SAGE Online Platform

Online web based affinity space for SAGE assessments ,courses and evaluations

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1. Introduction

The primary motivation behind this project is to integrate all the separate components of the SAGE platform and bring them under a common web portal so that the components could be easily utilized, and the created assessments and games could be reused and accessed globally. Further we aim to make the portal even more gamified by making this holistic system reward based and introducing recommendations and learning paths for students to further sharpen their computational thinking concepts.

Using gamified versions of classroom teaching and exercises to build interest in computer science and develop computational concepts within students has always been a keen topic of interest within educators and scientists. The results from various research shows that the interest and performance of students using games or visual medium with a gamified format to learn computational concepts is far greater than those following the traditional approach of classroom education. While this could be extended for all possible subjects, computational thinking concepts and computer science education with its roots firmly entrenched in logic and conceptual thinking provides one of the best subjects to implement this.

There have been many visual tools to build games and gameful assessments for education. One of the most popular tools among them is Scratch which provides a highly intuitive drag and drop tool to create visually appealing games and assessments along with having a massive online community of people creating games and providing helpful insights.

While Scratch is a popular and highly efficient platform, the community of games build using Scratch is not necessarily targeted towards education. SAGE extends the functionality of Scratch by allowing instructors to create useful assessments in Scratch which the students can then work on to learn computational concepts and improve their understanding of computer science. Further implementation of SAGE include automatic evaluations of the assessments and dashboards to track the progress of students. However , the current platform of SAGE is distributed across servers and is not integrated .As a result , the usage of the platform is difficult and persuading instructors to use the platform as a tool of imparting education would require complex training and instructions and thus could be non effective.

We propose to integrate all the existing SAGE components under a single web platform so that both the students and instructors can access all the required functionalities at a single place. This integration would enable the students to login and work on the assignments they have been assigned and give the instructors an easy medium to build courses based on assessments and track the progress of the students.

Having all these features under a single roof opens incredible opportunities to use the affinity space in a more efficient manner. Students could also work on assessments available on the server which are not assigned to them specifically independently and build upon their concepts. Instructors could create courses and merge the courses to create a sequential learning path which would give the students a better understanding over a family of concepts or maybe a mastery over one. Reuse of existing assessments and games would prove to be highly efficient under this platform. We intend to construct all these features in the web portal to create a better experience for both the students and instructors.

Along with the building upon the existing capabilities ,we intend to include automated recommendations based on the student's attributes and the features of the games. These recommendations would be useful for students to explore other games in the portal which could be beneficial for them. This would pave way for a gamified reward based system for the student highlighting his/her accomplishments and give them a sense of purpose and fulfilment. Our proposal intends to build a web based affinity pace for SAGE to integrate all its components and use the portal in a efficient way to create better educational experience

2. Related Work

2.1 GradeCraft

GradeCraft (Holman, C., Fishman, B., Aguilar, S. 2013) is a game-inspired learning management system. Researchers behind GradeCraft started with basic gameful mechanics, such as - using points and incremental levels instead of grades; awarding badges to recognize achievements and skill-acquisition; allowing students to redo assignments; giving students the choice of assignments; having students work together in both self-selected and pre-arranged groups and many more - and devised a interface in the form of GradeCraft, to build further on nuanced gameful functionality in the future.

GradeCraft, primarily, has 2 dashboards - Student and Instructor dashboards.

