Case Study: Postgraduate Students' Class Engagement in Various Online Learning Contexts When Taking Privacy Issues to Incorporate with Artificial Intelligence Applications

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Abstract—**Artificial Intelligence (AI) has transformed the Education sector. It made it possible for academic institutions to personalize content according to students' individual needs and improve administrative tasks such as grading assignments. This has increased efficiency in teaching and learning but has also raised relevant concerns about data privacy issues. Researchers have pointed out the potential hindrance of this concern to the further development and implementation of AI technology in Education. In this research project, the authors conducted a mixed method to investigate the above issue by assessing students' class engagement in various online learning contexts when considering AI privacy issues or not. The first part of this project presented a quantitative approach (quasi-experimental design) while this paper focused on the qualitative approach (interviews) conducted with the same group of 99 students from the postgraduate school via Zoom. Individual student interviews were conducted with randomly chosen 9 students from the two experimental groups in phase one of this research, and thematic analysis was used to analyze the relevant data based on the 4-factor theoretical framework (skills, emotion, participation, and performance) from The Online Student Engagement Scale (OSE). The study discovered that the majority of the students regarded the privacy consent taken into consideration when implementing AI applications in an online learning context had enhanced their class engagement. In addition, the findings indicated that students' emotions and participation engagements increased the most out of the four OSE factors.**

Keywords—**artificial intelligence, applied computing, computing methodologies, security and privacy, science education, student class engagement**

I. INTRODUCTION

Artificial Intelligence (AI) has been massively adopted in our lives and in particular, has shown the benefits of implementing it in higher education [1]. However, as AI technology collects a vast amount of data that it uses to enhance the effectiveness of the educational system, it raises serious debate about the negative impact of implementing this technology in education [2]. Relevant studies already suggested that security and privacy concerns would influence students' attitudes toward using similar technologies and failure to address the privacy issue can lead to trust issues and thus hinder the implementation of such technology [3]. In our previous research work of phase one of this project [4], the authors conducted a quasi-experimental design with pre-test and post-test on 99 postgraduate students from the same school and presented descriptive analysis and ANCOVA analysis on the data to assess students' class engagement in various online learning contexts when taking privacy issues to incorporate with AI applications. The first-stage project found a positive relationship between considering privacy issues when incorporating AI applications in online learning contexts and student engagement. This paper focused on the qualitative approach which was conducted with the same group of students to find out students' perceptions of the topic. The following research questions guided the present study:

- How do postgraduate students perceive their class engagement being affected after taking privacy issues into implementing AI applications in online study?
- Which Online Student Engagement Scale (OSE) factor(s) on postgraduate students' class engagement was (were) affected by taking privacy issues into implementing AI applications in the online study?

II. LITERATURE REVIEW

A. Student Class Engagement in Online Learning

The COVID-19 pandemic has restricted schools and caused university lockdowns which directly affected around 1.8 billion students [5]. In response to this, schools have moved to more technology-based online learning during the pandemic season [6] and many schools decided to conduct online classes [7]. It is thus crucial to develop and enhance the teaching and learning approaches for online learning to improve the practices.

There were works of literature highlighting the teachers' perspective on the challenges and opportunities for higher education on online learning during the COVID-19 pandemic including the challenge to create an engaging environment across emotional, cognition, and social aspects [8]. Students' perspectives are as equally important since it is one of the primary elements of effective online teaching [9], and thus this study focused on students' perspectives related to their class engagement during the COVID-19 pandemic in online learning.

To define student class engagement, Azevedo [10] had been given multidimensional conceptual and theoretical definitions and measurements from the past. Shehzadi *et al.* [7] first introduced the concept of student learning engagement which involves learners putting relevant energy, focus, and commitment into the learning process. Swan *et al.* [11] suggested social interaction with educators, and classmates and easy learning guidance are important attributes of high learning engagements. Similar to the online learning environment, researchers also found that measuring student class engagement in higher education is a good indicator of education quality. The authors of [9, 12] discussed a few types of engaging activities to measure students' engagement in online learning including concept or problem solving, discussion forum or collaboration, group projects, and assignments. Further to this, Dixson [13] introduced the Online Student Engagement (OSE) Scale from four dimensions including 1) Skill, 2) Emotion, 3) Participation, and 4) Performance Engagement. The OSE theoretical framework provided the ground for this study to explore the relationship between postgraduate students' class engagement and the privacy issue consent in AI applications in various online learning contexts.

