Shih, JL. et al. (Eds.) (2023). Proceedings of the 31st International Conference on Computers in Education.
Asia-Pacific Society for Computers in Education

Investigating Students' Perceptions of Knowledge-building Environment and Learning Engagement

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Abstract: Knowledge-Building pedagogy emphasizes engaged learning, with students collaboratively working towards advancing shared ideas within a community. This study explored the relationship between students' perceptions of the knowledge-building learning environment and their learning engagement in Knowledge Forum activities. A total of 259 undergraduate students from courses that used Knowledge Forum participated in this study. The study employed partial least squares structural equation modeling (PLS-SEM) analysis to examine the relationship. The findings revealed that assuming agency positively influenced students' cognitive, emotional, and social engagement, indicating that students who exhibited a sense of autonomy and enjoyment demonstrated higher levels of engagement. Additionally, students' perceptions of fostering community positively predicted cognitive and social engagement, underscoring the importance of students' sense of identification with the community. These results provide potential insights for designing or refining knowledge-building learning environments and activities, highlighting the significance of promoting student agency and fostering a sense of community to facilitate learning engagement.

Keywords: Perceptions of learning environment, knowledge-building, learning engagement, PLS-SEM

1. Introduction

Knowledge-building is a socio-constructivist approach to learning that places students' ideas at the center and aims to advance community knowledge (Scardamalia & Bereiter, 2014, 2022). In knowledge-building environments, participants are encouraged to actively contribute to developing and enhancing their community's shared ideas and knowledge. Knowledge Forum (KF) is a platform specifically designed to implement knowledge-building pedagogy, providing a digital platform that enables students to engage in knowledge creation and innovation online. Students can use this platform to contribute their ideas, build on each other's contributions, and even elevate their collective thinking to a higher level using the rise above function. In Taiwan, an increasing number of university classrooms are adopting Knowledge Forum to provide students with a knowledge-building learning environment.

In research on technology-enhanced learning environments, understanding students' perceptions of the learning environment is crucial (Chang et al., 2015). By understanding students' perceptions of the learning environment, we can gain insights into the characteristics of the learning environment and further improve it. Understanding students' perspectives becomes even more important in a learning environment like Knowledge Forum, which relies on student communication and collaboration. To assess students' perceptions of knowledge building environment, Lin et al. (2014) categorized the 12 knowledge-building principles by Scardamalia (2002) into three categories: working with ideas, assuming agency, and fostering community, and further developed a scale based on this framework.

In a platform like Knowledge Forum, students' continuous engagement and contributions are also crucial for knowledge-building activity (Chan & van Aalst, 2018). Learning engagement has been a widely discussed topic, with various dimensions of engagement proposed. For example, Fredricks et al. (2004) categorized school engagement into three types: behavioral, emotional, and cognitive. However, behavioral engagement has limited predictive power for higher-level cognitive activities (Sinatra et al., 2015). In a knowledge-building environment that emphasizes students' collaborative creation of knowledge, behavioral engagement is relatively less emphasized. Instead, social engagement becomes a practical form in such a learning environment that deserves attention since it is closely tied to the interaction within the community. A qualitative study by Zhu et al. (2021) found that refining the design of knowledge-building courses in which students participate can positively impact their emotional, cognitive, and social engagement.

In sum, students' perceptions of the learning environment are closely related to their learning engagement (Opdenakker & Minnaert, 2011). However, there is limited quantitative research investigating the relationship between knowledge-building learning environments and learning engagement. By understanding the relationship between students' perceptions of the knowledge-building learning environment and their learning engagement, we can gain more insights into the design of activities on the knowledge forum. To fulfill this objective, we seek to adapt and validate the knowledge-building environment scale (KBES) developed by Lin et al. (2014) with students who have experience using Knowledge Forum by addressing the following questions: What are the structural relationships between the different indicators of KBES and students' cognitive, emotional, and social engagement?

