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Anonymous Online Peer Review for Innovation-Based Learning

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Abstract

This paper presents a distributed, scalable, student-driven method to provide timely, nuanced, unbiased, and personalized feedback to students learning in diverse self-defined project teams. We report on a new implementation of anonymous peer review within a custom-made online learning management system designed to support Innovation-Based Learning. The system automatically and anonymously assigns multiple students to review each work product of their peers. Students benefit doubly from peer review. First, students receive more feedback more quickly with more personalization compared to instructor-reviewed or computer scored activities. More importantly, new opportunities for learning are created when students assume the role of reviewer; they must analyze the work of others, provide technical justification for their review comments, and communicate professionally. Peer review also benefits the instructor and institution as it addresses scalability challenges for non-routine assignments and qualitative evaluation. We describe how the peer review workflow was implemented, and we evaluate peer review effectiveness in terms of the quantity of peer reviews performed and whether peer review increased the odds of an item subsequently receiving instructor approval. Student opinions of peer review were also gathered in an end-of-semester survey. The implementation was a mixed success; lessons-learned and subsequent improvements are also reported.

Introduction

The new online deployment of tokenized learning with anonymous peer review (PR) was designed to support an existing Innovation-Based Learning (IBL) course. A short overview of IBL will provide context for the current work.

IBL has evolved out of Project-Based, Discovery-Based, and Experiential Learning. Innovation-Based Learning can be understood through Daniel Pink's framework of Autonomy, Mastery, and Purpose [1]. Autonomy is most visible at the beginning of each semester as students enjoy both the freedom and responsibility to propose a project and then self-assemble a working group [2]. Purpose, which we often speak of as "external value" or "external impact" is emphasized in two important ways during the course. First, as the course begins, potential projects must address a societal gap/need; students must identify a federal funding opportunity or similar market demand which justifies the work [2], [3]. Purpose is then re-emphasized during the course as each project is assessed on an impact scale which rewards external activities such as symposium presentations, conference papers, company formation, or patent applications [4]. Mastery is promoted by student tokens (learning objectives) which are tailored to the individual, are threshold-based, and can be revised throughout the course. It is these student tokens, and the use of PR to prompt revision, which this paper considers.

Historically, students shared their plans for and accomplishment of learning objectives (now tokens) during synchronous in-person classroom meetings. In recent years, to support scalable and collaborative participation by students from different institutions and locations, learning objectives moved to a custom online learning management system (LMS) [5]–[9]. As both the course and the LMS have co-evolved, we have attempted to learn from and incorporate (loosely) the blockchain principles of an immutable ledger, proof-of-work, verification, and consensus [5]. In the fall of 2020, this led us to adopt the term token to replace learning objective; tokens each represent an "atom of work". Each token is characterized by a specific goal and evidence of accomplishment. Evidence may take many forms including videos, images, and documents. Tokens also possess attributes rating the level of knowledge and impact. PR is used to evaluate whether a token's evidence is complete, accurate, and correctly rated on the two scales (knowledge and impact). Tokens are either complete or incomplete; there is no concept of an "A level" vs "C level" token. Students may revise and resubmit a token without penalty. This paper describes both the implementation details and the performance results of electronic learning tokens with anonymous PR within a course conducted in the fall of 2020.

Motivation

We have designed our course around IBL because we believe it delivers superior student learning outcomes. Each semester, we seek to make our course both more effective and more accessible. We believe that the addition of online anonymous PR enhances IBL in several ways. Though our context is IBL, the following motivations and benefits of PR are broadly applicable whenever students are producing non-routine work such as capstone projects, project-based courses, or constructivist activities.

Cementing and Extending – PR provides twice the learning opportunities compared to Instructor Review (IR) because both the reviewer and the recipient are learning. The reviewer is arguably the greatest beneficiary; they first cement factual knowledge and then extend their conceptual understanding as they consider the work of their classmates. To review a token, the reviewer must first understand what they have seen/heard, next compare it to their own knowledge, then evaluate whether it is correct, and finally explain/justify their opinion. Reviewers' cognitive demands are consistent with levels 2 and 3 of Webb's Depth of Knowledge (DOK) [10]–[12]. Or, in terms of the Revised Bloom's 2D Taxonomy, reviewers are exercising Factual and Conceptual Knowledge paired with the Cognitive Processes of Remember, Understand, Analyze, and Evaluate [11], [13]. PR supports higher-order thinking and learning by allowing students to work on free-form non-objective problems [14]. Implementing PR within an online learning management system offers the benefits of anonymity (blind review), asynchronous access, and the chance to apply analytical tools such as machine learning [15].

Scalability – Peer reviewers are a resource that scales with enrollment without a corresponding escalation of financial cost. PR promotes accessibility and equity in education by reducing IBL adoption barriers for resource-limited institutions. Institutional leaders might protest, "I see IBL's value to students, but we don't have the resources to implement it." PR addresses this concern by providing high-touch personalized feedback on unique non-routine student work regardless of student-to-teacher ratio. Institutions need not allocate more staff nor increase tuition to offer IBL to their students.

