



The Impact of Social Annotation on Student Engagement and Collaborative Learning

ABSTRACT

This scholarship of teaching and learning (SoTL) study explores how integrating a social annotation tool for pre-class preparation in a flipped hybrid course influences undergraduate students' engagement and collaborative learning. Grounded in social constructivism, the research examines how social annotation enhances engagement and facilitates collaborative learning, with implications for pedagogical practice. Using a mixed-methods approach, participants (N=39) completed an online survey that evaluated engagement, collaboration, and potential challenges with social annotation. Findings suggest significant positive attitudes towards social annotation, revealing specific pedagogical strategies for leveraging social annotation in order to address student isolation and enhance active reading in blended learning, including structured annotation prompts and balanced reading loads. The usability of Perusall is a key strength, with challenges including workload and unclear scoring guidelines.

KEYWORDS

social annotation, active reading, collaborative learning, social constructivism, reading load

INTRODUCTION

Compared to writing, reading is an invisible skill within the classroom, making it challenging for higher education instructors to address in class. This lack of visibility, however, does not mean that reading is absent from post-secondary courses. On the contrary, university-level instructional plans are often based on the assumption that students will complete the assigned readings proficiently across different courses. Assigned course texts are judiciously selected, and instructors view reading as “fundamental to disciplinary thought” (Hovland 2019, 512). Undergraduate students are expected to engage critically with different forms of texts across multiple disciplines. Yet, such active reading skills do not come naturally. Reasoning about the text is often missing when students approach readings passively and uncritically and simply take them as they are (Hovland 2019). While instructors expect students to prepare for class by completing pre-class readings and other activities, students often arrive unprepared or assume they can perform well in a course without reading assigned texts (Benjamin 2023). Common reasons include finding the class boring, assuming the professor will discuss all the major points in class, readings being too challenging, prioritizing other responsibilities with family or work, course load, lack of motivation, or lack of time (Benjamin 2023; Kerr and Frese 2017).

This study focuses on addressing these challenges by integrating social annotation into a flipped classroom in order to support active pre-class reading and peer interaction. This research adopts a SoTL lens in order to explore ways to make reading a visible skill in a flipped classroom,

without overextending to examine broader flipped learning or hybrid pedagogies. It intentionally addresses a persistent challenge in higher education, where critical reading skills are expected but rarely explicitly taught, and it is grounded in reflective practice and student-centered inquiry. In this study, the flipped hybrid structure provides the context for exploring how social annotation supports active reading during pre-class work.

In the context of this mandatory, reading-intensive course, reading has two primary purposes (Ihara and Del Principe 2018). The first reason is reading to master the course content, as it could offer thorough explanations critical for students to internalize and effectively engage in class discussions. The second reason is that reading serves as a foundation for intellectual conversations in class. Students read to respond and make connections among different texts. However, these two reasons suggest that the difficulty of reading assignments may demotivate students, and the isolated nature of reading may hinder their exposure to multiple perspectives from an authentic audience as they interact with the text (Li et al. 2023).

Social annotation tools provide an interactive learning experience for reading assignments, allowing students to engage with the course readings, the instructor, and each other. Several research studies provide examples of how social annotation tools enhance students' engagement with the text, particularly during online classes (Lee et al. 2023; Li, Mao, and Zhou 2021; Li et al. 2023). For clarity, this study specifically examines Perusall's role in fostering engagement and collaborative learning, not its scalability or broader educational technology (edtech) implications. More research is needed to explore students' engagement, perceived learning, and satisfaction with such tools. This study analyzes student perceptions of Perusall, a social annotation tool, in a flipped classroom, with the flipped model providing context rather than being a variable under investigation. In a flipped classroom setting, student engagement with course readings is critical to their learning. As a pre-class preparation, undergraduate students are expected to practice active reading where they critically engage with assigned texts. Yet, instructors predominantly focus on students' written work with minimal, if any, feedback provided on reading.

Grounded in social constructivism, the study aims to investigate the shift in focus from an individualistic approach towards a collaborative one, focusing on social online learning. The aim is to cultivate a learning community where students share their understanding of the readings, scaffold each other, and collaboratively construct new knowledge.

This study contributes to SoTL by evaluating Perusall's scalability in a mandatory interdisciplinary course. Most research on Perusall focuses on discipline-specific courses (e.g., STEM), where motivation dynamics differ and challenges may vary from those students encounter in elective courses (Alebrahim and Ku 2020; Lin, Hung, Kinshuk, and Chen 2019; Zheng, Bhagat, Zhen, and Zhang 2020). Students may lack intrinsic motivation, so it is worth exploring Perusall's influence on student engagement. Moreover, the course is characterized by a heavy reading load, which calls for research on annotation tools in reading-intensive contexts, without claiming to assess institution-wide adoption or broader hybrid learning strategies (Zhu, Chen, Avadhanam, Shui, and Zhang 2020).

How do undergraduate students perceive Perusall's effectiveness in promoting engagement and fostering collaborative learning?