2. Methodology

2.1 Participants

A total of 259 university students in Taiwan from various courses participated in this survey. All of the courses utilized the Knowledge Forum platform for their class activities. Basically, teachers provide weekly topics such as Socio-Scientific Issue for students to discuss. Students are required to make contributions, which is posting content, and build on, which is replying to others' contributions on the Knowledge Forum platform. Students can participate by accessing the platform through various electronic devices (i.e., PC, Tablet, or mobile phone). Through these discussions, students develop a comprehensive understanding and gain deeper insights into the topics. The teacher or teaching assistants assess students' weekly contributions and provide grades based on their content.

2.2 Instruments

After participating in a semester-long course, each student completed two questionnaires to assess their perceptions of Knowledge-Building environment and learning engagement. The details of the questionnaires are described below.

2.2.1 Knowledge-building environment scale

Knowledge-building environment scale is a questionnaire developed by Lin et al. (2014) based on the 12 knowledge-building principles. The original questionnaire consists of three constructs, which are working with ideas (e.g., In this course, it is important to embrace divergent ideas.), assuming agency (e.g., In this course, one need to plan and execute one's learning plan.), and fostering community (e.g., In this course, all members have to actively participate in discussion.), with a total of 24 items. The internal consistency (Cronbach's alpha) coefficients for the three constructs are .84, .88, and .91, respectively. Each item uses a 5-point Likert scale from 1 = strongly disagree to 5 = strongly agree for students to select.

2.2.2 Learning engagement instrument

This study utilized the science learning engagement instrument developed by Lin (2021) and made some minor modifications to align the context for this study. In the original questionnaire, Lin (2021) categorized five different types of learning engagement. For this study, three types were selected for use: cognitive engagement (e.g., I review the discussion question carefully and make sure I understand the content), emotional engagement (e.g., I

enjoy learning new things related to knowledge building learning), and social engagement (e.g., I can refer to other people's ideas). This scale has excellent reliability and validity, with the composite reliability value ranging from .89 to .92, and the average variance extracted value ranging from .67 to .80. Each item also uses a 5-point Likert scale from 1 = strongly disagree to 5 = strongly agree for students to select.

2.3 Data analysis

The partial least squares structural equation modeling (PLS-SEM) technique was employed to investigate the relationship between students' perceptions of knowledge-building environment and their learning engagement. Unlike covariance-based structural equation modeling (CB-SEM), partial least squares structural equation modeling (PLS-SEM) was a variance-based latent variable SEM technique. A confirmatory factor analysis (CFA) was conducted to ensure the reliability and validity of the data. Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE) were obtained to calculate the items' reliability, convergent reliability, construct reliability, and internal consistency (Hair et al., 2011).

This study chooses PLS-SEM due to the limitation of the sample size. PLS-SEM uses a nonparametric bootstrapping method and can be estimated with a smaller sample size (Hair et al., 2011). Additionally, giving the study's exploratory nature, PLS-SEM was chosen to investigate the structural model for students' perceptions of knowledge-building environment and their learning engagement. This study used the SmartPLS 4 software to validate the proposed model.

3. Results

3.1 The measurement model

The measurement model was obtained by conducting a confirmatory factor analysis (CFA) through PLS-SEM analysis. As shown in Table 1, a total of six factors are in the proposed model. Five items were retained for the "Working with idea" and "Assuming agency" factor, and eight items were retained for the "Fostering community" factor. For engagement, four items were retained for the "Cognitive engagement" and "Emotional engagement" factors, and three items were retained for the "Social engagement" factor.

For items' reliability, most of the factor loadings are over 0.6. Therefore, the factor loadings of these items are acceptable. Besides, Cronbach's alpha values for each variable exceeded the minimum value of .7 (0.80 – 0.93), and the composite reliability (CR) for each variable exceeded the minimum value of .7 (0.87 – 0.94), indicating the data have excellent consistency and construct reliability. Regarding the average variance extracted (AVE) value, each variable exceeded the minimum value of 0.5 (0.62–0.75), indicating the data have a decent convergent validity.