2.1.1 Student Dashboard

An example snapshot of the Student Dashboard, displaying comprehensive course progress, is provided below. The top portion contains information pertaining to student's own progress in terms of points won, badges earned, predicted points and more. This information has a motivational effect on the students, as preliminary research indicates that this type of display boosts user motivation to complete tasks (Kohler, Niebuhr, & Hassenzahl, 2007).
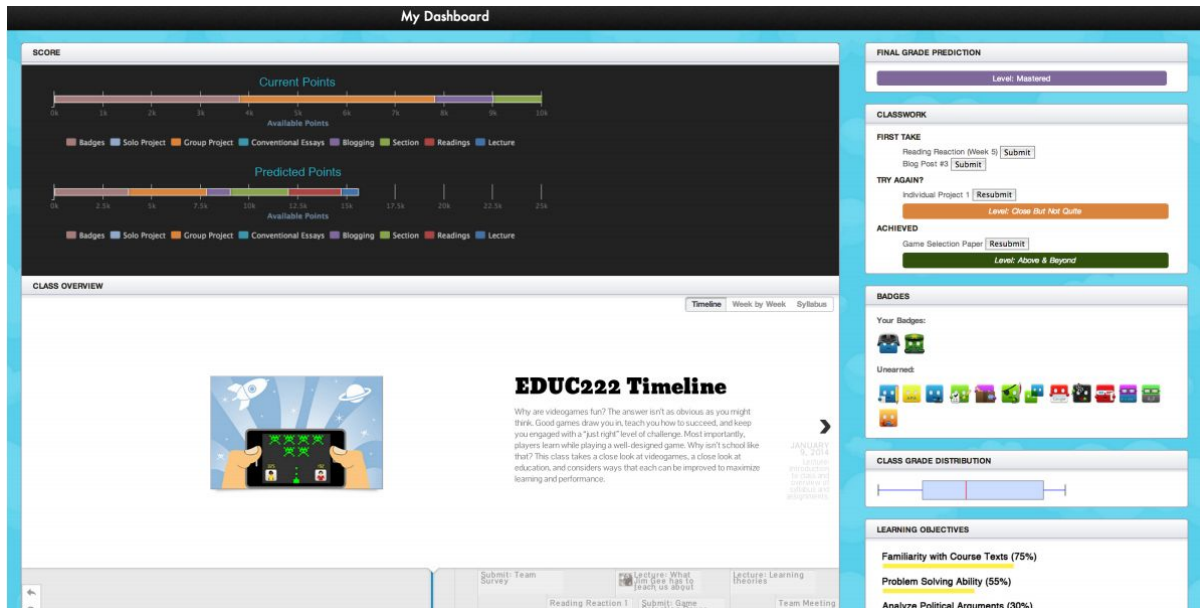
The dashboard also shows a To-Do list for upcoming assignments, assignments that could be re-submitted to improved performance, progress towards achieving the course learning objectives, and distribution of student's own performance against his or her own peers.

2.1.1 Instructor Dashboard
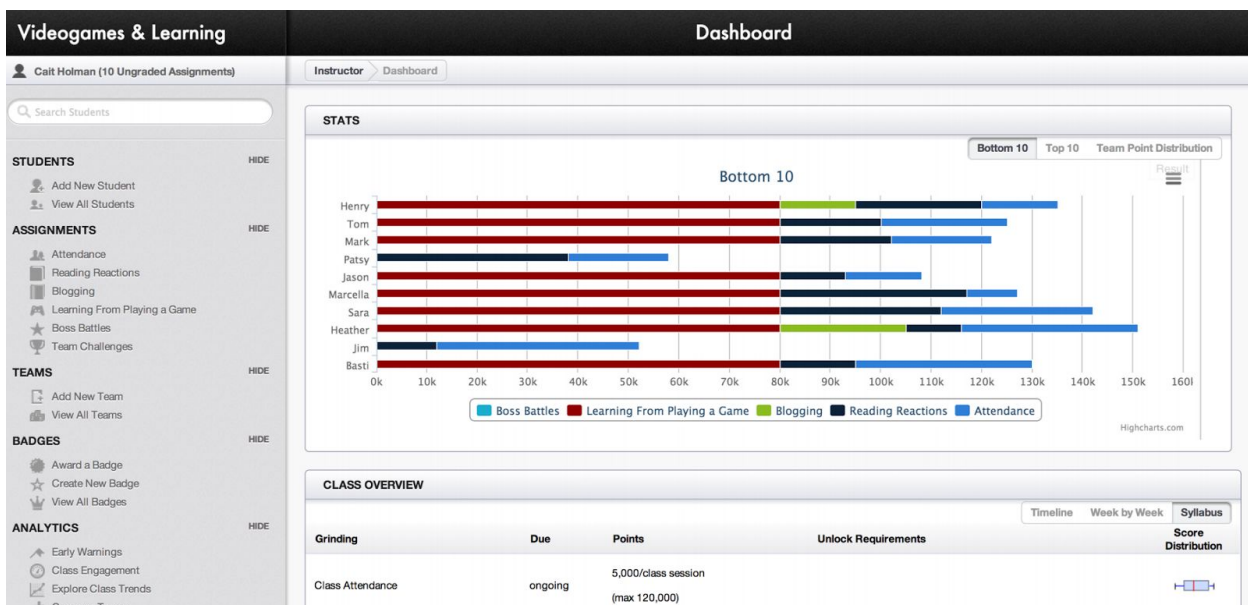
Instructor Dashboard, as shown above, provides the performance the class within a single view. Pedagogies that present more choice to learners and result in a broader variety of

representations of learning are more difficult to manage than "traditional" didactic pedagogies (e.g., Crawford, 2000). Therefore, GradeCraft equips the instructors with tools and metrics to better manage the gameful structure of the class itself. It shows the top and bottom percentile of the class in form of the stacked bar charts. This assists instructors to identify the students in need earlier. A box and whisker plot is used to capture the overall class performance, displaying the range of achievement as well as situating how the majority of students are doing.