LITERATURE REVIEW

Social constructivism

A constructivist viewpoint on education perceives learning as a collaborative social activity (Sarwar et al. 2024). According to social constructivism, we create knowledge by interacting with one another and our surroundings (Kay, MacDonald, and DiGuiseppe 2019). Thus, our comprehension of

knowledge is socially and culturally built. Social constructivism also emphasizes that people integrate their experiences and their interpretations of these experiences with other people of different backgrounds to create their own meanings (González-Salamanca, Agudelo, and Salinas 2020). This is why multiple world perspectives exist as we socially construct knowledge, sharing, and negotiating meaning (Vygotsky 1978). As Xu and Shi (2018, 883) put it, “the largest community is mankind,” and “knowledge is not waiting to be discovered, but rather it is constructed by humans by interaction with the world and with each other.” Student collaboration, engagement, and interaction are foundational to the social constructivist theory of learning (Butzler 2014). As such, the role of educators is not to impart knowledge but rather to promote its construction, supporting students in an active learning environment that is conducive to their growth. Collaboration occurs through conversations, analysis, and evaluation of content in order to attain a deep understanding of concepts. Evidently, students are at the center of the learning process as instructors adopt the role of facilitators.

Social annotation

Most research on social annotation tools is conducted in higher education settings, exploring students’ perceptions of the tools’ effectiveness (Sun, Hwang, Yin, Wang, and Wang 2023). Social annotation tools more broadly support engagement, critical thinking, and collaborative knowledge construction across disciplines (Sun et al. 2023; Zhu et al. 2020). Students generally have a positive view of social annotation tools, such as Perusall, and report higher engagement and motivation to complete the course readings primarily due to the interaction with peers (Kalir, Morales, Fleerackers, and Alperin 2020; Lemanski and Venneman 2023; Li et al. 2023; Sun et al. 2023). In a study by Sigmon and Bodek (2022), 63 undergraduate students reported an increased sense of community from using Perusall, making them feel more comfortable asking questions in a flipped classroom, which supported their learning.

Other studies have investigated the impact of social annotation tools on undergraduate students’ academic performance and self-reported learning. In general, students highly rate their learning and report better performance on course assignments when using social annotation tools (Adams and Wilson 2022; Benitez, Quinones, Gonzales, Ochoa, and Vargas 2020; Suhre, Winnips, de Boer, Valdivia, and Beldhuis 2019). For example, Adams and Wilson (2022) found that, over time, Perusall helped students make connections across different readings, and students were more likely to add substantive comments to challenge their peers rather than just agree with them. This allows students to move from isolated, individual text analysis to collaborative inquiry, developing multiple perspectives and connections across people and ideas (Allen and Randall 2023). Group learning made accessible by social annotation tools facilitates negotiation and shared knowledge construction (Kalir et al. 2020). These findings highlight Perusall’s potential to enhance pre-class preparation in flipped settings.

It is important to note an essential condition of educational technology. Garcia and Nichols (2021) state that an edtech tool is not inherently effective and will not work for every student. As educators, we must thoughtfully select and apply these tools, acknowledging any challenges or design issues that may impact the development of a learning community. Therefore, it is necessary to examine specific tools, like Perusall, in specific teaching contexts in order to understand their potential benefits and limitations.

Social annotation systems allow students to engage with the assigned readings as a collaborative social activity. Students can highlight, annotate, and add comments or questions on articles, webpages, videos, and images. They can work in groups, reply to the instructor’s or their peers’ comments, and upvote annotations they find interesting or useful. A systematic review by

Novak, Razzouk, and Johnson (2012) examines the use and effects of social annotation tools across disciplines. When compared to printed material, students demonstrated improved metacognitive skills when using social annotation tools, as well as favorable attitudes towards social annotation. A more recent review by Zhu et al. (2020) details that social annotation supports argumentation, inquiry, peer assessment, development of literacy skills, and knowledge construction. A study by Chen and Chen (2014) reported similar results; they found that students perceived social annotation as interactive and supportive of their learning, particularly in collaborative contexts relevant to this study.

