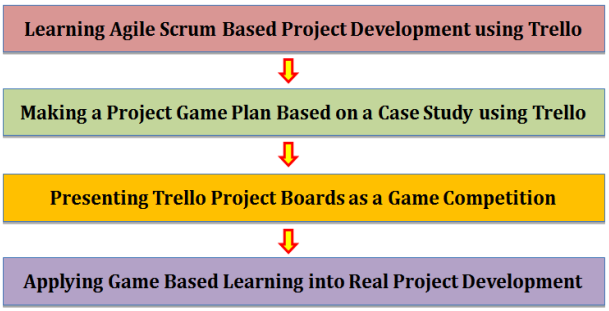

Fig. 1: Stages of the Proposed Trello-Based GBL Approach

B. Making a Project Game Plan Based on a Case Study using Trello

Once the learning is accomplished, students are divided into team of 2-3 and assigned a software development project based on a case study to design using Agile Scrum in Trello. During this development period, students work as a team and apply their learning of Agile Scrum and Trello exploring a variety of ideas to make their Trello Project Board better than other teams so they can win rewards during the presentations of their developed project scenario in Trello. Students learn that a number of events and points have to take place in the background when producing a software development project. These include user experiences and UIs being designed, roadmaps are planned, backlogs are built, code is written, bugs are caught and fixed. However, students as engineers learn to identify problems, and design solutions to ensure everything works when required. During the sprints it is emphasised that without good team communication, clear goals and priorities, and an up-to-date roadmap, workloads can quickly become disorganized. They learn to be agile; there is no time to be aggravated at yet another last-minute request for *a quick change* to the plan.

They utilise Trello to set sprint tasks and run efficient retrospectives, collaborate on bug fixes to celebrating product deployments, taking part in the daily ceremonies conducted by the scrum master. Students can easily monitor product development through collaborative communication using Trello, they use this software to visualise sprint and product development. In addition, they are developing and honing their communication and collaboration skills whilst learning how the Agile Scrum methodology works.

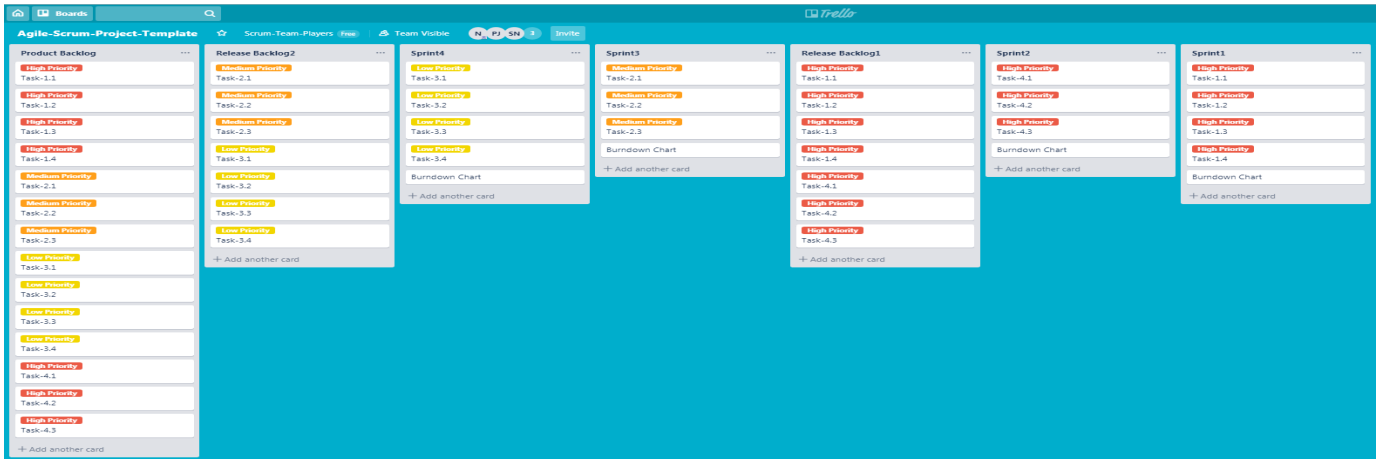

Fig. 2: Demonstration of a Designed Agile Scrum Project Template and its Components using Trello Board

