Collaboratively Discovering the Joy of Meaningful Learning

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Introduction

Every instructor has experienced dealing with students who are totally ignorant of the lecture, browsing their social network profiles or random web pages, texting, dreaming, or feeling sleepy. Having such an experience makes instructors try to identify ways of motivating their students to want to follow the lecture and learn the course content. for this purpose, teachers use multiple self-discovered techniques. Theses techniques include having discussions in class and assigning certain points for students' participation in those discussions, bringing up funny stories in the middle of the lectures, frequently taking quizzes, and more recently, there is a tendency toward gamification in online and offline courses (Holman, Aguilar, & Fishman, 2013). A central theme among all of these techniques is to provide some extrinsic motivation for students to pay attention to the course.

Extrinsic motivation for learning in education systems ranges from a college degree/diploma/certificate of completion, reputation among classmates, points accumulated through a game, to joy of playing games and listening to funny stories. Several experiments (Fishman & Aguilar, 2012; Graham, 1999; Holman et al., 2013; Kouyoumdjian, 2004; Landers, 2014; Masten, Morison, & Pellegrini, 1985) show a causal relationship between these extrinsic motivations and higher course grades. However, Nicholson (2015) explains overjustification effect and how providing such extrinsic motivation crowds out intrinsic motivation for long term learning. Jonassen (2008); Mayer (2002); Novak (2002); Novak and Cañas (2008) explain that intrinsic motivation is the main foundation of meaningful learning. So, providing higher extrinsic motivation results in lower intrinsic motivation for learning that diminishes meaningful learning.

Collins, Joseph, and Bielaczyc (2004) explore the reason behind this tendency toward extrinsic motivation for learning and explain that most education systems consider standard test results "as the 'bottom line' measure of how a student, teacher, or school is doing." Whereas, employers care about showing up on time, taking responsibility for getting a job done, working well with others, and putting in one's best

effort to succeed. Collins et al. (2004) demonstrates the consequences of evaluating interventions based on test results and states "Education needs to produce 'expert learners' (Brown, Ellery, & Campione, 1998), who love learning and who know how to find things out for themselves." Otherwise, we will misjudge our interventions badly and worse, we will mislead the design of our education system to emphasize the wrong goals, namely 'teach to the test' (Jerald, 2006). In this study, we explore how to apply theories of social psychology and learning science in design of a collaborative online learning environment that provides intrinsic motivation (joy) of meaningful learning for students. We believe providing a sustainable social incentive can encourage students' intrinsic motivation for long-term learning.

Literature and Design Concept Overview

People like to use social networks to connect with their friends and family (Ellison, Steinfield, & Lampe, 2007). They explain the advantages of Facebook usage and how social networks empower their users by providing them with social capital. On the other hand, Kirschner and Karpinski (2010) show a negative correlation between Facebook usage and both GPA and hours spent per week studying for courses. Similarly Junco (2012) reports time spent on Facebook negatively affects engagement scale score and overall GPA.

From another point of view, Chou and Edge (2012) surveyed 425 Facebook users and showed that those who have had Facebook accounts for several years are more likely to perceive others as happier and life as unfair. In addition, those with more strangers among their Facebook friends, and those who spend more time on Facebook, on a weekly basis, tend to think of others as having better lives than they do. This negative effect is boosted in social networks as Jordan et al. (2011) explains a pervasive tendency to underestimate others' negative emotions in communities. Finally, through two studies Steers, Wickham, and Acitelli (2014) discover that social networks, such as Facebook, negatively impact users' mental health. They show that Facebook usage is associated with greater depressive symptoms by providing people with the opportunity

to spontaneously engage in any social comparison (Festinger, 1954).

From the users' perspective, people naturally have intrinsic motivation to expose their unique capabilities, including wealth, knowledge, and ideas. This is specifically observed in social networks as people self-express themselves as being happier than they actually are (Jordan et al., 2011). We believe a social network can be designed in such a way that leverages this intrinsic motivation for self-exposure of capabilities to incentivize people to share the joy of learning things that they find helpful with their friends.