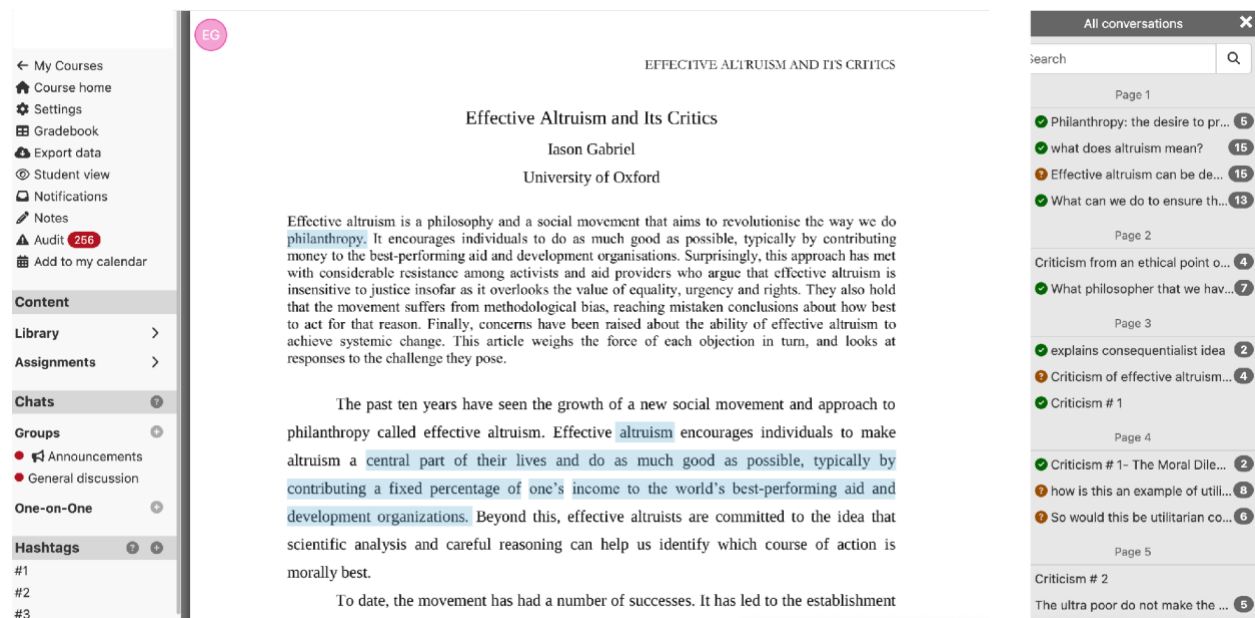
Collaborative learning

Collaborative learning allows students to work as a group in order to construct knowledge. It enhances peer interaction and facilitates sharing knowledge, skills, and expertise among students in a learning community (Gao 2013). Grounded in social constructivist theory, collaborative learning recognizes the value of cognitive and social engagement in the learning process. A wealth of studies highlight its benefits to student learning, such as promoting critical thinking, fostering peer interactions, and enhancing problem-solving skills (Adams and Wilson 2020; Chen and Chen 2014; Gao 2013; Hovland 2019; Kalir et al. 2020; Suhre et al. 2019). As such, the social and cognitive domains are essential for social annotation activities to effectively support student learning and establish interpersonal relationships (Kreijns, Van Acker, Vermeulen, and van Buuren 2013).

Creating a learning community facilitates collaboration among peers and is considered imperative for student success. The social constructivist theory underpinning this research study focuses on the importance of interacting with others and how such interactions shape how we construct our values and identity (Adams and Wilson 2020). Collaborative learning in a classroom community allows students to pool their knowledge, learn from each other, and apply their learnings in novel ways (Holmes 2013). However, social interaction within collaborative learning communities does not inherently support the development of higher-order thinking skills. To successfully teach with an edtech tool, Wilson and Cardullo (2018) state that “the teacher must have knowledge of students, content, pedagogy, and technology, as well as a positive disposition toward teaching with technology and an adaptive approach to teaching” (p. 5). With that in mind, the instructor selected Perusall, an evidence-based tool designed to enhance student engagement.

Perusall

Motivating students not just to read but to read actively by engaging with the content can be challenging, especially since this required task occurs independently, without support, and outside class hours. Developed by Harvard University and supported by extensive research, Perusall employs active learning principles to deepen students' connection with the text. Perusall visualizes active reading, an active learning, student-centered approach that transforms independent reading into a collaborative experience as students engage with each other, the instructor, and the course readings (Figure 1).

Figure 1. Interface of Perusall platform (instructor-view)

Existing research examines the benefits of Perusall in enhancing engagement and collaboration (Adams and Wilson 2022), but few studies explore its integration in hybrid contexts where dynamics are different from those of fully online contexts, which may introduce unique challenges. This study addresses this gap by examining Perusall in a blended, interdisciplinary course, offering insights into its adaptability across other learning modalities. Although other collaborative annotation tools (such as Hypothes.is) are available, this study focuses on Perusall because it is an evidence-based tool, created at Harvard, and suitable for supporting engagement and collaborative learning in this course context.

Objective of the study

The study aimed to investigate how undergraduate students perceive the effectiveness of Perusall in enhancing their active reading engagement and fostering collaborative learning in a flipped classroom context. The study aims to contribute to SoTL by providing evidence on the role of social annotation in supporting pre-class preparation and peer interaction in mandatory, interdisciplinary courses.

Context

In this study, the instructor integrated Perusall into a three-credit, mandatory general education course as a platform where students could engage in collaborative, active reading. The 60 enrolled undergraduate students were from different majors and had little prior knowledge of the course's concepts. The course included 25 sessions on Perusall, with readings for each session uploaded by the instructor. Assigned readings included academic articles, videos, and/or website articles. Completing the assigned readings every session was due one day before class. This was particularly significant given the course's flipped learning and blended model (two online classes and one face-to-face session), both of which require students to independently engage with course materials outside the classroom. The instructor evaluated students' annotations based on the

Perusall's scoring algorithm, which was set by the instructor. However, these scores were used as a formative assessment of the students' quality of annotations.