Table 1. *The item factor loadings, CR, AVE, Cronbach's alpha values and the instrument variable descriptive statistics (n = 259)*

Variables and items	Factor Loadings	CR	AVE	alpha	Mean (S.D.)
Working with idea (ID)	---	0.93	0.70	0.89	4.37 (0.55)
ID 1	0.61				
ID 2	0.90				
ID 3	0.89				
ID 4	0.89				
ID 5	0.88				
Assuming agency (AG)	---	0.91	0.67	0.88	4.22 (0.53)
AG 1	0.84				
AG 2	0.80				
AG 3	0.82				
AG 4	0.81				
AG 5	0.82				
Fostering community (FC)	---	0.94	0.66	0.93	4.36 (0.53)

FC 1	0.85				
FC 2	0.84				
FC 3	0.87				
FC 4	0.80				
FC 5	0.67				
FC 6	0.84				
FC 7	0.81				
FC 8	0.80				
Cognitive engagement (CE)	---	0.87	0.62	0.80	4.18 (0.51)
CE 1	0.77				
CE 2	0.79				
CE 3	0.77				
CE 4	0.82				
Emotional engagement (EE)	---	0.92	0.75	0.89	3.77 (0.66)
EE 1	0.91				
EE 2	0.86				
EE 3	0.84				
EE 4	0.87				
Social engagement (SE)	---	0.90	0.75	0.83	4.28 (0.54)
SE 1	0.88				
SE 2	0.92				
SE 3	0.80				

Note: CR: composite reliability, AVE: average variance extracted

3.2 The structural model

The structural model was examined using a bootstrapping method with 5000 subsamples to establish the significance level for model examination. The results are shown in Figure 1 (only significant paths were drawn). We discuss the relationships by predictors in the following paragraphs.

3.2.1 Working with idea

The results indicate that students' perception of "Working with idea" does not predict any form of learning engagement. This might suggest that even if students perceive ideas as important in knowledge-building activities, they might not put much effort into participating. In other words, when it comes to learning engagement, expressing ideas or embracing different perspectives may be less crucial.

3.2.2 Assuming agency

The results indicate that students' perception of "Assuming agency" was a positive predictor for cognitive engagement (path coefficient = 0.31, p <.001), emotional engagement (path coefficient = 0.44, p <.001), and social engagement (path coefficient = 0.22, p <.01). In other words, students who perceive planning, reflecting and monitoring their learning process as more important in knowledge-building activities also exhibit significantly higher engagement across the three dimensions.

3.2.3 Fostering community

The results indicate that students' perception of "Fostering community" was a significantly positive factor for cognitive engagement (path coefficient = 0.34, p <.001) and social engagement (path coefficient = 0.42, p <.001). Specifically, students who perceive the importance of interacting with and engaging with others in the knowledge building process demonstrate higher cognitive and social engagement.