2.2 MOOC Platforms

MOOC (Massive Open Online Courses) platforms, are proving to be the game changers for higher education and employee skill-set development. By offering free online courses on number of topics, through quality instructors and universities, they are providing learning and development to virtually everyone, anytime, anywhere in the world with internet access.

One of the things that MOOC platforms, like Coursera, are really efficient at, is the ability to recommend courses based on participants' features, such as past courses and interests. For example, if a participant is shown to pursue Computer Science courses in the past, he or she is more likely to get a recommendation of CS courses. We see an opportunity to use a similar recommendation system described later in the following sections.

These platforms also provide excellent learning paths for "degrees" in particular topics. These topics often contain several related courses, modeled in way to advance from beginner to higher levels. For instance, the Master of Science in Data Science degree on Coursera, offered by University of Illinois, Urbana-Champaign consists of courses on data visualization, machine learning, data mining, cloud computing, statistics, and information science, on completion of which the participant earns a "degree" in that topic. We plan to model such learning paths, curated by instructors.

3. Proposal

The primary proposal is to build a single web based platform to integrate all the components of SAGE into a single web portal for students, instructors and other members of the community to access all across the globe. The aim is to create a web portal which would be intuitive for students to login and complete the courses and the associated assignments as well as easy for the instructors and other developers to create new courses /assignments and track the progress of students.

The major part of this integration is to be achieved through dashboards - which is primarily divided into two- student and teacher dashboard. All the required abilities and features would be linked to the dashboards. The platform itself would have machine learning based recommender systems to suggest courses for students based on their attributes and the features of the courses.

3.1 Dashboards

The dashboard would be the online portal for the individuals(student or teacher) to access all the required features.

3.1.1. Student Dashboards

Students would be able to access courses, assignments assigned to them ,their progress, their accomplishments and their status reports through their dashboards
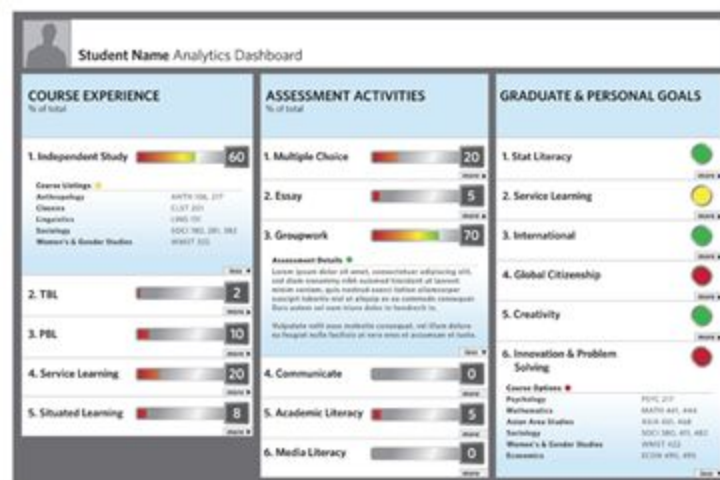
The dashboard would show the current statistics of the students including the progress on courses and assignments currently being pursued . It would also showcase their progress based on different levels -learning paths > Courses > Assigments.
Further, it would also display the courses completed and the accomplishments or badges earned from their successful completions .

From all these information , the dashboard would provide real tracking tracking of their overall progress in learning computational concepts .This would enable the students to realise their position and access more relevant courses to increase their understanding of certain concepts

The dashboard would also allow them to access the courses and their assignments and provide them with a plugin to play and complete the assessments required from within this portal. They could also select from the list of available courses or learning paths available from the server apart from the ones they are assigned to.