Professional Development – Industry uses PR to catch errors sooner and fix them at lower cost. Students who are familiar and comfortable with PR will be better equipped for their future careers. Reviewers learn to not only identify errors but also explain how to implement corrections or improvements. Because IBL permits revision of tokens without penalty, review recipients learn to receive feedback not as a final judgement but as a catalyst for revision. Students learn to interact rationally and professionally rather than with Seth Godin's emotional and combative 'Lizard Brain' [16].

Communication Skills – Giving and receiving critique respectfully and constructively is hard. PR provides students with practice in both expressing their knowledge/thoughts and listening carefully to others. Those receiving a critique may initially feel sad or angry, and they may respond dismissively, defensively, or with an ad hominem attack. Receiving critique as helpful eustress, rather than distress, requires practice. Providing constructive critique on a peer's work is also challenging as it first requires courage to state, "this is incorrect," and then mental effort to express how the work can be improved. Through repetition and instructor coaching, students grow in their competence and confidence to communicate.

Authentic Audience – "Explain it to me like I'm five," is not just a popular internet meme, it is a valuable mindset for students who are expressing their knowledge. As Derek Bruff notes in *Intentional Tech*, instructors are an, "important audience, but not a particularly authentic one" [17]. Unlike an instructor, a five-year-old (or fellow student) cannot be expected to, "know what I'm *trying* to say," during a discussion. Students author their tokens differently when they know that the first audience will be their peers [17]. As reviewers, students become the audience and experience both clear and unclear explanations first-hand. Finally, when they receive feedback, students learn what their audience likes and what elements/approaches need more work.

Anonymous and Electronic – To protect student privacy and intellectual property rights, a non-public platform was desired [18], [19]. Next, anonymity within the review process was chosen to minimize peer pressure and encourage reviewer honesty [20], [21]. Other high-quality PR tools, such as UCLA's CPR (Calibrated Peer Review), satisfy the above criteria [22], but we chose to create a custom implementation because of IBL's reliance on individualized (not whole class)

activities which are defined by each student (not the instructor) resulting in a variety of submission formats (not only written).

Methods

The complete workflow for a student token is shown in Figure 1. Each student token is required to pass through two stages of PR: Definition (step two) and Evidence (step five). At each PR stage, the token is randomly and anonymously assigned to five other students in the course. At the Peer Review for Definition (PRD) stage, reviewers are asked to evaluate: planned work, planned evidence, knowledge level, and impact level. At the Peer Review for Evidence (PRE) stage, all prior fields carry forward and the "Evidence provided" field is added.

