Gameful Affinity Space and Field Study Design

COMS W3998 Section 28

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Abstract

Our goal for this project is to implement a means of data collection and analysis to better improve the SAGE's (Social Addictive Gameful Engineering) user-centered design aspect within the "Gameful Affinity Space" and "Field Study Design and Publication Strategy" epics, in particular, Curricula Integration, Learning Metrics, and SAGE Feasibility Study. We hope to implement a preference system in regards to motivational signaling within the existing Learning Metrics infrastructure, and update SAGE's UX/UI from user and teacher feedback. Following the completion of these three tasks, we will analyze how the changes have impacted the SAGE user base, teachers, and volunteers within the classrooms.

Introduction

Our motivation for this project is to update the way students interact or see Learning Metrics and SAGE's UX/UI in an effort to analyze student and teacher feedback. We want to incorporate user feedback analysis when implementing SAGE's features to better present its mission of infusing computational thinking in 6-8 curricula. We are also motivated by the need to bring SAGE out into the real world into diverse classrooms, preparing surveys and setting up parameters to make the best use of experimentation time. Focusing on the Gameful Affinity epic, we want the Curricula Integration feature and the Learning Metrics feature to reinforce one another, ultimately strengthening SAGE's impact on the student. Within the Field Study Design and Publication Strategy epic, meanwhile, we will collect and analyze user feedback from volunteers, teachers, and students before and after classroom sessions, ensuring seamless integration along the way.

SAGE's social axis is accompanied by the Nurturing Affinity Space Principle, which fosters an inclusive environment where students can collaborate with and support one another thus sustaining computational thinking [1]. The Gameful Affinity Space is the platform through which this principle is employed. Students and teachers use this platform to facilitate the integration of computational thinking curricula; however, the Affinity Space could improve to present a computational thinking curriculum that is apparent to the students. It is important to be conscious of the interfaces presented to the student as interfaces affect the overall impact of educational games as a tool for learning [2] [3]. Hence, it is important to consider student and teacher feedback when updating SAGE's Gameful Affinity Space's interface.

Related Work

2.1) Data analysis with Hairball and PECT

Hairball, an automated system and lint-inspired static analysis of Scratch Projects, can be used both by a student to point out potential errors or unsafe practices, and by a grader to assist in inspecting the implementation of Scratch programs[5]. Because automatic analysis will not be able to determine the sensory effect, Hairball focuses instead on the implementation, including safe/robust programming practices. Hairball, which has been used in previous data analysis projects in previous semesters, can be of use when comparing the new SAGE data we will collect when we go into the classrooms with data from the past that has already been accumulated through researchers' past contributions to scratch wild data analysis.

```
class BlockCounts(HairballPlugin):
def analyze(self, scratch):
blocks = Counter()
for block, _, _ in iter_blocks(scratch):
blocks.update({block: 1})
return blocks
```

Additionally, another similar data analysis model, the Progression of Early Computational Thinking (PECT) Model, is a framework for understanding and assessing computational thinking in grades 1 to 6, which synthesizes measurable evidence from student work with broader, more abstract coding design patterns, which are then mapped onto computational thinking concepts [6]. Below are some graphs created from the PECT model, which focus on the different design pattern variables that students frequently use, visualized in graphs.

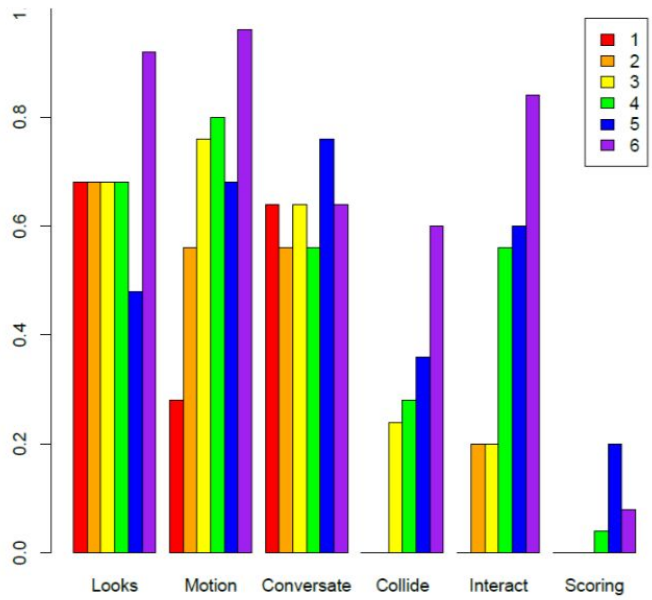

Figure 6 -- Frequency of use of the six Design Pattern Variables among the student projects in Grades 1-6