III. METHODOLOGY

A. Research Context and Design

In our research report of phase one of this project [4], the researchers previously presented a quantitative experimental design and data analysis results with 99 postgraduate students from the same local university in Hong Kong participating. Fig. 1 shows the research procedures for this entire study, and the entire study was conducted online and through online teaching with the same teacher. The 99 participants were randomly separated into three groups, first as an experimental group one with an intervention using AI application in online learning; second as an experimental group two with an intervention using AI application in online learning plus the disclosure to address privacy issues before the learning; and last group as the control group that only use the standard online learning platform without any intervention. The individual student interviews only focused on the two experimental groups. Pre-test and post-test were conducted and based on The Online Student Engagement Scale (OSE).

To have a more in-depth investigation, this study continued the project as the second-stage investigation in a qualitative approach with the same group. Individual student interview discussions were conducted after the post-treatment test at the semester's end with nine students randomly chosen from the three groups of high, medium, and low scores in the post-test. Individual student interview discussions were conducted using a semi-structured interview format. It was conducted over a Zoom online video meeting which lasted around 15 to 20 minutes with each student, and the medium of the interview conducted was in English.
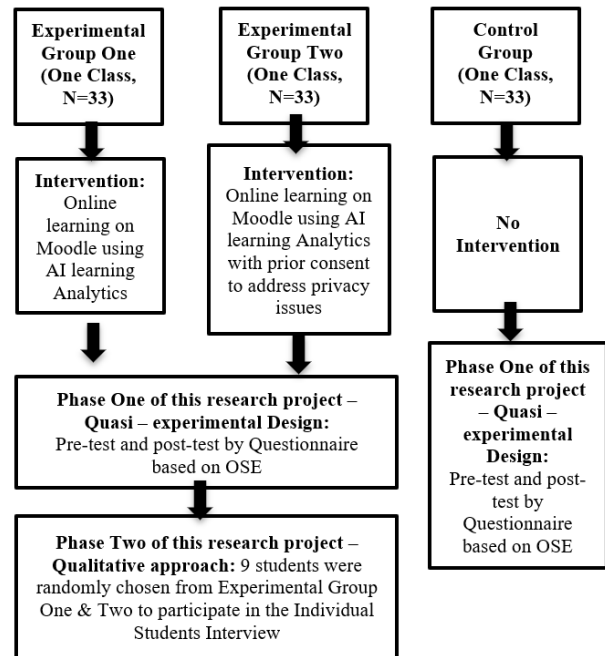

Figure 1. Research procedures for this entire study.

B. Ethical Measures

An ethical review application form was approved by the panels of the Office of Research. The instructions and consent forms were sent by the local University Program Director to their students requesting their consent and participation in this study. Students were also asked to give their permission for participating in the experiment, complete questionnaires, and conducting interviews. Throughout the study process, students were allowed to withdraw from any point without any negative effect. Information obtained was anonymized and treated as confidential.

C. Data Collection

The semi-structured individual interviews took place at the end of the 4-week experiment, with nine students randomly chosen from the two experimental groups. Participants' views on how their class engagement was affected after taking privacy issues into implementing AI applications in the postgraduate online study were collected. The interview design involved reviewing relevant pieces of literature on students' class engagement in online learning and was built based on the theoretical framework of the OSE scale. All participants clearly understood the primary purpose of this study.

Consent was given to the students to record the zoom interview sessions, and the researchers took notes to facilitate later analysis.

D. Individual Student Interviews Guided Questions

Based on The Online Student Engagement Scale (OSE) [9] theoretical framework, we designed the following questions that were asked in the individual student interviews as shown in Table I.