During the first week of classes, students created an account and logged into Perusall during class time. The instructor demonstrated the key features of highlighting, annotating, upvoting, tagging peers, or attaching files and images as additional resources. Instructions, examples of the annotations, sample sentence frames, and guiding questions were provided to the students. Expectations for thoughtful engagement were set, emphasizing the depth of comments and responses (e.g., not just "I agree" or "I disagree" but also indicating why you agree or disagree) and prompting connections to course content and real-world experiences.

Students received detailed feedback on their engagement with Perusall every week, establishing expectations for subsequent annotations and peer responses in future reading assignments. The instructor followed up with students' annotations to further clarify class content, made connections between concepts, or prompt self-reflection from students within the context of the reading. The instructor also identified areas of confusion and interest to follow up on based on the statistics displayed by Perusall, such as the most frequently asked questions or annotations with the most upvotes. While Perusall annotations contributed to classroom engagement scores, which account for 40% of the final grade, their primary role was to support students' preparation and participation. The course assignments were designed so that success depends on students' engagement with the assigned readings rather than external sources. The syllabus and grading scheme were determined at the department level.

METHODS

The study employed a mixed-methods design to evaluate students' perceptions of Perusall in terms of engagement and collaborative learning. A survey was conducted using a Likert scale and open-ended questions. Students received the survey online via Google Forms at the end of the semester. Participation was voluntary, and the course's learning management system (LMS) distributed the survey link. Students could answer the survey for two weeks, with a reminder email sent to encourage participation. The researcher analyzed quantitative data using Wilcoxon signed-rank test and Spearman's rho to test hypotheses about engagement and collaboration. This test assessed whether students' perceptions differed significantly from a neutral midpoint, while correlations explored relationships between engagement, collaboration, and usability variables identified in the literature. The researcher then thematically coded qualitative data to explain quantitative trends, following an explanatory approach (Creswell and Plano Clark 2011). For example, student responses about Perusall's annotation features contextualized scores related to user experience. Prior studies on active reading and social annotation (e.g., Kalir et al. 2020; Li et al. 2023) informed survey items and coding frameworks to promote validity and alignment with the research question.

The University's Research Ethics Board Office provided ethical approval (Ethics Clearance Number: ZU24_014_F). The study only used data from students enrolled in the course and who signed the written consent form. The researcher excluded all other data from the analysis. As stated in the consent form, the analysis phase ensured participant confidentiality with the removal of all information from the dataset that could potentially identify participating students.

Participants

The participants include all the students registered in the course sections assigned to the instructor. Including all enrolled students aligns with SoTL's commitment to ensure that diverse

perspectives inform pedagogical recommendations. Moreover, incorporating all students as participants is imperative for comprehensive data collection, ensuring a representative sample that reflects the diverse range of student experiences, needs, and preferences for completing pre-class work. This inclusivity enhances the validity, generalizability, and applicability of research findings and promotes equitable educational outcomes. 39 second-year undergraduate students aged 19 to 21 completed the survey out of 60 enrolled students in the course (response rate: 65%). The cohort represents multiple disciplines with diverse educational backgrounds, and students were completing different programs at the College of Interdisciplinary Studies. This demographic is typical of the university's foundational, mandatory courses.

Data collection

To address the main research question, the researcher collected quantitative and qualitative data using a survey administered via Google Forms, consisting of 15 closed questions (e.g., Perusall allowed me to engage with readings more than I usually do) and a selection of open-ended questions (e.g., What challenges did you face using Perusall?), informed by prior studies on active reading and social annotation (Kalir et al. 2020; List and Lin 2023). Students could complete the survey at the end of the semester. The literature on active reading and the research on the use of Perusall as an active learning tool informed the items on the questionnaire. Items are positively and negatively worded to control confirmation bias. Each item is associated with a six-point Likert scale ranging from strongly agree to strongly disagree. In open-ended questions, the survey asked students to share their experiences with their peers and reflect on the challenges they encountered during the process, what they benefited from Perusall's activities, and where they could be improved.

Prior to administering the survey instrument to the participants, three university professors teaching the same course but not involved in the study first evaluated the face validity of the instrument. The course instructor also consulted them regarding construct validity in order to evaluate if the survey items reflected the key constructs of engagement, collaboration, and user experience of Perusall's features to align with the research question. The instructor piloted with a group of 10 demographically representative students to check their understanding of the survey items. The instructor refined items causing confusion.