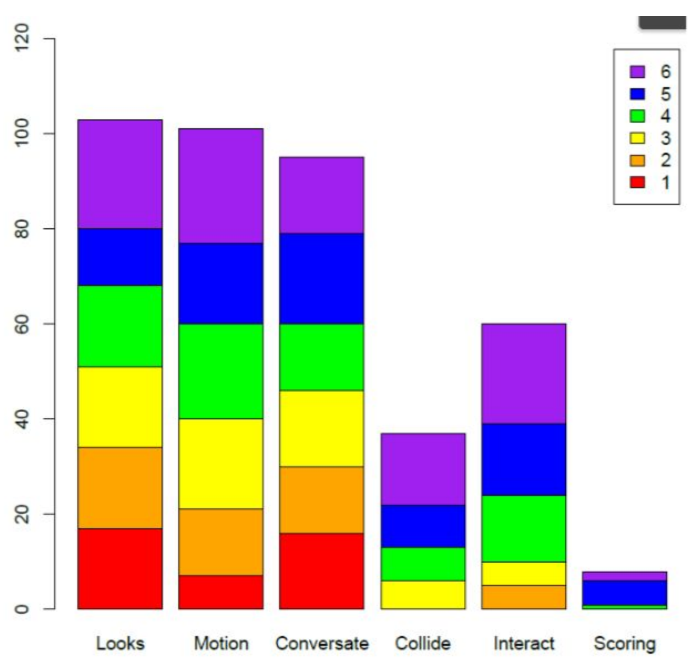

Figure 7 – Grade breakdown of Design Pattern Variable Use

2.2) Intelligent Tutoring System (ITS)

In order to structure a full and expansive Curricula feedback mechanism there will several references and tributes to the already implemented Intelligent Tutoring System (ITS). There are several features and meta information that can be referenced and not recreated. The processes that are configured in order to attempt to prompt users with suggested projects, hints and feedback are all instruments that can re-utilized in structuring personalized curriculum. As it stands student Quest Progress, Parson's Progress and Constructionist Game Progress are all displayed to the user in a fixed format [4]. It is in the best interest of SAGE to take advantage of knowing which progress models are the most motivating and which are not. It is in this way that students can be targeted to learn more via motivation signals of preference (i.e. progress bar, Parson's Puzzle progress, student leaderboard).

2.3) Canvas

A platform similar to the concept of the Gameful Affinity Space is Canvas. Canvas is a learning management system used in Columbia University, as well as many other universities across the country. It bridges students and professors together, where professors upload files and assignments to the website and students engage with the material. There is a student dashboard and an instructor dashboard facilitating this interaction, thus making learning and teaching for students and professors, respectively.