It would also provide them with recommendations which would be discussed in section 3.1.3

3.1.2 Instructor Dashboards

Instructors would be able to track the progress of their students , view course statistics of the course they have created and have the ability to create assignments, assessments ,courses and learning paths from the dashboard
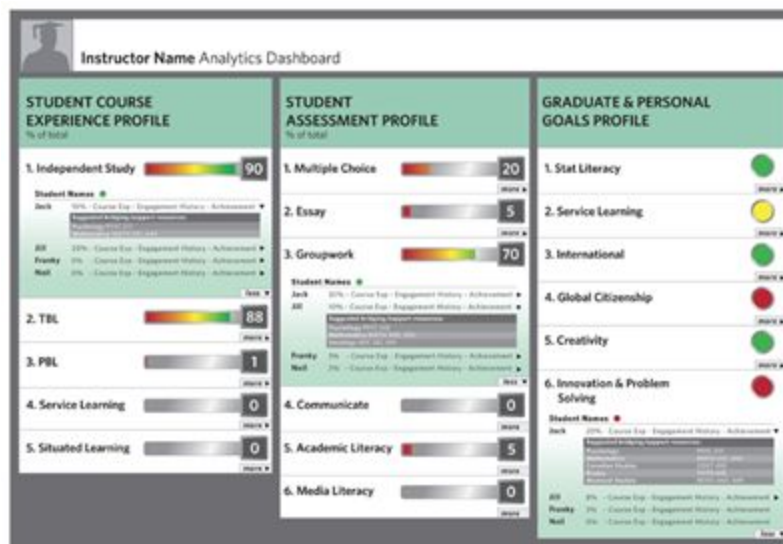
Instructors would be able to access the tools to create assessments .They would have the ability to create courses by replicating the existing courses available and making modifications as required or they could opt to build a course from the beginning using the SAGE creator.

Further , they would be able to track the progress of the students working on their courses as well as the statistics of the courses they have created as well.

3.2 Learning Paths

Sometimes a single course is not enough to gain understanding over a subject . Hence we propose the concept of learning paths which would in essence be a sequence of courses , or a progression of courses designed to build upon the basics and through a progression model , create a mastery over a concept for the students .

Since we intend to create a gamified version of education with the platform of SAGE, we could form these paths as quests with each course designed as a level that comes in a sequence .To master the quest , the students would have to accomplish each level i.e succefully complete each course .

Building these paths or quests could be carried out by the instructors. To supplement that ,we would have sample quests like solving Parson's problem as done in previous works on SAGE.

3.3 Recommendations

If we intend to reach out to a global audience with the platform we would need to provide courses to students based on their requirements. Hence we propose to have recommendation systems which would use collaborative filtering to match courses with students.

While the creation of a new course, it would be tagged with features like subject,difficulty level,age group intended etc. These features for a course would help us categorise them and recommend them for students interested in or taking similar courses.
Along with this ,we intend to research and extract user attributes from student profiles like user behavior, CT concepts learnt, concepts struggling in, comfort and interest levels and then use collaborative filtering to match courses according to these.This would result in more beneficial recommendations and suggestions.

4. Milestones

Building and integrating the dashboards	●Building connectivity among the dashboards ●Embedding the assessment creators and players within the dashboards ●Establishing real time statistics gathering and visualisation	●28th February ●13th March ●25th March
Recommendations	●Researching the features that would provide the best recommendations ●Implementing the algorithms and displaying the recommendations	●7th April ●18th April
Learning Paths	●Researching ways to produce guided learning paths ●Implementing creation and availability of learning paths in the platform	●21st April ●28th April
Mid Term Project Progress Report		●25th March
Final Written Report and Presentation		●4th May

5. Future Work

We foresee a number of future improvements and/or implementations to this platform that we may or may not be able to complete due to time constraint.

Machine learning algorithms to measure the student's progress within an assignment have been implemented in part or are being researched. However, we are also interested in Machine Learning algorithms could measure the learning trends of students and what affects the process of gameful thinking.

Also, as we propose to open this platform to the community, over time we may have influx of courses of different qualities. Instead of manually implementing quality control with human intervention, we propose to implement a rank based model identify better quality courses. The rank could be calculated in combination of factors like users' ratings, number of completed courses, comprehensiveness etc.

Another possible future work is to implement algorithms to extract meaningful metrics from this platform. These metrics may be useful in further research or spin-off products. A way to consume such metrics could be through RESTful APIs.

By no means are these the only possible future works, as there may be countless other possibilities. We shall revise future works in the coming months.