The instructor distributed the survey electronically to ensure easy access and timely responses. Students received the survey during the last week of classes, during class time, in the face-to-face session. In line with the university's ethics approval, a fellow instructor (not the course instructor) explained to the students the purpose of the study, the voluntary and anonymous nature of participation, and the use of the data before administering the survey. This approach ensured students felt free to give informed consent without pressure from the course instructor being present. The students completed the survey during that class. Following this session, all students received a reminder email with the survey link for those who had not participated during class or were absent. No incentives were offered for participation.

Themes and hypotheses

Theme 1: Perceived effectiveness and engagement

(H1): Students perceive Perusall as effective in enhancing their active reading practices and report higher engagement with assigned readings than traditional methods.

Sample supporting survey items include:

- Q3: Active reading on Perusall contributed significantly to my learning.
- Q4: Perusall allowed me to engage with the readings more than I usually do.
- Q11: Perusall encouraged me to read more of the assigned readings than I usually do.

Theme 2: Collaborative learning

(H2): Students perceive Perusall as fostering a collaborative learning environment, enhancing peer interaction and knowledge construction.

Sample supporting survey items include:

- Q6: I made modifications to my work based on the discussion on Perusall.
- Q10: Annotating readings with my peers increased my sense of community in this course.

Subthemes include usability, future use, and challenges

Sample supporting survey items include:

- I experienced discomfort, hesitation, or nervousness while using Perusall.
- I would like to use Perusall again.
- Active reading on Perusall was challenging.

The researcher calculated Cronbach's alpha to ensure the survey's reliability ($\alpha=0.89$), indicating good reliability and supporting the survey's consistency in measuring Perusall perceptions. Subscales were defined based on the study's themes: Engagement (Q3, Q4, Q11, Q13, Q15), collaborative learning (Q6, Q7, Q10), and subthemes (Q1, Q2, Q5, Q8, Q9, Q12, Q14).

RESULTS

The results presented below directly address the objective of this study: examining how students perceive the role of Perusall in enhancing engagement and fostering collaborative learning in a flipped classroom context. The researcher used the Jamovi statistical software to analyze the quantitative data. The researcher then conducted a Wilcoxon signed-rank test to compare students' responses (1 = Strongly Disagree, 6 = Strongly Agree) against the scale's neutral midpoint (3.5). Spearman's rho was calculated to identify relationships between key variables (such as engagement and usability). The researcher thematically coded qualitative data from open-ended responses using Braun and Clarke's (2006) six-phase approach to contextualize quantitative findings and triangulate the results.

Theoretical linkages between constructs helped the instructor select correlation pairs. These linkages are derived from the literature on the flipped classroom model (e.g., user experience → engagement; peer feedback → learning community). Pre-specified pairs were tested to minimize Type I errors.

The primary analyses focused on two composite indices (Engagement and Learning, Collaborative Learning), minimizing the risk of inflated Type I error due to multiple comparisons. P-values reported as < 0.000001 indicate values beyond the precision of the statistical software, indicating highly significant results. The researcher did not apply Bonferroni correction across individual survey items, as the primary analyses focused on composite indices. Results for individual items are reported descriptively in Table 1 to provide context for students' perceptions.

Table 1. Quantitative results of Perusall perceptions across key dimensions

Question	% Agree/strongly agree	Mean	Median	Wilcoxon statistic	p-value
Engagement and learning					
Q1: Perusall is user-friendly.	80.0%	4.90	5	55	<0.000001
Q3: Active reading contributed to learning.	68.0%	4.62	5	111	0.000038
Q4: Increased engagement with readings.	75.0%	3.87	4	290	0.166766
Q5: Annotations clarified readings.	87.0%	5.13	5	30.5	<0.000001
Q11: Encouraged more assigned reading.	72.0%	4.28	4	189.5	0.0045
Q13: Good use of time.	79.0%	4.15	4	212	0.012092
Collaborative learning					
Q6: Modified work based on peer discussions.	58.0%	4.28	4	161	0.000997
Q7: Enjoyed active reading on Perusall.	35.9%	3.87	4	290	0.166766
Q10: Annotations increased sense of community.	65.0%	4.64	5	112	0.000041
Subthemes					
Q2: Experienced discomfort using Perusall.	25.0%	2.64	2	169.5	0.00155
Q8: Scoring accuracy.	69.2%	4.46	5	144	0.000365
Q9: Would use Perusall again.	70.0%	4.13	4	226	0.021316
Q12: Active reading was challenging.	30.0%	3.62	4	329.5	0.41055
Q14: Perusall should be integral to courses.	60.0%	3.92	4	291	0.171134
Q15: Active reading improved my work.	67.0%	4.67	5	110.5	0.000038

ANALYSIS AND THEORETICAL ALIGNMENT

Data were analyzed using the Wilcoxon signed-rank test to compare students' responses on the Likert scale, with one being Strongly Disagree and six being Strongly Agree, against the scale's numeric midpoint (3.5). The analyses focused on the two themes: student engagement and collaborative learning, in alignment with the research questions and hypotheses. However, challenges related to workload and feedback clarity emerged. The researcher explored descriptively subthemes, such as usability, preference, and challenges, to provide further context on students' experiences. The Wilcoxon signed-rank test results, along with mean, median, and percentage of positive responses (Agree or Strongly Agree), are reported for each survey item in Table 1. Qualitative data from open-

ended responses were thematically analyzed to contextualize quantitative findings and provide deeper insights into students' experiences.