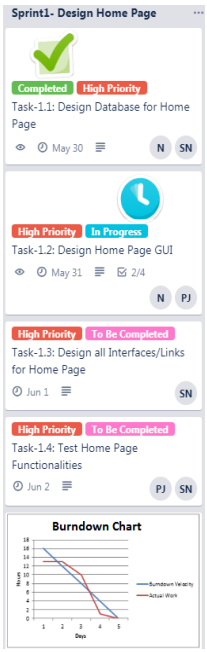

Fig. 3: Demonstration of a Designed Agile Scrum Sprint and its Components using Trello List

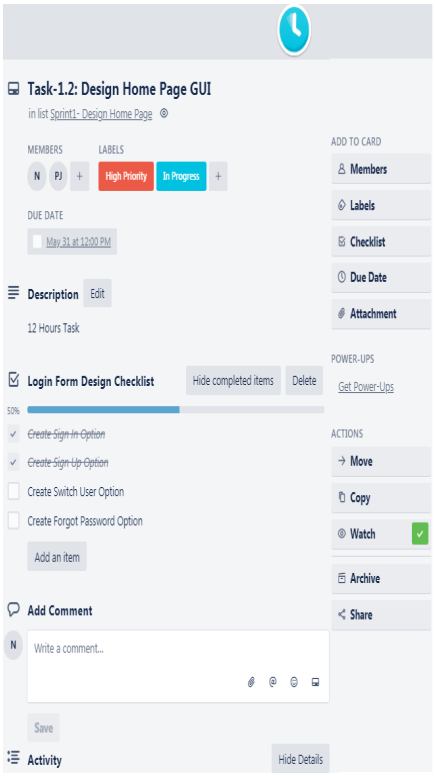

Fig. 4: Demonstration of a Designed Agile Scrum Task and its Components using Trello Card

C. Presenting Trello Project Boards as a Game Competition

The final presentation of their developed software project in Trello is organised as a game competition to offer them some incentives and encouraging them to work hard as a team and learn from each others work. The students are given the opportunity to act in the different roles during the scrum development, this gives rise to competition within the team as to who was the most effective Scrum master and developed the most sprints, who managed to develop a sprint in the shortest time, and who was the most effective team. Game competition gives an opportunity for the whole class, staff and other attendees to ask questions and offer feedback. This is the real evaluation of their work presented by each development team as it is not just assessed by one or two lecturers but all participants, which is more effective than just designing a project in Trello in isolation. Irrespective of the award, everyone gains some useful feedback and knowledge related to Agile Scrum based software development project in Trello, which is very helpful for their final stage of real project development in their course.

D. Applying Game Based Learning into Real Project Development

Later, when they start their real projects, they employ Agile Scrum using Trello for their project development. At this stage, each student has learnt Agile Scrum in Trello and enhanced their team working skills, which makes this whole project development process easy and familiar to them. In general, the final projects given to students are more complex and time constrained, where requirements are often volatile, which means that an Agile Scrum approach is well suited to these types of projects. Students begin by establishing links with the main stakeholders and follow the setup of their Trello Project Board. They begin by interviewing the stakeholders to establish the user stories and hence the product backlog and sprints. The Trello-based approach offers transparency to all stakeholders by providing immediate updates on the project.