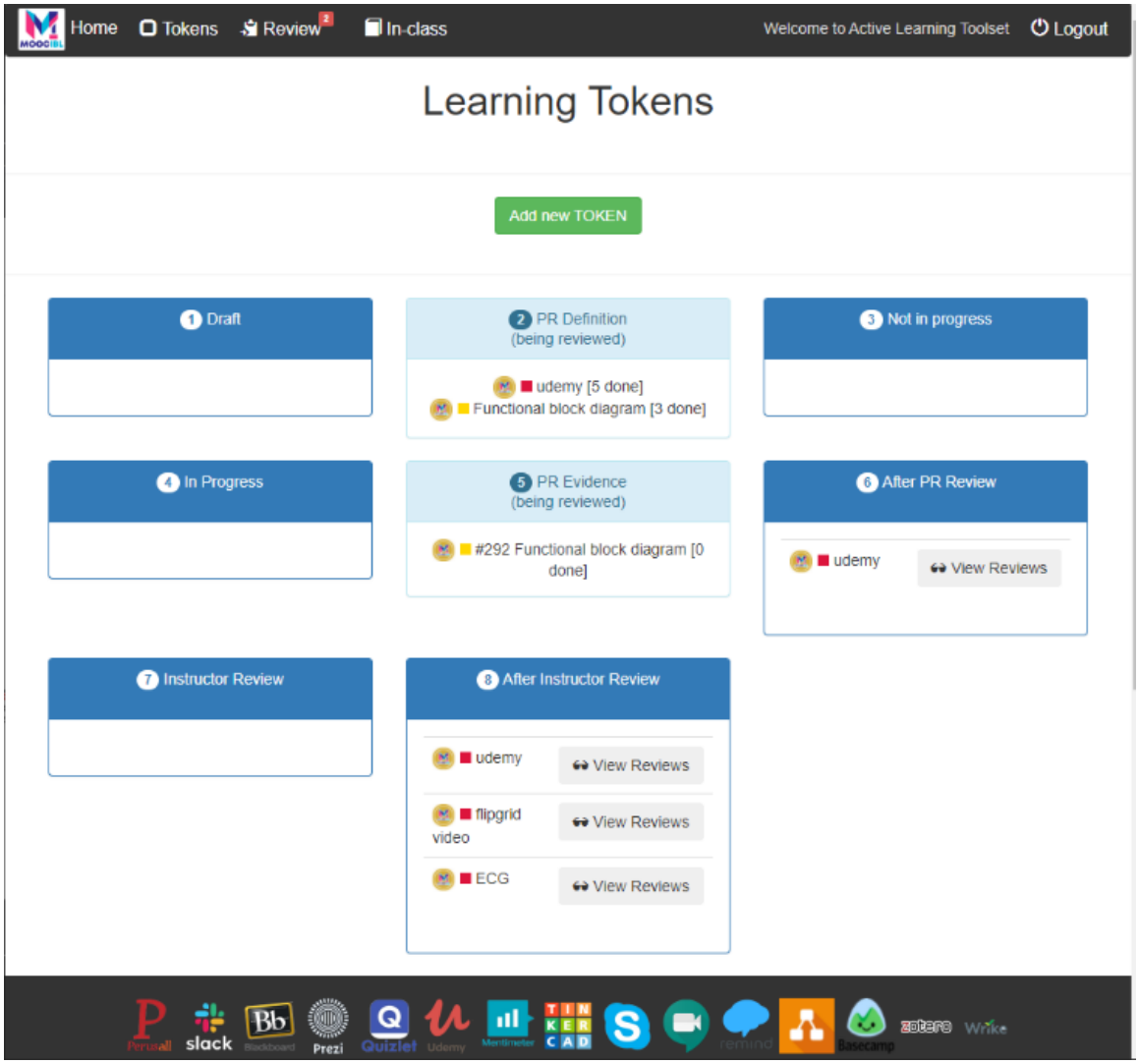

Figure 1. *Student tokens pass through an 8-step workflow which begins at Draft (1) and ends at After Instructor Review (8). The workflow includes two stages of PR (2 and 5) as well as an Instructor Review stage (7). Tokens may move backward as well as forward; workflow steps may be repeated without penalty.*

As shown in Figure 2, the PR dialog provides a text box to enter comments or suggestions. Reviewers are also provided with drop-down boxes to blindly rank the token's knowledge and impact levels (they are unaware of the token owner's desired/intended levels). Importantly, there is no grade assigned by the peer reviewer; the peer reviewer does not even rate the token as complete/incomplete. The PR is concluded by clicking the save button. By intentionally omitting quality scales and relative rankings, PRs are designed to be formative and constructive critique rather than summative or judgmental assessments.