Hypothesis 1: Perusall enhances engagement and learning

As shown in Figure 2, students overwhelmingly found Perusall effective for active learning and engagement across multiple dimensions, with usability being the strongest perceived benefit. Students reported positive perceptions of Perusall as a tool for active learning and engagement. Most students agreed that Perusall is user-friendly (Q1), a particularly important finding that suggests minimal technical barriers for higher education adoption. Students reported that active reading contributed to their learning (Q3), a core educational benefit of Perusall, and increased engagement with readings (Q4) and reading more than usual (Q11), further supporting the engagement hypothesis. All Wilcoxon tests for these items indicated statistically significant positive perceptions ($p < 0.05$).

These results are reflected in the students' answers to the open-ended questions:

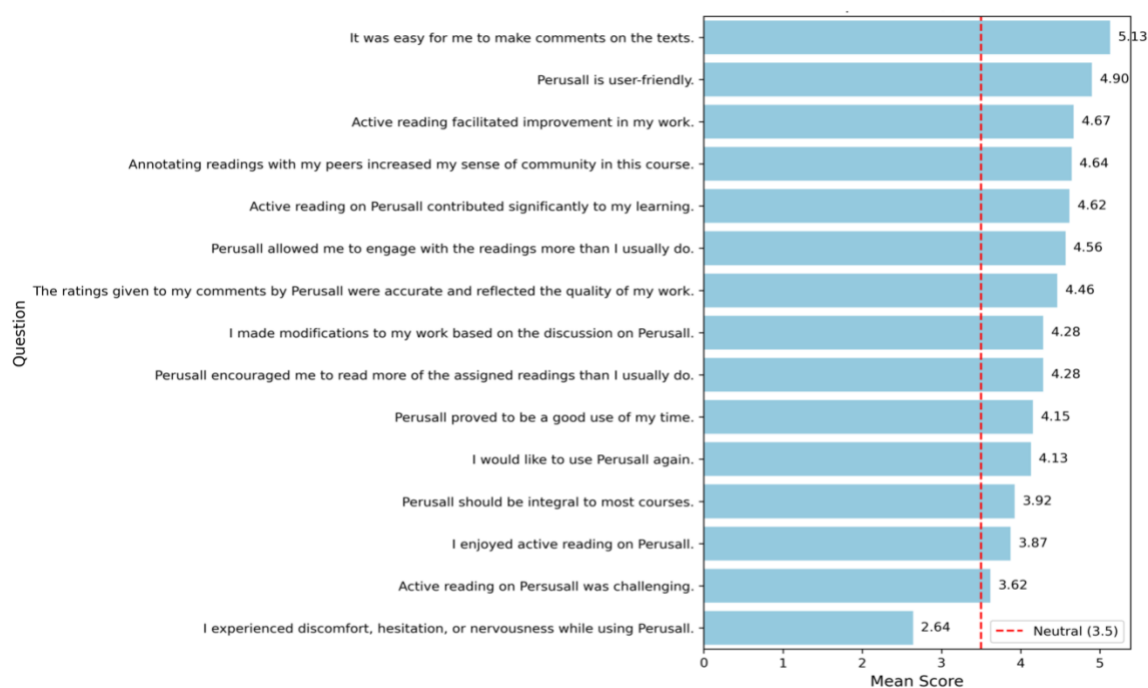
- “Annotating helped me focus on key points and discuss them with peers.”
- “I read more thoroughly because I knew others would see my comments.”

The results provide evidence that students perceive Perusall as effective in enhancing their active reading practices and report higher engagement with assigned readings than traditional methods. Moreover, students reported higher engagement with active annotations due to peer interactions on Perusall.

Students also noted how highlighting and annotating improved their understanding of the assigned text, leading them to apply annotation skills in other contexts as well:

- “I learned to read the important notes.”
- “Annotating and making comments are two aspects I implement every time I have an article to read.”

Figure 2. Mean scores of Perusall experience questions vs neutral value



Hypothesis 2: Collaborative learning

Students perceived Perusall as a tool that fostered collaboration. Most students (65.0%) agreed that annotating with peers increased their sense of community (Q10) and that group annotations enhanced peer interaction, taking into consideration that only 25.0% of students reported discomfort (Q2) while using the tool. Annotating assigned readings collaboratively enhanced peer interactions and likely created a sense of community, which aligns with the social constructivist learning theory. The results support the hypothesis that students perceived Perusall as fostering peer collaboration. Even though some students asked for clearer guidance on peer feedback, to be addressed later in the challenges section, the hypothesis is accepted, supporting the idea that Perusall fostered collaboration among students. This was further reported by the students sharing that:

- “Seeing peers’ questions clarified concepts I missed.”
- “Group annotations made me feel less isolated in online learning.”