Imagine in a class, every student can explain each concept from their perspective and finally students will vote on the explanations for every concept and will be able to learn the most accurate, easiest to learn, concise, and enjoyable ones. This is specifically helpful for those concepts that are more difficult to learn for most students. Our interviews with instructors at STEM undergraduate courses at the University of Michigan showed that those instructors who have been teaching specific courses for a long period of time have created lists of difficult courses that every semester students struggle with. These instructors encouraged us to develop and provide them with this social platform through which students can collaboratively discover easier and more enjoyable ways of learning these difficult concepts. More importantly, in the following semesters, students will not start from the scratch, but they will use the product of collaboration of their peers in the previous semesters and will improve them for themselves and the nest semesters. Does this not only improve motivation to engage in the community to learn and help others learn, but also the nature of social comparison (competing) for being helpful, will have a positive externality on peers.

This collaborative learning environment is also beneficial for those who contribute to it and provide helpful ways of learning concepts for others. Cortese (2005); Frager and Stern (1970) characterize teaching others as the most effective way of learning and contributors to this online learning community try to discover and teach others the most efficient and enjoyable ways of learning different concepts. This way, they improve their understanding of the concepts and retention of their learning.

From creativity research perspective (Guilford, 1962), divergent thinking is

considered the most influential factor that result in thinking creatively and generation of new ideas. In comparison between intelligence and creativity, scientists explain that: intelligence requires convergent thinking, expecting to find a single correct answer, which has been highly considered in conventional education systems. In contrast, creativity requires divergent thinking and encouraging people to come up with many potential explanations (Sawyer, 2011). Many of those explanations and ideas might not be helpful or even correct. However, we believe letting students to discover different ways of thinking about concepts and encouraging them to try new ways that they discover by themselves, and more importantly, providing them with tools to assess their own and others' discoveries, significantly improves their creativity and critical thinking. Our social learning platform contributes to learning science by encouraging students to think more divergently about concepts and always try to find more understandable and more concise explanations and examples for learning different concepts. This way, our vision is to improve creativity and critical thinking in the education system.

Basic Design

Proposed solution

We propose an online social network, "Gaku," where users can post the ways they learn helpful things, such as, mnemonics for memorizing vocabulary, representative heuristics for understanding difficult concepts, examples for learning formulas and conceptual definitions, and other creative ways that they discover to help themselves and their peers learn concepts in a more enjoyable way. The system also provides a collaborative assessment tool that makes students think more critically about theirs and others' ideas and explanations. Every post will be assessed by other students through up-votes or down-votes on how helpful and enjoyable it is to learn this specific concept through the corresponding explanation. From another perspective, posts will not be editable by others, providing the students in each class with a free market in which they can easily improve upon someone else's explanation and earn more reputation. This way, as oppose to crowd-sourced systems like Wikipedia, each contributor would have a

sense of ownership on their contribution and any up-vote or down-vote on their contributions will have a direct effect on their reputation in their learning environment as an online/offline community.

Naming: "Gaku"

We name our online social platform "Gaku." This name comes from a Japanese sound. In Japanese, when one pronounces "gaku," there are at least two meanings: One is "to enjoy" and the other is "to learn." For example, when people say "on-gaku," it means "music", because this word consists of "on (sound)" plus "gaku (enjoy)." When one says "gaku-kou," it means "school", because this word consists of "gaku (learn)" plus "kou (place)." Since the vision of our social platform is to collaboratively bring the enjoy of meaningful learning, the sound "Gaku" would make sense.

How it solve the issue?

People naturally have intrinsic motivation to expose their unique capabilities, including wealth, knowledge, and ideas. This is specifically observed in social networks as people self-express themselves as being happier than they actually are (Jordan et al., 2011). Our social network leverages this intrinsic motivation to incentivize people to share the joy of learning with their friends. Since teaching others is the most effective way of learning (Frager & Stern, 1970), our social network helps users to learn effectively.