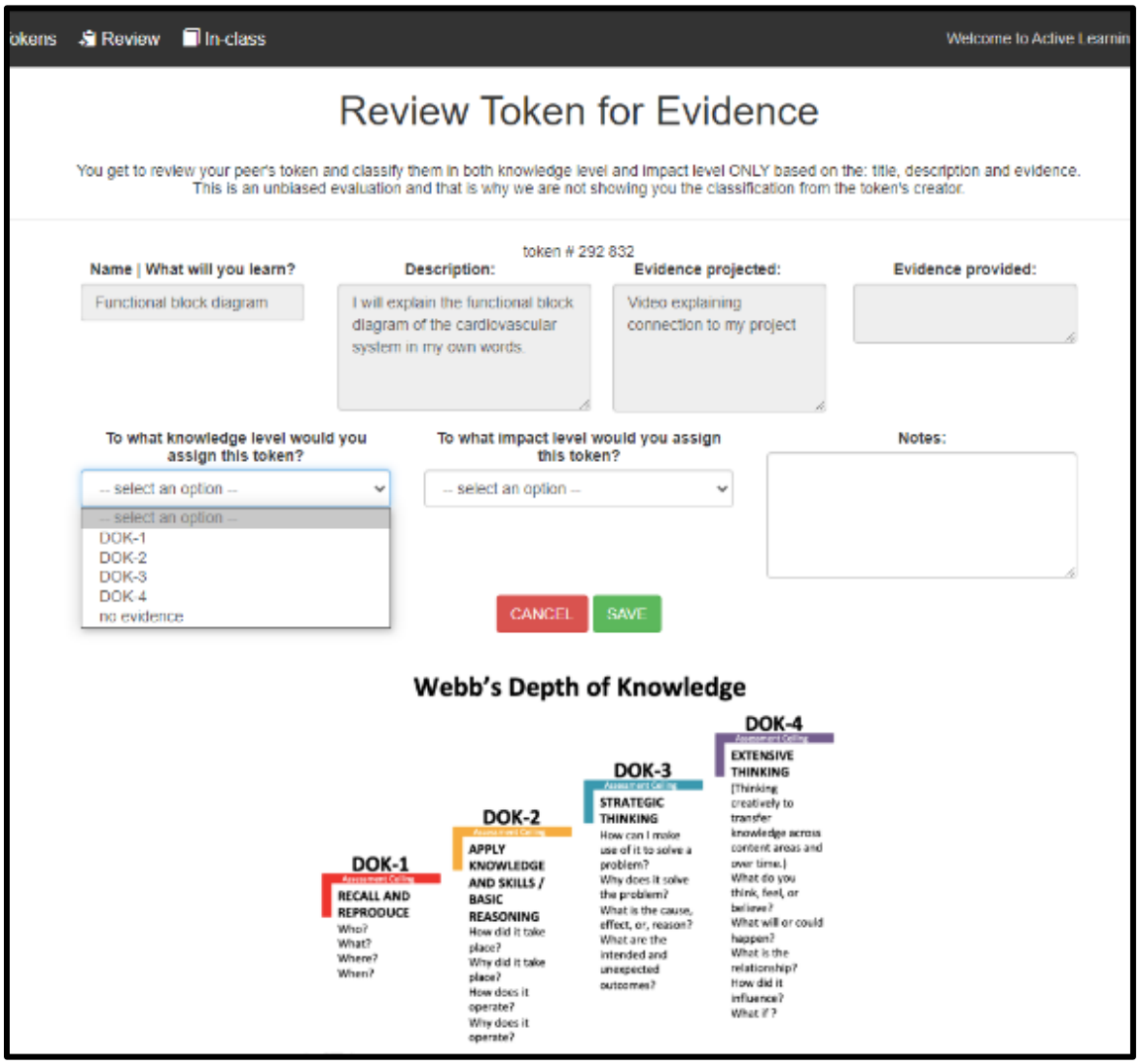

Figure 2. *The Peer Review for Evidence dialog is shown.*

Upon entering a PR workflow stage, a token is effectively locked until it has received at least three reviews (recall that five were originally assigned). When locked in PR, a token owner may not change the token's contents or workflow state in any way.

When a token exits PR, its owner is presented with each reviewer's comments and their rankings of knowledge and impact levels. The token owner now has the option to either proceed forward in the workflow or revise and repeat the PR stage. A notable difference between PRD and PRE is the opportunity to edit a token in subsequent steps. Upon exiting PRD (step 2), a token may progress forward and be edited when In Progress (step 4). This means that token owners could adopt constructive feedback received during PRD without repeating that stage. In contrast, a token exiting PRE (step 5) proceeds to After PRE (step 6) before passing into IR (step 7). After PRE (step 6) does not permit owners to edit token contents. Therefore, students wishing to use PRE feedback to revise their token before IR must repeat steps 4-6 in the workflow.

At the end of the workflow, each token passes through IR. Unlike PR, IR provides a final judgment of Complete (Agree) or Incomplete (Disagree) for the token. Like PR, IR seeks to establish a consensus opinion: three different instructors review each token. The third reviewer serves as arbiter; if the first two reviewers agree, then the third reviewer simply aggregates comments from the prior two and assigns the status agreed upon by the preceding reviewers. In the event of a split decision by the first two instructors, the third reviewer breaks the tie, aggregates prior comments, and assigns the final token status (Complete or Incomplete).

It should be noted that the workflow was not strictly followed. Near the end of the semester, it was observed that a majority of students were going to fail the course due to tokens which could not complete the workflow before the course ended. The time delays associated with waiting for their peers to complete assigned reviews meant that the students could not change their fate without a change in workflow. So, for the final three weeks of the course, PR was suspended. Tokens were permitted to skip workflow steps 2 and 5 (PRD and PRE). The effects of this change can be seen in the results section below.

In prior years, students received three or four in-class opportunities to share their learning objectives and receive feedback. Moving to online asynchronous tokens was expected to provide review feedback more frequently, in larger quantity, and with greater quality/specificity. In short, the token workflow was designed to support a mastery learning model where intrinsically motivated students could complete tokens at their own pace and revise them without penalty. We had three hypotheses (expectations) for PR in this course:

- Peer Review would successfully identify token deficiencies (improvement needed)
- Students would use Peer Review feedback to revise and improve their tokens
- Peer Review would result in a high rate of success (token approval) at the Instructor Review stage

Results

Table 1 presents high-level statistics for the semester. In a single semester, a class of 36 students created hundreds of tokens and performed thousands of PRs. In partial support of our aims, students gave and received a high volume of review feedback. Contrary to our objectives, feedback was not "more often"; Figure 3 will show that the bulk of PRE occurred late in the semester rather than being evenly distributed.

Table 1. Course Statistics: Students, Tokens, and Reviews

	Total	Per Student (average)
Enrolled Students	36	
Tokens Created	584	16
Tokens which completed all stages	499	14
Peer Reviews for Definition	2918	81
Peer Reviews for Evidence	2483	69
Instructor Reviews	1969	

Because the system did not support a delete token operation, some tokens were abandoned mid-workflow for various reasons. This accounts for the 85 incomplete tokens which can be inferred from Table 1. Together with the end-of-semester workflow change discussed above, this also explains the different "Total Tokens" in Table 2. Table 2 shows the number of reviews performed at each workflow stage and the number of tokens which repeated each workflow stage, presumably in response to feedback from the preceding review. The data shows that students seldom chose to repeat the PRD phase and that more tokens were revised in response to IR than PRE. The 23% of tokens which were revised and passed through PRE twice supports our hypothesis that students would use PR to revise and improve their tokens.

Table 2. Reviews and Revisions by Workflow Stage

	Reviews	Total Tokens	Token Revised and Repeated	% Repeated
Peer Reviews for Definition	2918	583	14	2%
Peer Reviews for Evidence	2483	412	93	23%
Instructor Reviews	1969	499	131	26%

Table 3 examines whether passing through and/or repeating PRE increased a token's approval rate at IR. This data shows that, contrary to our hypothesis, tokens which passed through the PRE stage multiple times were far less likely to succeed in their first IR. On the other hand, an unintended pseudo-control group provides subtle support for the hypothesis. Recall that, due to

end-of-semester schedule pressure, PR stages were suspended for the final three weeks of the semester. As a result of this suspension, over 100 tokens passed through IR without any prior PRE. Comparing the 1x vs. 0x PRE tokens, we see that tokens which did receive PRE were 1% more likely to be approved the first time at IR than those which did not receive PRE.