TABLE I.   INDIVIDUAL STUDENT INTERVIEWS GUIDED QUESTIONS

Question	Purpose / Assessing Area
Please kindly introduce yourself	Build a rapport, show respect, and address privacy and confidentiality consent
Tell me what do you think "Taking privacy issues to incorporate AI applications in your online learning" has affected your overall class engagement?	All four factors of the OSE Scale
How do you think "Taking privacy issues to incorporate AI applications in your online learning" has affected your skills engagement?	OSE factor - Skills
How do you think "Taking privacy issues to incorporate with artificial intelligence (AI) applications in the online course" has affected your emotional engagement?	OSE factor - Emotion
How do you think "Taking privacy issues to incorporate with artificial intelligence (AI) applications in the online course" has affected your participation engagement?	OSE factor - Participation
How do you think "Taking privacy issues to incorporate with artificial intelligence (AI) applications in the online course" has affected your performance engagement?	OSE factor - Performance
Is there anything else you'd like to share that we haven't covered yet?	An open question to encourage more discussions

E. Data Analysis

This study collected interview data from students' verbal responses during zoom interview sessions, then the researchers converted the data into transcripts, coded, and categorized them into interpretable data under the OSE framework via an online qualitative research software called Delve Tool. Deductive codes were derived from the theoretical framework of OSE and relevant kinds of literature related to the 4 OSE factors. Codes extracted from the data were then reviewed to identify, categorized, and rearranged based on the categories using Delve Tool. Lastly, we then put the categories into the 4 OSE factors namely Skill, Emotion, Participation, and Performance for analyzing the students' class engagement changes.

IV. FINDINGS AND DISCUSSION

A. Code of the Participants

As for the coding on the participants' demographic, "ST1" refers to the first student who joined the interview, "ST2" stands for the second student, and the range of code is from "ST1" to "ST9".

B. Code of the Transcripts

Individual student interview discussions were conducted to see how students perceive their class engagement in taking privacy issues when incorporating AI applications in postgraduate study. Interviews were conducted using a semi-structured interview format via a Zoom online video meeting, and students' answers were coded to conduct thematic analysis.

The coding of the interview answer transcripts was based on The Online Student Engagement Scale (OSE) [9] across 4 main factors including "Skills", "Emotion", "Participation", and "Performance". Each relevant keyword that appeared in the interview answers was coded and categorized into the respective OSE factors. As shown in Table II, the keywords coding categories are based on the OSE.

TABLE II.   KEYWORDS CODING CATEGORIES BASED ON THE OSE

Coding keywords	OSE Factor(s)
Regular read, review notes, pay more attention to class, efforts	Skills
Comfortable, enjoyable, motivated, desire, have fun	Emotion
Autonomy, engage, interact, help, discuss, forum	Participation
Do well in quizzes, better grades, higher score	Performance

TABLE III.   DATA CODING OF TRANSCRIPTS BASED ON THE OSE

Interview Transcripts Examples	Coding keywords	OSE Factor(s)
ST1: "When I knew the reason for collecting my data was for learning analytic purposes, I would feel motivated to pay more attention to my learning activities which further helped me pay more attention to class."	Motivated, more attention	Emotion & Skills
ST4: "I felt so much more comfortable when I was told how and why my data was collected, and I could enjoy the learning process."	Comfortable, enjoy	Emotion
ST7: "From the online learning analytic data tracking on my and my groupmates' data, we would be able to see our progress. Thus, we could adjust our time and efforts accordingly. It also gave us the chance to engage with others and see if any of the classmates needed more help."	Autonomy, time, effort, engagement, help	Participation & Skills
ST9: "Since I was more aware of my class performance being tracked and shared with the rest of the class, I tended to put more effort in-class quizzes and ended up scoring higher scores."	Efforts, awareness, higher scores	Emotion & Participation

In Table III, the interview answer transcripts were coded into keywords and further into the respective OSE factors. The authors used online computer software called Delve Tool to help manage and analyze the qualitative data collected.

C. How Do Postgraduate Students Perceive Their Class Engagement Being Affected after Taking Privacy Issues into Implementing AI Applications in Online Study?

Through the individual interviews, it was found that a great majority of students regarded the privacy consent taken into consideration when implementing AI applications in an online learning context to have higher class engagement and gave them more opportunities to conjecture alternatives.