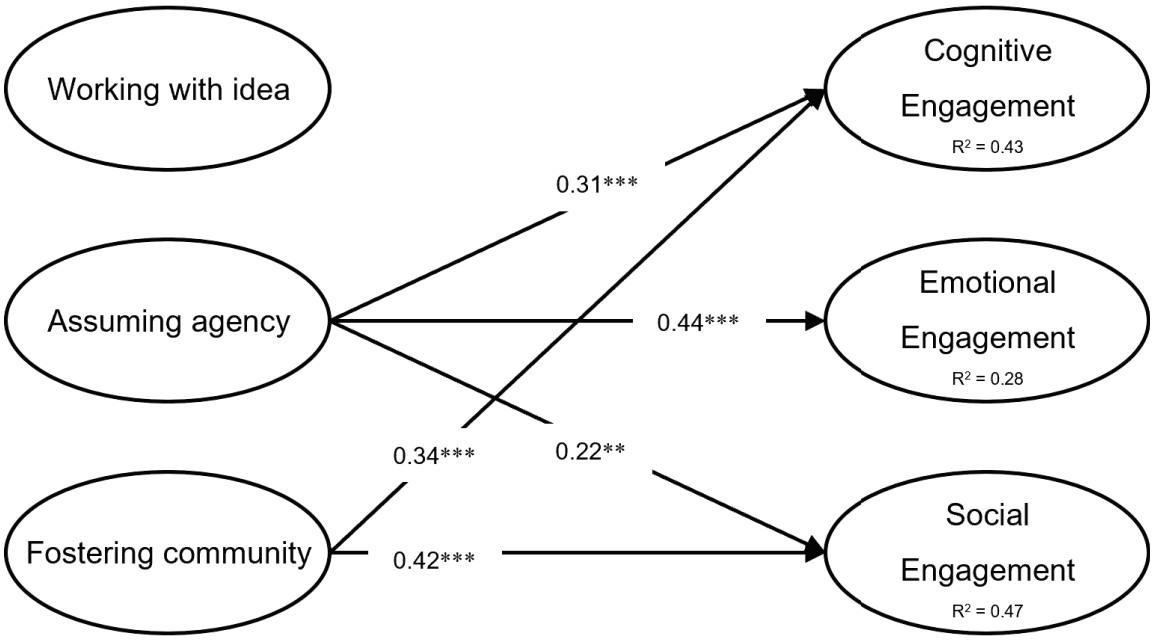

Figure 1. The structural equation model of the relationship among knowledge-building environment and learning engagement. (**p < .01, ***p < .001)

4. Discussion

This study extends the relationship between students' perceptions of the learning environment and their learning engagement into a specific context of the knowledge building environment. Specifically, we examined the relationship between three core principles crucial in knowledge building and three different types of learning engagement. Knowledge building is an approach that differs from traditional teaching methods, which encourage students to produce and develop their ideas. Therefore, working with ideas is a critical concept in a knowledge-building environment. However, the findings of this study suggest that even if students value these ideas and respect, integrating others' ideas, it does not necessarily enhance their learning engagement. This result could be related to students' unfamiliarity with operating the Knowledge Forum platform. In other discussion activities, students could immediately express their ideas verbally. However, on the Knowledge Forum platform, they need to convert their ideas into texts, which adds a step and may decrease their level of engagement.

This finding further indicates that assuming agency is crucial in the knowledge-building learning environment. In this study, students with higher assuming agency tended to show positive cognitive, emotional, and social engagement in a knowledge building environment. Moreover, it was noteworthy that assuming agency positively predicts emotional engagement. In general, students may have lower motivation to participate in these knowledge-building activities as they are requested by the teacher. However, students with high levels of assuming agency can enjoy participating in such activities and engage in them autonomously. This is essential for the sustained development of a knowledge-building community.

Last but not least, we found that the perceptions of fostering community positively predict cognitive and social engagement. It is pretty intuitive that students who embrace the concept of community tend to exhibit higher levels of social engagement. As for cognitive engagement, it is possible that students perceive the community as meaningful, and thus they are motivated to refrain from presenting hasty ideas. Consequently, they engage in knowledge-building activities with a more careful and diverse perspective.

The study contributes to a model of factors relating to students' perceptions of the knowledge-building learning environment and their learning engagement. These findings provide insights for designing or refining a knowledge-building learning environment. However, it is worth noting that this study had a relatively small sample size, and the duration of students' engagement in knowledge-building activities was limited to one semester. Future

research could expand the sample size and investigate specific students over extended periods.

Acknowledgements

This work was financially supported by the “Institute for Research Excellence in Learning Sciences” of the National Taiwan Normal University (NTNU) from The Featured Areas Research Center Program within the framework of the Higher Education Sprout Project by the Ministry of Education (MOE) in Taiwan and by the National Science and Technology Council, Taiwan, under the following grant numbers: 109-2628-H-003 -001 -MY3, 110-2511-H-003 -035, 112-2628-H-003 -003 -MY3.

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