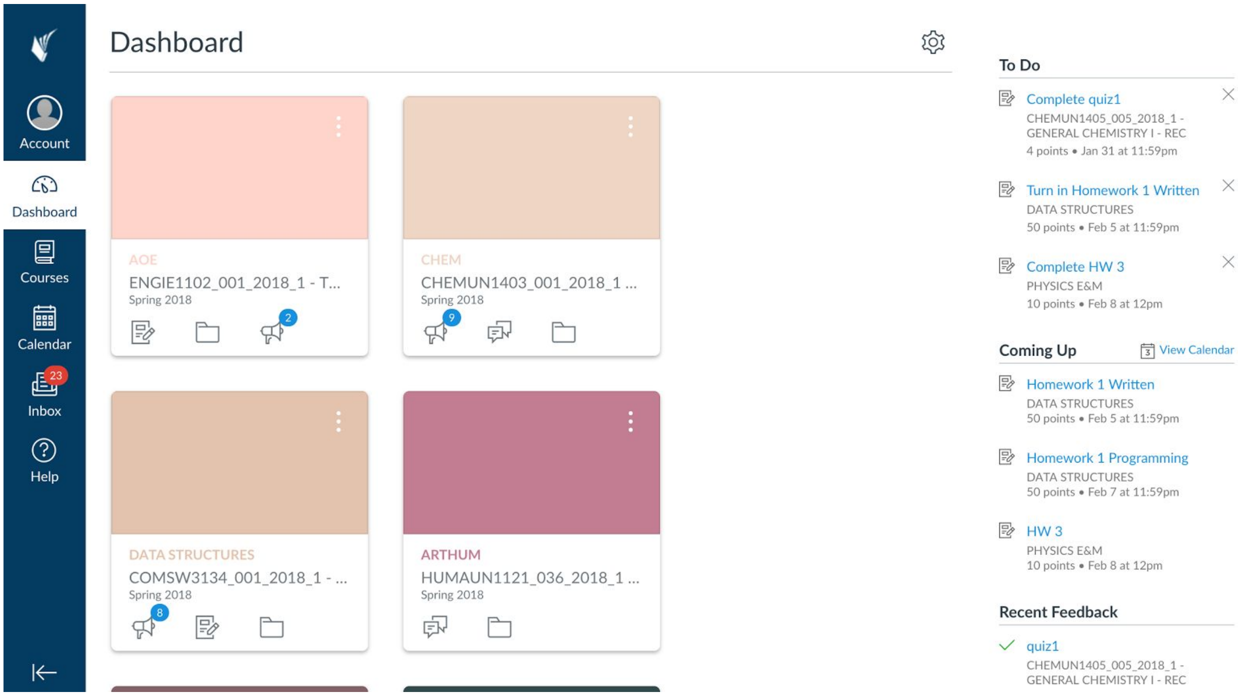

Figure 1: Canvas Dashboard for Columbia University

Proposal

3.1) Individualized Learning Metrics

By far a pivotal turning point in SAGE's effort is student and teacher user experience. In the collective, SAGE strives to satisfy its user base and only positively impact its students in regards to a gameful learning experience. This desire to build off and work in conjunction with the soon to come *User Feedback & Data Analysis* suite. In reference to *Gameful Intelligent Tutoring System: Using Bits and Data Driven Models,* the motivation behind that project was to allow user to perform on-demand hinting options as well as hint generation based on individual user data. Taking off from these two things, we hope to implement the *Individualized Learning Metrics suite,* which yearns to assess these user interactions and quantify both the student and teacher experience in a means to create the capability to "fine tune" each user's interaction with the platform. The aim is to create a user experience that is highly individualized.

We will investigate a means of slightly changing a user's interaction with the platform. Managing to rank a student's preference in terms of motivational "signals" such as display of the leaderboard, parson's progress, quest progress etc. could be advantageous in order to increase motivation to complete said task. As deployment of the ecosystem expands it would be interesting to understand the ways in which students prefer to be reminded of their tasks or motivated to continue their tasks. It could be that students prefer to see how they are doing in comparison to the class but, it could also be that they do not. With the updated individualization of Learning Metrics, there would be a definitive answer.

3.2) Curriculum UI/UX Presentation

The Gameful Affinity Space is the platform through which the Nurturing Affinity Space Principle is employed. Students are able to collaborate with each other through features such as script sharing and peer-visible explanations [1] that help reinforce computational thinking. Teachers are able to have a space to integrate computational thinking within the curriculum.

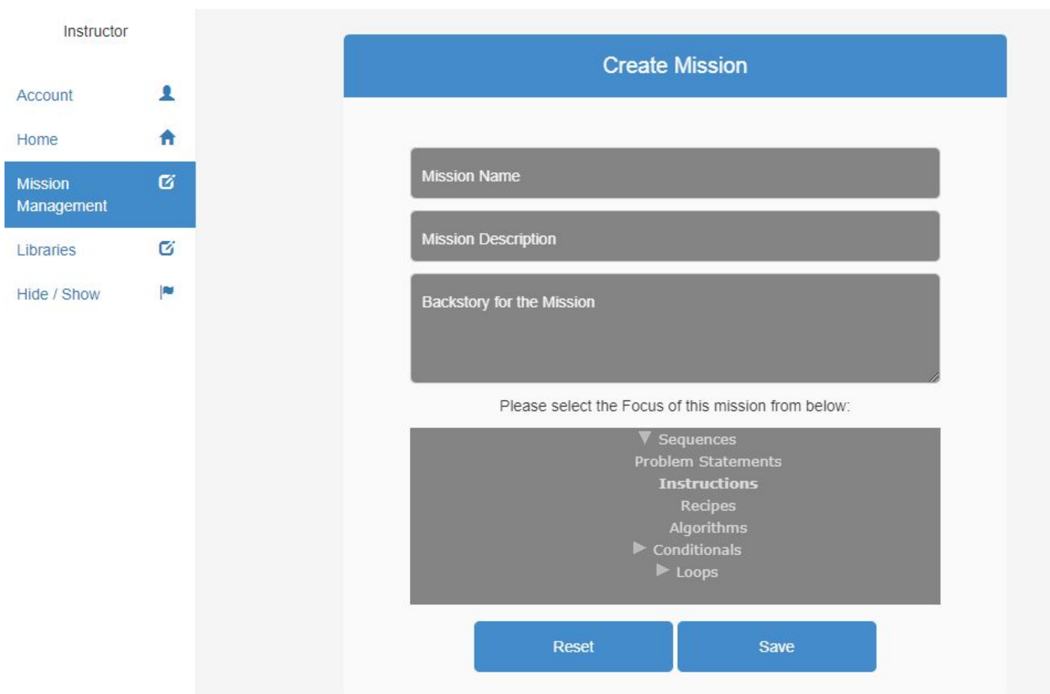

Figure 2: Instructor Affinity Space

We aim to present a clearly-designed computational thinking curriculum in the Affinity Space for the benefit of the student. The interface would be updated centering the needs of the students and teachers and the goal of computational thinking based on our previous experience as instructors. After fieldwork, in which student and teacher feedback would be collected and evaluated to target specific areas of improvement in the Affinity Space's interface design, the interface will be tweaked again to suit the diverse populations we hope to serve.