Peer discussions allowed students to value different perspectives and also helped them understand complex ideas, as some students reflected:

- “These readings made me know more about other people’s ways of thinking.”
- “If I didn’t understand something, I might find someone else who understood it and we can help each other out.”
- “Discussing with peers clarified my understanding.”

Subthemes and challenges

As for the challenges, 30.0% of students found active reading challenging (Q12), often due to the workload of the assigned readings, and 25.0% reported discomfort using Perusall (Q2). These findings suggest the need for scaffolding, which may be in the form of shorter texts and clearer scoring guidelines. Student responses supported these findings:

- “Highlighting was intuitive, but grading criteria were unclear.”
- “Long readings were overwhelming; breaking them into sections would help.”
- 70.0% would like to use Perusall again in the future, and 60.0% support integrating the tool into other courses.
- “I’d use it if readings were shorter or mixed with videos.”
- “Long articles are time-consuming.”
- “Copy-paste restrictions for definitions were frustrating.”

Spearman’s rho correlations identified meaningful relationships between key variables, with correlation coefficients presented in Table 2. The strongest correlation is between user experience, i.e., user-friendly tool (Q1) and improved work (Q15), where ease of use strongly correlates with self-reported coursework improvement. This finding provides insight into what features enhanced learning outcomes and aligns with the qualitative feedback related to the value of annotation tools (e.g., “Highlighting was intuitive”). The strong association between usability and perceived improvement suggests that instructors can adopt Perusall with minimal technical training, facilitating its integration into reading-intensive courses.

Moderate correlations further support engagement between active reading (Q3) and increased engagement (Q4), as well as between Perusall encouraging reading (Q11) and Perusall being a good use of students’ time (Q13). These correlations indicate that students perceive annotation as a useful way to engage with the readings and to reduce potential procrastination, as

noted in the open responses (e.g., “I read more thoroughly due to peer visibility”). However, it also implies that annotation alone is insufficient to sustain engagement. Other factors, such as peer visibility (e.g., “I read more because others saw my comments”), may drive student engagement apart from active readings. Social presence, as well as cognitive presence, can be a driving force that fuels engagement (Kreijns et al. 2013).

Table 2. Correlation pairs

Engagement and learning	Spearman's rho	p-value
User-friendly (Q1) ó improved work (Q15)	0.733	<0.000001
Perusall supports active reading (Q3) ó increased engagement (Q4)	0.605	0.000045
Improved engagement (Q4) ó encouraged reading (Q11)	0.595	0.000065
Encouraged reading (Q11) ó good use of time (Q13)	0.601	0.000053
Perusall scoring is accurate (Q8) ó good use of my time (Q13)	0.767	<0.000001
Collaborative learning		
Peer feedback (Q6), ó sense of community (Q10)	0.435	0.005659
Sense of community (Q10), ó Perusall should be integral (Q14)	0.624	0.000022
Subthemes		
Discomfort using Perusall (Q2), ó would use Perusall again (Q9)	-0.342	0.03285
Would use Perusall (Q9), ó Perusall should be integral (Q14)	0.855	<0.000001
Increased engagement (Q4), ó active reading was challenging (Q12)	-0.437	0.005443
User friendly (Q1), ó Perusall should be integral (Q14)	0.58	0.000108
Increased engagement (Q4), ó improved work (Q15)	0.618	0.000027

Other correlations indicate that students who felt that Perusall's scoring was accurate viewed it as a tool worth their time (Q8 and Q13). Perusall's transparent grading algorithm enhanced students' positive perception of its utility. Students who engaged more with the readings felt that Perusall's features motivated them to read. Positive interaction with peers encouraged students to modify their work based on the feedback they received on Perusall. Finally, the strong correlation between students' willingness to use Perusall again (Q9) and interest in integrating it into other courses (Q14) highlights Perusall's perceived value and interest in using it for other courses, echoing comments like “Group annotations made me feel less isolated.” Perusall's perceived value drives long-term adoption and continued use of edtech tools, reinforcing the high usability score (Table 1). This suggests that when students find a tool to be user-friendly, they are significantly more likely to accept it for future learning (Q1, mean=4.90).

The findings suggest a significant weak correlation between peer feedback (Q6) and the sense of community (Q10), indicating that even though students used feedback from their peers to modify their work, it did not necessarily help create a learning community. This may be due to other challenges noted by the students, such as the unclear feedback guidelines (e.g., Grading criteria were unclear), which may impact student collaboration.