Table 3. Token Iterations at Peer Review and Instructor Review

Token Type	# of Type	% of Type	% of Total
2x+ PRE	***93***		***19%***
2x PRE, 2x IR	62	67%	
2x PRE, 1x IR	31	33%	
1x PRE	***301***		***60%***
1x PRE, 2x IR	50	17%	
1x PRE, 1x IR	251	83%	
0x PRE	***105***		***21%***
0x PRE, 2x IR	19	18%	
0x PRE, 1x IR	86	82%	
Grand Total	**499**		**100%**

PR takes time, and college courses occur within a fixed period of time. This competition between valued but slow activities within a fixed calendar proved to be a major factor in the execution and success of this teaching experiment. An individual student cannot quickly accelerate their path through the workflow described in this paper because several steps involve waiting for peers or instructors to complete assigned reviews. As previously mentioned, the workflow had to be amended near the end of the semester to allow students to complete enough tokens to earn a passing grade in the course. Figure 3 displays the occurrence of four token activities by week: Token Creation, PRD, PRE, and IR. PRD, PRE, and IR are counted based on the date they were completed, not assigned.

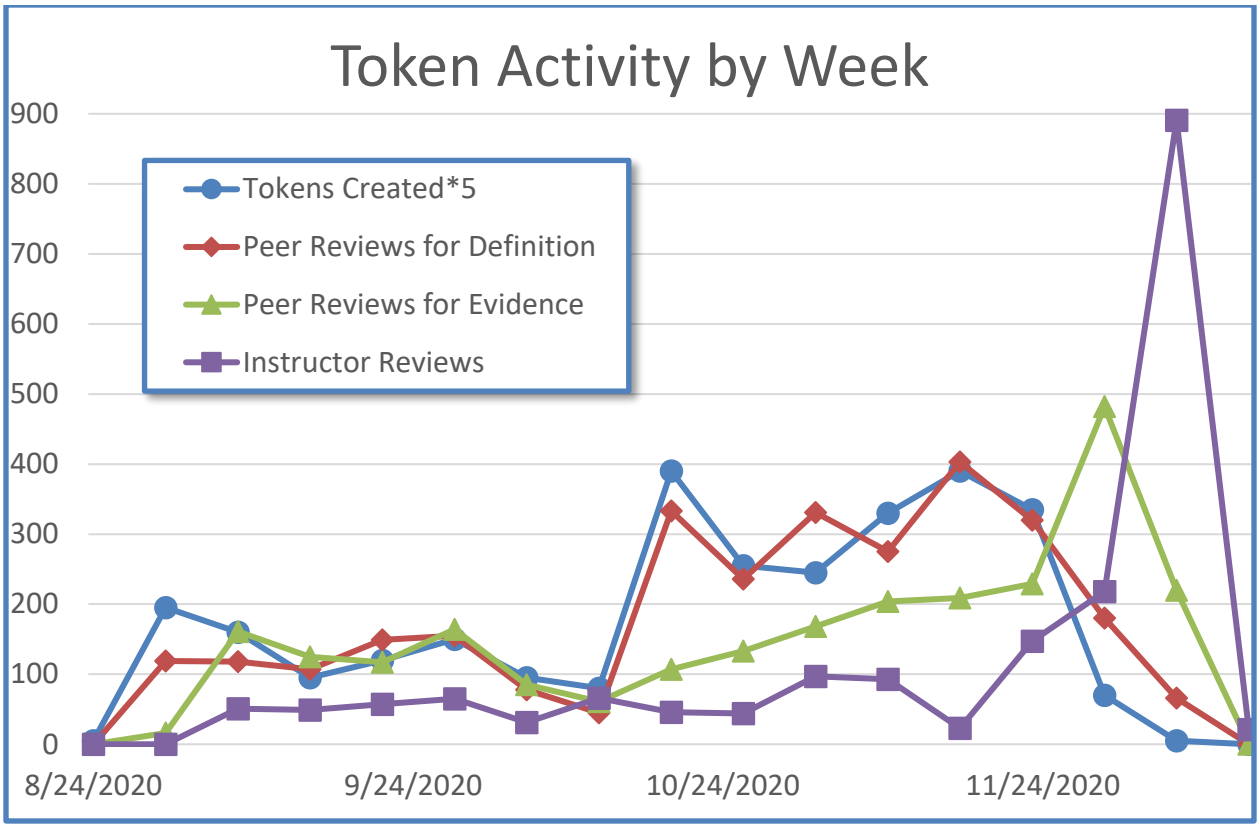

Figure 3. *Token creation and review activities are plotted by week. Note that token creation is scaled by 5x to facilitate comparison with reviews (five PRs per token are assigned).*

To facilitate visual comparison between the creation and review of tokens, the token creation data in Figure 3 is scaled by 5x because five PRD's and PRE's are assigned per token. PRD tracked very closely with Token Creation throughout the semester. This shows that token owners did not allow tokens to linger in the Draft stage; they submitted tokens to PRD promptly after creation. It further shows that reviewers promptly completed their assigned PRD's. Tokens progressed efficiently through stages 1-4 of the workflow throughout the semester. Though there was little delay in the early workflow stages, problems arose due to students delaying token creation and evidence submission until late in the semester. Based upon information provided in the syllabus and early in-class instruction, students were expected to use token creation as a planning tool by creating all their tokens for the semester and then getting feedback on their plan by submitting all tokens to PRD. Instead, relatively few tokens were being created until mid-October, and then many tokens were created right up until the announced deadline in late November.