3.3) Curriculum Development

We will work on SAGE being able to store CT curricula so that students can learn concepts, practices, and perspectives in an appropriate order, so a data model should be produced to store CT curricula and associated state standards and the SAGE base curriculum should be stored in the database. Additionally, we will stem off of our previous tutoring experience to develop the gameful curriculum. Time permitting, we hope to work on code to associate games with curricular items so that students learn as they play and allow teachers to upload videos on CT concepts and associate the videos with games so that students can access additional info on-demand.

3.4) SAGE v.06 Experiments and Field Study Design

Based on our team's strong background with teaching young students computational thinking one-on-one, an important contribution to the progress of SAGE will be field study design as we have direct experience working with the type of population that SAGE will one day reach. SAGE will potentially be implemented within two nonprofits that aim to teach youths computational thinking: CodeHER, Inc., with an audience of middle school, middle-class females, and TeCanal, Inc., with an audience of individuals with disabilities, low-income minorities, and immigrants in middle school with varying backgrounds and interest in programming. Deploying SAGE into and obtaining feedback from these communities as well as standard middle schools is an important way to ensure inclusivity and diversity in the platform we are building. We will interview experienced CodeHER and TeCanal tutors and executives one-on-one and update the SBECA survey to set up parameters for SAGE experimentation and execution. Afterwards, we will closely monitor SAGE's deployment in these environments and keep in touch with executives in each organization regarding SAGE's progress in the classrooms, collecting and analyzing data along the way with the same methods used as those in previous projects, such as wild scratch analyses. Time permitting, we will compare the data gathered from SAGE with the data analyzed in the past from Scratch wild projects and assess similarities and differences.

Timeline

Table 1 outlines the proposed milestones and their estimated completion dates, as well as the date for the final report.

Milestone	**Estimated Dates**
Environment Setup	February 2 - February 15 (Sprint 0)
Individualized Learning Metrics	February 16 - March 1 (Sprint 1)
Improvement of Cirricula UI/UX	March 2 - March 15 (Sprint 2)
Cirricula Integration	March 16 - March 29 (Sprint 3)
Fieldwork: Feedback collection from students, teachers, and volunteers[1]	March 30 - April 12 (Sprint 4)
Feedback and data analysis	April 13 - April 26 (Sprint 5)
Final Report	April 27 - May 3

Table 1: Proposed Milestones and Estimated Completion Dates

[1] *Fieldwork* is set at a tentative date as deployment in classrooms is a volatile scheduling and logistical activity.

Conclusion

Following the completion and assessment from the student progress information and individualized student interaction would be research into the effect of making this change. Following the new change to the Learning Metrics suite would be research and development into the next steps and how this added feature impacts the user space. After embedding computational thinking within the interface of the Affinity Space, further research should be done to investigate the effects of updated interface. Student assessments, as well as student and teacher feedback, would be evaluated and analyzed to see the correlation, if any, between the updated interface and student performance. In addition, feedback should be evaluated to determine areas of improvement.

References

[1] Bender, J., 2015. "Scratch Analyzer: Transforming Scratch Projects Into Inputs Fit for Educational Data Mining and Learning Analytics" Columbia University, New York, NY.

[2] C. Harteveld, G. Smith, G. Carmichael, E. Gee, and C. Stewart-Gardiner, "A Design-Focused Analysis of Games Teaching Computer Science," in *Proceedings of the Games, Learning and Society Conference*, 2014.

[3] M. Evans, E. Jennings, and M. Andreen. "Assessment Through Achievement Systems: A Framework for Educational Game Design," in *Developments in current Game-Based Learning Design and Deployment*. IGI Global, 2012.

[4] Sajal Khandelwal and Plaban Mohanty 2017, *Computational Thinking Platform for SAGE* in COMS3998 Sec 014.

[5] B. Boe, C. Hill, M. Len, G. Dreschler, P. Conrad, D. Franklin. "Hairball: Lint-inspired Static Analysis of Scratch Projects." UCSB, 2013.

[6] L. Seiter, B. Foreman. "Modeling the Learning Progressions of Computational Thinking of Primary Grade Students." John Carroll University.