Target Audience and context

1. Higher education

   We want to start with STEM courses because in STEM courses, students have a large spectrum of opportunities to discover more helpful ways of learning different concepts and share their discoveries with their peers.

   Our initial target is undergrad students at University of Michigan. We may approach them through ECouch. We are going to work with ECouch to run this

social network in undergrad classes at the U of M the next winter. This semester, ECouch is made a requirement for all the undergraduate students and this is a good opportunity for us to reach all the undergraduate classes at the U of M. However, what is challenging is to provide a seed content for them to start using the system. That will be a starting point for them to interact with the system and generate more contents based on their courses' progress.

2. Coursera

   Students are used to study online; Their population is huge; They have higher motivation to learn. They do not study for a degree. Just to learn.

Persona 1: John MaCartney

John has studied in two universities simultaneously. He usually spends a lot of time deeply thinking about concepts that he learns in different courses. He says, "I spend a lot of time to learn some difficult concepts in courses. As a result, I usually find other concepts that are related and I already know. Then, I learn the difficult concepts through heuristic representations resembling the concept I have difficulty with through concepts that I know very well." He writes very nuanced notes and flashcards, usually using Evernote or other note taking softwares.

- Profile

  Student - Researcher, Male, 27 years old, single, student at University of Michigan

- Needs

  - Collaborate with those who have taken the courses in previous semesters.
  - Earn some reputation among his friends because of the time he has spent on learning how to learn difficult concepts.

- Frustrations

  After each semester, I feel like I have spent a lot of time and the results of my notes and flashcards will not be useful anymore.

- Key attributes
  - Knowledge: middle
  - Experience: middle
  - Time: low
  - Motiation: high

Persona 2: Ling Ling

Ling Ling is a banker who is interested in studying abroad to get MBA. Although her native language is not English, she try to use Coursera to prepare MBA study and obtain knowledge about finance. She is also interested in making friends who have similar interest and aspiration. She is taking a statistics course on Coursera. One day, during a lecture of regression analysis, she can't get a point about the concept. Although she tried to solve it through discussion forum of the class, she hesitate to post her question because most of the discussions are about specific solution for a question. Then she came to know our site and find good tips for learning. She also start having an aspiration to show her learning.

- Profile

  Banker, 24 years old, resident in Taiwan, native language is Chinese

- Needs
  - Collaborate and build social network with other students.
  - Looking for a platform to discuss and learn concept.

- Ideal features
  - Knowledge sharing and social network building
  - Discussion or sharing knowledge except for English

- Frustrations

  Coursera's discussion forum is mainly for solutions and occasional communication.

- Key attributes
  - Knowledge: low

- Experience: low
- Time: middle
- Motiation: high

Learning Goals

From the Designers' perspective

- Improve intrinsic motivation for learning.
- As a result, provide meaningful learning.
- Encourage students' creativity, which is the result of high levels of meaningful learning.
- Our vision is to turn results of social comparison in education settings from negative externalities to positive ones. Instead of crowding out intrinsic motivation to learn, we believe design of a social network can leverage social comparison to provide higher levels of intrinsic motivation to learn.

From the Users' perspective

- A social platform to share with others how to learn useful but difficult concepts, including formulas, vocabulary, theories, ...
- When a user spends a fair amount of time learning a concept that they have difficulty with learning, finding an effective way of learning that concept becomes very valuable, because they have tried different methods and spent some time and effort to discover it. This way of learning might be through an intuitive example, other concepts that are more understandable, an alternative explanation, mnemonics, etc. Now that the user has found this helpful way of learning, it is valuable to share it with others. This altruistic behavior will result in a synergy that will make all the participants better off.
- From another perspective, users can earn reputation by sharing helpful ways of learning difficult concepts with others. Those who learn in this platform, express

their feelings about the shared content by liking or disliking them that will result in reputation for the contributor of the content. This reputation results in a kind of social comparison that might improve intrinsic motivation to learn.

- Helping others to learn useful concepts will result in friendship among the members of the community.