Unlike the sharp and sustained increase in Token Creation, PRE proceeded slowly through October and November. This was due to both token owners who were slow to submit tokens into PRE stage and reviewers who were slow to complete assigned reviews and allow tokens to exit PRE stage. By late November, it became clear to the instructional team that PRE was happening

too slowly for the course schedule. To ensure that tokens could pass through IR before the semester ended, the PRE workflow stage was suspended; for the final 3 weeks of the course, tokens could be submitted for IR without PRE. This resulted in a surge of IR during the final week of the course.

At the end of the course, a survey was administered in which students were asked to share their opinions of the token process and suggestions for improvement. Selected student responses appear below:

"Get rid of the peer review stage since no one takes it seriously. Make it so you can review tokens at any step. Also make it such that the student can pull a token out of a step."

"Maybe not having to do a definition review on tokens."

"Send users a notification of when they have a peer review to do or when they have received a token."

"strict deadlines for tokens so they are timelined assignments"

"… Remove peer reviews because they are not valuable … Make it so we can view all the token details at any step of the process. Make it send email notifications … The peer review process needs to be taken out or seriously rethought. It is rarely beneficial, and people don't check their reviews quick enough. There is no apparent accountability for not doing a good job. Tokens should be able to be viewed at any time, and taken out of a stage at any time…"

Students were also asked to rate various aspects of the course on a 5-point Likert scale where 5 represents the most pleased/positive response and 1 the least pleased/positive. Results are shown in Table 4.

Table 4. Post-Course Survey of Student Opinions

Survey Question	**Average Response, out of 5 (21 respondents)**
Receiving peer review helped me improve my tokens/learning.	2.87
Giving peer review helped me improve my tokens/learning.	3.39
I am satisfied with the people I was paired with for my project.	4.59
I am satisfied with the topic of my team project.	3.95

Table 4 shows that students were highly satisfied with their teammates and very satisfied with the project they worked on too. Though not as highly rated as teammates/project, students did agree that giving PR helped them learn. Against these responses, receiving PR stands out as the lowest score and the only score less than 3.0 (below neutral).

Discussion

As a reminder, the desired outcomes for PR of tokens were:

- Peer Review would provide students with more feedback more often
- Peer Review would successfully identify token deficiencies
- Students would use Peer Review feedback to revise and improve their tokens
- Peer Review would result in a high rate of token approval at the Instructor Review stage

Based on both student feedback and the measures above, this first deployment of an anonymous online PR implementation was deemed a mixed success. Students did give and receive review feedback in large quantities (150x per student). Many students did choose to revise their tokens in response to peer feedback (nearly ¼ of all tokens repeated a PR stage), but students found the process slow and frustrating. Worse yet, PR did not obviously or consistently increase token quality as measured by first-pass instructor approval. Despite regular in-class encouragement, students delayed token creation and evidence submission until late in the semester. Delays were also seen in the completion of assigned reviews. At the end of the semester, PR had to be suspended, many tokens reached IR with uncorrected errors, and the instructional team suffered a flood of reviews in a short period of time. Unlike prior years, when the semester ended with a celebration of each student group's learning and accomplishments, this semester concluded with both students and instructors mentally exhausted by the crush of last-minute token reviews and revisions.

Action Steps: Revising Peer Review

Based on reflections within the instructional team and student input, the token and PR process has been revised in several ways. These are shared as both principles (see italicized headings) and specific actions.

Keep It Simple

PR is valuable, but it also requires time and mental energy. Our first change was to eliminate the Peer Review Definition stage. Very few tokens repeated this step, and its removal has the immediate benefit of eliminating 50% of all PRs. Furthermore, removing PRD helps to maintain motivation early in the workflow by avoiding self-control fatigue (ego depletion) [23], [24].

Keep It Fast

To prevent tokens from "stalling" in PR stages, PRs are no longer assigned to specific students. Instead, all tokens submitted to the PRE stage exist in a pool; any student wishing to complete a review may select a token from the pool and provide their review. This change offers benefits both philosophical and mechanical. Philosophically, this change shifts the reviewing effort from an assigned (extrinsic) task to a voluntary (intrinsic) task. This change also improves the mechanics of review because it prevents particular tokens from experiencing inordinately long delays to an unlucky group of assigned reviewers who all complete their tasks slowly. Tokens (then and now) are not allowed to exit PR until three (or more) reviews have been completed. Under the assignment model, five reviewers were assigned. If three of a token's assigned reviewers fail to complete their review, the token is stuck. Several students expressed frustration with tokens in this state.