IV. Agile Scrum Project Template in Trello

Fig. 2 shows a designed Agile Scrum project template and its components using the *Trello Board*. This Trello Project Board contains seven main components in the form of seven *Trello Lists* with three *Scrum Team* members. The first component is the product backlog which contains four main tasks with many sub-tasks from the user stories and prioritised as high, medium and low priority. Later, this complete product

backlog is divided into two release backlogs with each release backlog further divided into two sprints. Fig. 3 shows a sprint and its components explaining its detail design using the *Trello List*. It also includes a burndown chart showing the current progress of this sprint, which can be seen by everyone. The Scrum development team owns the sprint but any stakeholder can subscribe it for regular updates, thus, they know the current status of the sprint. Finally, each task is designed using the *Trello Card* as shown in Fig. 4. This task uses the functionality of the *Trello Card* such as *due date, checklist, attachment, watch and comment*, used for managing and communicating information relating to the task.

V. Results and Analysis

This proposed Trello-based GBL approach for Agile Scrum development was introduced in two undergraduate courses in 2016, where the Agile Scrum methodology was taught in the traditional way. Subsequently the Trello-based GBL approach has been successfully employed for both degree schemes continuously. The success of this approach can be evaluated at different levels such as assessment results of the Agile Scrum task, presentation and team working skills, rewards and commendation, and results of their final project. This section will illustrate the assessment results of the Agile Scrum task given to students as a gaming activity for both undergraduate courses. Fig. 5 shows the average marks of Agile Scrum task for the cohort 1 during 2014 to 2019, where Trello-based GBL approach was used from 2016 to 2019, and non Trello-based traditional approach was used in 2014 and 2015. This comparison of average marks for the last six years reveals two important facts: 1) the average marks are improved by at least 11% when the Trello-based GBL approach is employed in comparison to the non Trello-based traditional approach; 2) the improvement in the results is consistent for the last four years. Fig. 6 shows the average marks of Agile Scrum task for the cohort 2 during 2014 to 2019, where Trello-based GBL approach was used from 2016 to 2019, and non Trello-based traditional approach was used in 2014 and 2015. This shows almost similar findings as the results of the cohort 1, where average marks are improved by at least 10% when Trello-based GBL approach is employed in comparison to the non Trello-based traditional approach; and the improvement in the results is consistent again. These two average results demonstrate the success of this Trello-based GBL approach for Agile Scrum software development in addition to the other improvements such as presentation, communication and team working skills.

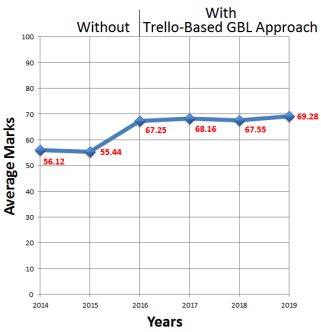

Fig. 5: Average Marks of Agile Scrum Task for Cohort1

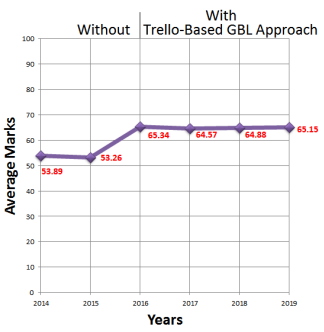

Fig. 6: Average Marks of Agile Scrum Task for Cohort2

VI. Conclusion

This paper presented a Trello-based GBL approach for Agile Scrum development. Trello is not a Scrum tool, thus, its features were transmuted into a Scrum tool and used to develop projects. This proposed approach was implemented into four stages: firstly, students learnt the Agile Scrum approach through Trello, next students were divided into teams and made a game plan to design a Trello Board for a given project case study, then they presented their Trello Boards in the game competition to compete for rewards. Finally, they used overall knowledge and experience of GBL in the development of a real project. This designed GBL approach used for the two undergraduate courses for the last four years, which demonstrated the constant improvement for both courses in their learning and assessment whilst comparing it with the traditional teaching approach for Agile Scrum. In future, it requires further evaluation to find how it helps to improve other skills such as project management and communication; this approach will be extended to other courses/subject areas.

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