A Hybrid Social Constructivist, Behaviorist, & Cognitive Design

From a Social constructivism perspective (the socio-historical work of Lev Vygotsky), active learning is a result of active construction. Students should be provided with opportunities to express their own questions, hypothesize explanations, and discover and test their own possible answers (Fosnot & Perry, 1996). If students are supposed to learn concepts based on dictated definitions, they would never find the opportunity to think about the concepts from other perspectives. This results in an attitude towards copying in contrast to creating.

Our system provides a social platform to discover novel explanations for each concept in a competitive environment to identify the most enjoyable way of learning each concept. So students will have "opportunities to explore different possibilities within meaningful contexts." (Fosnot & Perry, 1996) For this purpose, each student would have a unique profile and a dashboard in which they observe all the posts that they have picked from the system. They can pick posts that are relevant to the courses they are currently taking, those related to specific exams, etc. I.e., students will be able to put any post they like into their dashboard. In addition, they will be able to remove certain posts in their dashboard, make some of them prominent, or hide the explanations of some posts, only showing their subject lines. Each subject line represents a question that is explained in the body of the post. This design affords inquiry-based learning (Kirschner, Sweller, & Clark, 2006) and advantages it provides for the learners by intriguing their mind to try to find an answer for the question before reading the explanation.

In addition, we have designed mechanisms for students to explore posts created by

others, identify the helpful ones, pick them and add them to their dashboards for future review. For this purpose, they are provided with an auto-complete search functionality on subjects and bodies of all posts. Furthermore, all posts are socially tagged by the schools, majors, and courses that they belong to. Hierarchical filters are provided for students to easily list those posts that they are looking for under specific schools, majors, and courses. In addition, one can filter posts by the number of times the posts are viewed, bookmarked, or rated.

But mere exploration does not necessarily result in active learning. Learners need opportunities to reflect on their activity (Wilson, 1996). This is a necessity for critical thinking. In addition, Kirschner et al. (2006) shows that minimal guidance provided by the instructor during instruction does not result in a favorable learning outcome and the promises of constructivist, discovery, problem-based, experiential, and inquiry-based learning actually fail in practice. However, the design of our social platform equips constructivist discovery learning with a collaborative assessment, not only by the instructors, but also by the peers who are engaged in the learning process at the same time. In addition, learning through this system requires guidance of instructors as the original seed content providers. The original posts and the order of learning them through out the course are designed by instructors, and students will continue content generation and learning based on their supervision. We believe this approach provides the benefits of both behaviorism and constructivism approaches in a unified platform and while providing guidance through instructors, as the initial creators of seed posts in the system, students are incentivized not to rely on the explanations provided for them, but think creatively, and discover their own helpful explanations. Moreover, they are encouraged to think critically about their own and others' explanations and rate them and comment on them to discuss pros and cons of each approach, and collaboratively discover the most enjoyable ways of learning all the concepts throughout each course.

In order to encourage creativity and trying to find easier ways of learning each concept, each student is endowed with an initial reputation in the system that is reflected on their profiles. As a result of their contribution, other students and the

instructors rate on their posts. These rates change the students' reputation in the system accordingly and provide a competitive environment for the students to contribute high quality content to the system. At the same time, while voting, votes from those with higher reputations have a higher weight and as a result a greater effect on the corresponding posts. This way, the system makes sure that the instructors, as the most reputable users of the system, will have the most influential effect on the evaluation of contribution. This is a necessity in our design, because our interviews with instructors revealed that they are afraid of students being misled by a wrong explanation of a concept that has gained high votes due to its difficulty to understand. In this Learning Environment, the instructor becomes one of the contributors and a facilitator to provide support and direction to learners when needed. All the contributors, including instructors and students, have weights that correspond to their reputation earned in the system through helpful posts they have shared with others. Because of their expertise, the instructor usually obtains the highest weight. These weights are decimal numbers between 0 and 1 and will be multiplied by the vote the person assigns to any post. This way, instructors and high quality contributors' votes will be more influential than other students' votes. This ensures students will not develop a wrong understanding of complex concepts in this crowd-sourced platform.