DISCUSSION

These findings were interpreted in relation to the study's aim to investigate students' perceptions of Perusall's effectiveness for engagement and collaborative learning during pre-class preparation in a flipped course. Suhre et al. (2019) examined whether the social annotation tool

influences students' behavior and academic performance. In this study, students were allowed to explore and use the tool over the course of one semester so they could form their own perceptions about social annotation in general and Perusall in particular before conducting the survey. The study aimed to understand student perceptions of Perusall, using an online survey to examine students' experiences, engagement, and interactions with their peers when annotating assigned course readings. The mixed-methods analysis strongly supports both hypotheses. With high statistical significance, Perusall enhanced student engagement (H1) and collaboration (H2), and usability was the main factor that predicted students' satisfaction with the tool and willingness to re-use it in the future. Students generally had positive experiences with Perusall. They found it user-friendly; it contributed to their learning, and students appreciated how it encouraged reading and engagement. These findings reflect previous studies that reported positive user experiences (Li et al. 2023; List et al. 2023; Kalir et al. 2020). However, unlike prior studies focused on elective courses, our results reveal that Perusall can overcome motivational barriers in mandatory settings, with 75.0% of students reporting increased engagement, a key consideration for instructors designing blended courses. The qualitative responses revealed that while the integration satisfied most students, some suggested shorter readings or incorporating videos to maintain engagement.

The findings demonstrate how collaborative annotation supports the development of a learning community where knowledge is socially constructed, aligning with the social constructivist principles. Students' responses, such as "seeing peers' questions clarified concepts I missed" and "group annotations made me feel less isolated," lie in Vygotsky's (1978) zone of proximal development, where learning occurs as students socially interact with one another. Consistent with SoTL's focus on shared practice, it is recommended that instructors scaffold peer feedback with sentence stems on Perusall. The weak correlation between peer feedback and community learning suggests that unclear feedback guidelines may hinder collaboration, which highlights the need for structured scaffolds, a key SoTL insight for refining instructional tools.

LIMITATIONS

These promising results must be viewed in terms of the study's limitations. Of the 60 students enrolled in the course, 39 opted to complete the survey, leading to a relatively small sample size, which limits the generalizability. Findings may not apply to non-mandatory or graduate-level contexts. A larger study with a more diverse student body across several semesters may yield more significant results. A future SoTL study could compare mandatory and elective courses to identify context-specific strategies for social annotation. The second limitation is the focus on students' perceptions, which, while important, is a subjective measure of learning. Students may be subject to social desirability bias or limited self-awareness. Future work with social annotation tools could explore whether the tool positively impacts student learning or attainment of learning outcomes.

The researcher would like to point out that some students did not actively contribute to annotating the assigned readings, an observation also noted by Chen and Chen (2014). These students read their peers' annotations but lurked in the background and did not contribute to collaborative learning on Perusall, reducing interaction and affecting the class's overall reading comprehension. Finally, the course instructor's enthusiasm for Perusall may have influenced student perceptions, a bias that future SoTL studies could mitigate through external evaluators.

CONCLUSION

This study contributes to the scholarship of teaching and learning by demonstrating how social annotation tools, like Perusall, can transform reading into a collaborative, visible skill. This

study integrated the tool into the flipped hybrid model, which was a setting rather than the primary focus of analysis. Findings provide insight into how social annotation can transform reading from a passive activity to an active, collaborative learning experience that aligns with the principles of social constructivism. Analyzing the subthemes revealed some challenges. Some students found the reading load to be a barrier to their engagement with the text and their peers. This suggests the need for tailored scaffolding in courses with a high reading load, a nuance absent from existing literature. Drawing on SoTL's emphasis on actionable pedagogy, it is recommended that instructors interested in implementing Perusall or similar social annotation tools do the following:

- Set clear expectations on the quality and depth of comments and responses, not the quantity (Suhre et al. 2019).
- Provide annotation templates to guide peer feedback.
- Assign a variety of content types, such as readings and videos, to reduce fatigue.
- Break the assigned reading material into smaller sections.
- Add prompts for students to respond in order to facilitate the discussion.
- Explain how annotations are evaluated.
- Take time to provide students with feedback on their engagement in Perusall. Students with clear expectations are more likely to annotate and respond to their peers.

This study addresses the gap in research on social annotation in non-Western educational contexts and in mandatory general education courses. It is pertinent to a long-standing interest in active learning approaches and the value of collaborative learning in higher education. The study shows that students demonstrated a positive attitude toward learning with the social annotation tool. In general, findings provide evidence that social annotation is an effective approach to engage students in collaborative reading activities where they explore different opinions and learn from each other's perspectives. After integrating the Perusall platform into course design and exploring students' perceptions of their engagement and collaborative learning experiences, results show that Perusall may be a useful tool for active learning in blended learning settings. While university-wide adoption requires further research, its high usability provides a foundation for broader integration in reading-intensive courses. Future SoTL research could adopt a longitudinal design to assess Perusall's impact on learning outcomes across semesters, building on this study's findings on collaborative learning practices.

Perusall should be "used for novelty" and be strategically integrated into courses as one of several routes to engage students with the content (Eisenreich and Disney 2024, 42). Future research could compare elective vs. mandatory cohorts and use a control group with a larger cohort size to validate the impact of social annotation on student learning outcomes.

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DISCLOSURE

The author has no competing interests to declare.

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