Keep It Fun

A personal PR statistics dashboard was added. This feature seeks to enhance intrinsic motivation for PRs by applying gamification. Instructors can give a star to a student's PR. Students earn a thumbs-up when a token is revised in response to their PR comment. Students also see the total number of PRs they have completed and a Q (quality) statistic which is computed based on the words used in their review comment. The new dashboard is shown in Figure 4.

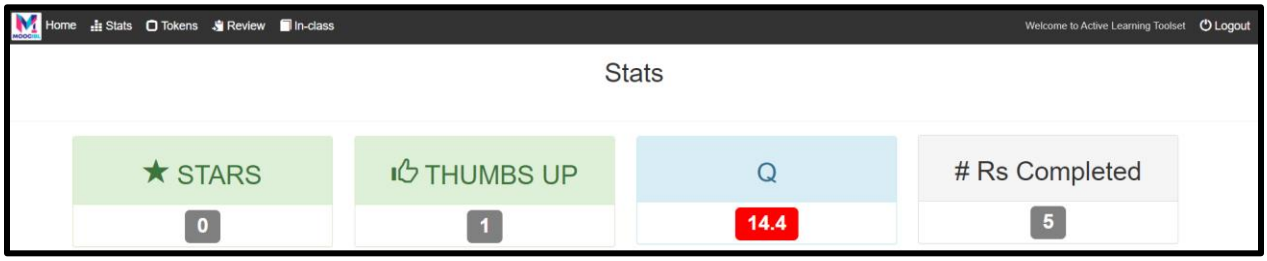

Figure 4. *The new student statistics dashboard gamifies reviews and increases awareness.*

Keep It Front-of-Mind

Finally, instructor communication regarding tokens has been revised. Figure 3 shows a sharp decline in token creation at the end of November. This corresponds to the communication of a token creation "deadline". Students were advised that all tokens must be created before the deadline. The deadline only pertained to the creation of tokens, not their progress through the workflow. No penalties were ever announced or applied with respect to this deadline. Nevertheless, the term deadline prompted students to not only create tokens but then advance them through the workflow stages as well. Consequently, the stronger term deadline will be used earlier in the semester to get students started on their tokens. By creating and advancing tokens sooner, more time will be available for effective PR and revision during the semester.

Keep Improving

Future improvements, not yet implemented but under consideration, include an e-mail notification/alert feature to remind students to visit the online portal and/or advise students of workflow status changes which require their attention. Reviewer calibration/training exercises are also under consideration; these activities could train students to become better reviewers using sample content and perhaps require a level of demonstrated competence before progressing to actual reviews [22] or perform intelligent matching between particular reviewers and tokens [25].

Conclusion

Historically, the IBL model has produced strong intrinsic motivation through student-defined teams, projects, and tasks [2]. Within this model, students require frequent qualitative feedback as they demonstrate their learning through a range of work such as presentations, posters, papers, and prototypes [7]. This paper reports on the addition of an online system of tokenized learning with anonymous peer review. In its first use, the system was a mixed success. Analysis of student website use, paired with end-of-semester surveys, have informed system improvements. Key takeaways were to: streamline the system, remove points of delay, and ensure that students submit their work for review early in the semester to allow sufficient time to receive feedback, revise the work, and resubmit. These lessons-learned transcend the context of tokens and IBL; they are principles to consider in any classroom using online peer review.

References

[1] D. H. Pink, *Drive: The Surprising Truth About What Motivates Us*. New York: Riverhead Books, 2011.

[2] R. Striker, E. A. Vazquez, M. Pearson, L. Singelmann, and E. M. Swartz, "A Scalable Approach to Student Team Formation for Innovation-based Learning," presented at the 2020 ASEE Virtual Annual Conference Content Access, Jun. 2020, Accessed: Mar. 05, 2021. [Online]. Available: https://peer.asee.org/a-scalable-approach-to-student-team-formation-for-innovation-based-learning.

[3] E. Alvarez Vazquez, M. Pearson, L. Singelmann, R. Striker, and E. Swartz, "Federal Funding Opportunity Announcements as a Catalyst of Students' Projects in MOOC Environments," presented at the 2019 Learning with MOOCS (LWMOOCS), Milwaukee, WI, USA, Oct. 2019.

[4] E. Swartz, M. Pearson, L. Singelmann, R. Striker, and E. Alvarez Vazquez, "Innovation-based Learning: Enhancing Innovative Problem Solving and Higher-order Thinking in Education Through Multidisciplinary Collaboration," in *2020 ASEE Virtual Annual Conference Content Access Proceedings*, Virtual On line, Jun. 2020, p. 34832, doi: 10.18260/1-2--34832.

[5] E. Alvarez Vazquez, M. Pearson, L. Singelmann, E. Swartz, R. Striker, and Ng, Stanley, "The MOOCIBL Platform," presented at the 2021 ASEE Annual Conference (preprint).