In order to ensure the credibility of the content provided by the students, similar to Wikipedia, in this system, contributors are encouraged to support their explanations by references in literature, including book chapters, journal or conference papers, etc. In addition, from a Social constructivism perspective (Wilson, 1996), Learners need opportunities to engage in dialogue with other members of their community of practice. Our social platform provides affordances to rate and comment on others' posts in order to encourage reflective integrative behavior. This affordance provides a constructive discourse among students reflecting on each others' idea and helps them learn to engage in scientific debates and defend their perspectives.

In order to support constructivist pedagogical goals (Wilson, 1996), this learning environment provides pathways for the learners to identify how to navigate through

posts and follow a guided sequence of learning provided by the instructors. For this purpose, there are affordances designed in the footer of each post that list the prerequisite posts that students need to learn in order to be able to understand the content explained in the current post. Also, there is another list of posts that are suggested to be learned after learning the current post. Another important constructivist pedagogical goal provided in this social platform is to incentivize students to think critically and creatively, learn more, and help others to enjoy from their discoveries. As opposed to conventional school assignments, when students post to our social network, their posts will be visible by the world and in case of gaining reputation in this system, their reputation will be also visible worldwide. Furthermore, at the end of the semester, their posts will not vanish and they might even earn more reputation in the following years when the prospective students vote on their posts. To this end, Gaku encourages ownership of contributions and give learners a voice in the learning process (Wilson, 1996). Moreover, this Learning Environment embeds learning in a social experience so that learners can interact and collaborate with other learners and teachers (Wilson, 1996).

Taking into account both of the cognitive theory of multimedia learning and constructivist pedagogical goals (Wilson, 1996), this system encourages the use of multimedia instructional messages to allow learners to manipulate and express themselves with different types of representations. In this case, we assume that learners can simultaneously process auditory and pictorial information (Mayer, 2014). In the design of the system we incorporated a constraint in post creation to make contributors create very concise explanation of only one concept per post. Having multiple concepts defined in the same post results in cognitive overload, because of learners' limited channels capacity (Mayer, 2014). At the same time, many types of multimedia are provided for the contributors to include in the design of their posts, including: hyperlinks, programming languages, pictures, videos, graphs, tables, mathematical formulas, symbols and special characters, footnotes and references, and maps. We believe by providing users with a large spectrum of affordances and constraining them

in creating only small posts in a competitive environment will result in active learning, in the sense of learning by teaching as doing (Mayer, 2014).

Finally, the system interleaves posts in both learner dashboards and public view of the website. The reason is that Interleaving of different types of practice problems (which is quite rare in math and science texts) significantly improves learning. In a number of experiments that have compared interleaving and blocking, Rohrer (2012); Rohrer and Pashler (2010) showed that interleaving produced better scores on final tests of learning.

Learning System (Social Media) Overview

Appendix 1 is the interaction map of Gaku. This interaction map is created at Lucidchart in order to explain the entire picture and main screen transitions. While we have both mobile view and laptop view, this interaction map represents only for laptop view. Our system can be divided into three parts: 1) authentication subsystem (green area), 2) public subsystem (blue area), and 3) private subsystem (orange area). By following the red arrows, you can experience screen transitions, which we explained in the final presentation. The brief explanation of subsystems are as follows:

Authentication subsystem

The purpose of this subsystem is to manage user information. When users need to sign-in or sign-up, the system navigates the users to this subsystem. There are two options to sign-up. The first option is to creates original ID and password. In order to secure their access, we set minimum length of the password. In addition, to prevent mistakes in sign-up process, we check the user's input, such as required field and unmatched password. The second option to sign-up is Google Account. In this case, users don't need to create new account and just give us permissions to access their account.

Public subsystem

This subsystem is applied to users who don't sing-in. In the public subsystem, although users can search topics and learn individual topics without sign-in but there are some restrictions. For example, users can't create a post to share their knowledge, and users can't evaluate other users' posts, and can't create own dashboard. Therefore, this subsystem is mainly used for the introduction and experience of Gaku for new visitors.

Private subsystem

Users can access this subsystem only after sign-in through authentication subsystem. This subsystem has all the learning and teaching functions of Gaku. In the next chapter, we explain the features of this subsystem according to learning theories.

Walk-through the Gaku

In this chapter, we provide a demonstration of Gaku with screen transitions. This demonstration focus on only private subsystem, in other word, after sign-in through authentication subsystem. We start our demonstration from the screen 1 "The Private Interface," which is located on the top of private subsystem (orange area) at Appendix 1 (interaction map). The order of transition is along with the red arrow in the interaction map.

1. The Private Interface

   This is the top page after sign-in. Users can see their dashboard with topics. Users can add and delete topics from their dashboard. The number of topic shown to the screen is optimized based on the screen size and font size. Each topic represents one learning concept.

2. Searching

   There are search box on the top of the page. When users enter some keywords that they are looking for, Gaku automatically shows matched keywords from our

database. When users click "Go!" with keywords, the screen shows the result of keyword search.

3. Browsing

   While user can see three learning topics on the screen, how to load more learning topics? When users scroll down the page, Gaku automatically load following results. This means that users don't need to click "Next page" button to load more topics.

4. Minimize

   The default view of each topic shows both learning topic and the contents. If users want to hide the contents, users can click minimize button. Then you can only see the topic title. Of course users can expand the minimized topic to normal size again.

5. Delete from dashboard

   When users want to delete a topic from their dashboard, they just need to click "x" button.

6. Filtering (Most Liked)

   In order to find topics efficiently, Gaku has several filtering options. The first option is "Most Liked" tab. When users click this tab, users can find options to filter topics, such as display own posts, back to dashboard, recently most liked, most shared, etc.

7. Filtering (School)

   As we define students in higher education as target audience, users can narrow down topics based on university name. The default value of the university is the university where the user belongs to.

8. Filtering (Major)

   After choosing university name, users can find a list of majors. Users can find their majors to narrow down topics to the specific major. If users don't choose

universities, it shows the list of majors at the universities where users belong to. The default value of the major is the major where the user belongs to.

9. Filtering (Course)

   Finally, users can choose specific course, for example, courses users are taking now. When users click the course name, users can see topics only related to the course. This means users can find the most efficient way of learning about the course and other classmates' contributions for the course. They can comment, evaluate, and encourage each other for the meaningful learning. If users don't choose universities and majors, it shows the list of courses in the majors where users belong to.

10. Post Comments

    With regard to each post, users can comment to the post. Comments can be one of the most important motivation for users to create posts. Users can communicate through comments, such appreciate the post and encourage user who post it. Users can also point out mistakes in the post. This is also important role of comments to improve the post to be more meaningful.

11. Post References

    When users find good topic, how users can judge if the contents is correct or not? Or how users can create posts more convincing way? References are one of the most strong information to make the post more convincing. Users can look at the references and learn more by them.

12. Post Tags

    When users look at a post, often they want to find related topics. Tags fit well for the purpose. The post owner can tag the post with relevant information, such as keyword, course ID, and subject. Users can follow the tags and find related topics.

13. Post Prerequisites

    It is common for learning topics to require prior knowledge about specific topics. For example, when we want to learn regression model in statistics, we need to

know statistical significance and confidence interval before learning it. This function helps the process. Post owner can add prerequisite information and users can easily access the prerequisite topics.

14. Post Follow-ups

    Similar to prerequisites, the post owner can navigate readers to the next learning topics. Users can see the list of follow-up topics and find which topic will be the next step.

15. Post Creator Mini-Profile

    When users click post owner's photo, they can see the post creator's mini-profile. In this mini-profile, users can see the post creator's information, such as previous topics and evaluation. This information can be an evidence to judge the reputation and contribution of the post creator.

16. Post Creation Date and Time

    Users can check when the post was created. Especially in the case of looking for information regarding current taking course, this information is useful to check whether this topic created in current semester or previous semester.