[6] M. Pearson, L. Singelmann, R. Striker, E. A. Vazquez, and E. M. Swartz, “Benefits of Long-distance Collaboration in Higher Education Institutions to Train Students in Innovation Practices,” presented at the 2020 ASEE Virtual Annual Conference Content Access, Jun. 2020, Accessed: Mar. 06, 2021. [Online]. Available: https://peer.asee.org/benefits-of-long-distance-collaboration-in-higher-education-institutions-to-train-students-in-innovation-practices.
[7] E. Swartz, M. Pearson, E. A. Vazquez, R. Striker, and L. Singelmann, “Innovation Based Learning on a Massive Scale,” in *2019 IEEE Learning With MOOCS (LWMOOCS)*, Oct. 2019, pp. 90–95, doi: 10.1109/LWMOOCS47620.2019.8939635.
[8] E. Alvarez Vazquez, M. Cortes-Mendez, R. Striker, L. Singelmann, M. Pearson, and E. Swartz, “Lessons Learned Using Slack in Engineering Education: An Innovation-based Learning Approach,” in *2020 ASEE Virtual Annual Conference Content Access Proceedings*, Virtual On line, Jun. 2020, p. 34916, doi: 10.18260/1-2--34916.
[9] R. Striker, M. Pearson, E. Swartz, L. Singelmann, and E. A. Vazquez, “21st Century Syllabus: Aggregating Electronic Resources for Innovation-Based Learning,” in *2019 IEEE Learning With MOOCS (LWMOOCS)*, Oct. 2019, pp. 75–78, doi: 10.1109/LWMOOCS47620.2019.8939640.
[10] N. L. Webb, *Criteria for Alignment of Expectations and Assessments in Mathematics and Science Education. Research Monograph No. 6*. Council of Chief State School Officers, Attn: Publications, One Massachusetts Avenue, NW, Ste, 1997.
[11] K. K. Hess, B. S. Jones, D. Carlock, and J. R. Walkup, “Cognitive Rigor: Blending the Strengths of Bloom’s Taxonomy and Webb’s Depth of Knowledge to Enhance Classroom-level Processes,” p. 8.
[12] N. L. Webb, “Depth-of-Knowledge Levels for Four Content Areas.” Unpublished Paper, Mar. 28, 2002, Accessed: Apr. 07, 2021. [Online]. Available: https://dpi.wi.gov/sites/default/files/imce/assessment/pdf/All%20content%20areas%20%20DOK%20levels.pdf.
[13] L. W. Anderson and D. R. Krathwohl, *A taxonomy for learning, teaching, and assessing : a revision of Bloom’s taxonomy of educational objectives*. Longman, 2001.
[14] E. F. Gehringer, “Strategies and mechanisms for electronic peer review,” in *30th Annual Frontiers in Education Conference. Building on A Century of Progress in Engineering Education. Conference Proceedings (IEEE Cat. No.00CH37135)*, Oct. 2000, vol. 1, p. F1B/2-F1B/7 vol.1, doi: 10.1109/FIE.2000.897675.
[15] H. Søndergaard and R. A. Mulder, “Collaborative learning through formative peer review: pedagogy, programs and potential,” *Computer Science Education*, vol. 22, no. 4, pp. 343–367, Dec. 2012, doi: 10.1080/08993408.2012.728041.
[16] S. Godin, *Linchpin: Are You Indispensable?*, 1st edition. New York: Portfolio, 2011.
[17] D. Bruff, *Intentional Tech: Principles to Guide the Use of Educational Technology in College Teaching*. Morgantown: West Virginia University Press, 2019.
[18] “FERPA | Protecting Student Privacy.” https://studentprivacy.ed.gov/ferpa (accessed Apr. 07, 2021).
[19] USPTO, “USPTO Manual of Patent Examining Procedure, Title 35 U.S.C. 102 Conditions for patentability; novelty.,” *Manual of Patent Examining Procedure*. https://www.uspto.gov/web/offices/pac/mpep/mpep-9015-appx-l.html#al_d1d85b_11e72_2ee (accessed Apr. 07, 2021).

[20] R. Lu and L. Bol, “A Comparison of Anonymous Versus Identifiable E-Peer Review On College Student Writing Performance and the Extent of Critical Feedback,” p. 17.
[21] C. Bauer, K. Figl, M. Derntl, P. P. Beran, and S. Kabicher, “The student view on online peer reviews,” in *Proceedings of the 14th annual ACM SIGCSE conference on Innovation and technology in computer science education*, New York, NY, USA, Jul. 2009, pp. 26–30, doi: 10.1145/1562877.1562892.
[22] P. A. Carlson and F. C. Berry, “CALIBRATED PEER REVIEW™ AND ASSESSING LEARNING OUTCOMES,” p. 6, 2003.
[23] M. Muraven and R. F. Baumeister, “Self-regulation and depletion of limited resources: Does self-control resemble a muscle?,” *Psychological Bulletin*, vol. 126, no. 2, pp. 247–259, 2000, doi: 10.1037/0033-2909.126.2.247.
[24] R. F. Baumeister and K. D. Vohs, “Self-Regulation, Ego Depletion, and Motivation,” *Social and Personality Psychology Compass*, vol. 1, no. 1, pp. 115–128, 2007, doi: https://doi.org/10.1111/j.1751-9004.2007.00001.x.
[25] R. Crespo García and A. Pardo, *A Supporting System for Adaptive Peer Review based on Learners ’ Profiles*. 2010.