17. Post Ratings

    This is one of the most important element to judge the reliability of the post. Users can see the rating about the specific post. All the contributors, including teachers and students, have weights that correspond to their reputation earned in the system through helpful posts they have shared with others. Because of their expertise, the instructor usually obtains the highest weight. These weights are decimal numbers between 0 and 1 and will be multiplied by the vote the person assigns to any post. This way, instructors and high quality contributors' votes will be more influential than other students' votes. This ensures students will not develop a wrong understanding of complex concepts in this crowd-sourced platform.

18. Creating Post

So far we have explained how to search and filter topics, and how to learn from the topics effectively and efficiently. From this screen, we demonstrate how to create new post.

19. Insert Link

    When users create a post, the creator can add several types of internet links to the post. If the creator insert a link, users can click the link to move to other information resources, such as website, media, etc.

20. Insert Code

    Since our first target is STEM courses in higher education, programming code can be one of the dominant topics. On the other hand, there are many types of programming languages that have different syn taxes. In order to overcome this challenge, we provide the function of inserting code that applies to multiple programming languages. At first, the post creator choose a programming language (screen 20-1). Then the creator input code sniped to the pop-up window (screen 20-2). When the creator click "OK," he can embed code sniped into his post. As screen 20-3 shows, some words are highlighted. This highlight is decided based on what programming language did the creator choose. Moreover, the creator can expand edit window when he click the bottom of edit window (screen 20-4).

21. Insert Picture

    As Wilson(1996) claims in the constructionist pedagogical goals, the use of multimedia instructional messages is encouraged. It allows users to manipulate and express themselves with different types of representations. Gaku has a function to insert a picture. The post creator adds the url of a picture and sets properties, such as size and alignment. As a result, the post creator can add pictures to make the post more understandable.

22. Insert Graph

    Gaku has a function to insert a graph. Graphs are also necessary tool to explain concepts in some subjects, such as mathematics, economics, and statistics. Gaku

provide several functions to embed graphs, such as bar graph, line graph, and pie chart.

23. Insert Formula

    Since our first target is STEM courses in higher education, mathematics formula is essential tool to explain learning topics. On the other hand, it is not easy to express mathematics formula online. So, Gaku provides a function to create mathematics formula. When the post creator can input a formula with specific rule, he can see the preview of the formula. And if the post creator click "OK," he can insert a mathematics formula into his post.

24. Insert Table

    Gaku also has function to insert a table. The post creator can define the properties of a table then input values into the table.

25. Insert Separator

    While we encourage one post one topic, sometimes separators can be useful for a post. The post creator can add a separator if necessary.

26. Insert Special Character

    There are many special characters in STEM subjects, such as omega and sigma. Gaku provides a function to support inputting these special characters. When the post creator clicks the omega icon, he can choose a symbol that he wants to insert to his post.

27. Insert Footnote

    When the post creator wants to add an additional information to the post, he can use this function. If the post creator adds a footnote, the footnote is displayed in a different square at the bottom of the post.

28. Insert Video

    The post creator can insert an online video. Gaku provide a function to insert an online video from several online video sites, such as Youtube, Vimeo, and

Dailymotion.

29. Insert Map

    The post creator can insert a map from Google Map. The creator enter keywords and sizes. Then, a map is generated and is embedded to the creator's post.

Conclusion

- Mechanism of scaffolding

  In this learning environment, students collaboratively identify complex concepts and questions, and decompose them into constituent parts, as interconnected posts. The system helps learners monitor their progress through gamification and building reputation on the system by posting helpful ways of learning concepts.

- Improving Creativity

  Learners not only learn from each other, but also find the opportunity to look at the concepts from other perspectives and try to identify new ways of making them easier to learn. There are many studies in the psychology literature that show the direct relationship between divergent thinking and creativity. (** citation e.g., McCrae, 1987 and Baer, 2014 **) This system improves creativity by encouraging divergent thinking.

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