They generally felt more comfortable engaging in the classroom after knowing why their data was collected. For example, ST1 described "When I knew the reason for collecting my data was for learning analytic purposes, I would feel motivated to pay more attention to my learning activities which further helped me pay more attention to class". Also, given the transparency of the data analytics review was shared among the class, they could review each other's progress. This helped massively to build a community amongst the students, and they could thus help each other. ST7 described as "From the online learning analytic data tracking on me and my groupmates' data, we would be able to see our progress. Thus, we could adjust our time and efforts accordingly. It also gave us the chance to engage with others and see if any of the classmates needed more help". With better engagement individually and collectively, the students demonstrated a higher level of class performance too.

This result confirmed a positive relationship between considering privacy issues and AI application implementation in online learning. This finding further supported the result from phase one of this research project that giving prior consent to students' data, helped with enhancing the trust between students and educators [4].

D. Which Online Student Engagement Scale (OSE) Factor (s) on Postgraduate Students' Class Engagement Was (Were) Affected by Taking Privacy Issues into Implementing AI Applications in Online Study?

The research also investigated the frequency of the keywords mentioned based on thematic analysis based on The Online Student Engagement Scale (OSE) [13] across 4 main factors further revealing how each factor affected students' perspectives related to their class engagement. It was found that "Participation" and "Emotion" were among the highest mentioned in Individual student interviews, followed by "Skill" and "Performance", suggesting considering privacy issues increased students' participation and emotional engagement the most. ST3 described that "I was more emotionally engaged in class

when I knew the transparency of our data usage", and ST4 stated, "I felt so much more comfortable when I was told how and why my data was collected, and I could enjoy more the learning process".

- Participation Engagement

Dixson [13] defined participation engagement as interaction, having students participate in tasks actively and proactively in teams or groups, or described it as cooperation and collaboration. Our intervention with implementing AI applications like Perusall and Wikiglass allowed students to have real-time peer-to-peer interactions, and discussions, giving prompt feedback to each other. These AI applications gathered a huge amount of data based on students' activity behaviors. By giving students prior consent to collect those data and letting them be aware of the purposes of the data, students shared a more trusted environment with their peers. They understood that data analytics were used to track their progress, so they could engage more meaningfully in online activities and offer those peers who need more help and build a supportive learning environment in their small community. ST7 agreed to the point that "From the online learning analytic data tracking on me and my groupmates' data, we would be able to see our progress. It also gave us the chance to engage with others and see if any of the classmates needed more help". ST9 described it as "Since I was more aware of my class performance being tracked and shared with the rest of the class, I tended to put more effort into in-class quizzes". This result confirms the social constructivist notions of learning that the "community" or the social presence is crucial to effective online learning [14].

- Emotional Engagement

Dixson [13] defined emotional engagement as a course that is appealing and interesting to the students and motivates them to learn and apply the knowledge to their own lives. Our research found that with privacy consent addressed, students perceived the learning process with more positive emotions, and "motivation" was one of the highest mentioned words in the student individual interview results. This is constant with the findings of [14] that e-learners who have positive emotions in the learning process would lead to a higher level of class participation engagement.

This further explains the previous studies around Self-Efficacy Theory (SDT) that individual behaviors are driven by inartistic motivations [15]. If the student feels that he/she can make decisions and choices voluntarily and by free will, it will enhance their interests, passion, and perseverance [16], and students will be more engaged [15]. Amabile [17] mentioned that higher motivation would increase students' comfort, pleasure, interest in assignments, and ability to take up more tasks. ST3 described that "I was more emotionally engaged in class when I knew the transparency of our data usage", and ST1 shared that "When I knew the reason for collecting my data was for learning analytic purposes, I would feel motivated to pay more attention to my learning activities".

V. LIMITATIONS

The whole research was conducted online due to the COVID-19 pandemic's physical restrictions. The individual student interviews were conducted via Zoom meetings, where the Internet stability and quality of the video were impacted based on the students' internet connection.

Another limitation to note is the control of the participants' demographics. The researcher selected all the participants from the same local university under the same postgraduate program to minimize any significant demographic differences. However, further studies on the participants' backgrounds such as age, gender, nationality, occupation, undergraduate major, etc. would also be helpful to reinforce the results obtained in this study.

VI. CONCLUSION

In this study, we further investigated the reasons behind students' class engagements in various online learning contexts when taking privacy issues to incorporate with AI applications. In this study, we conducted individual student interviews to find out students' perspectives on how taking privacy issues into implementing AI application changed their class engagements online. The study found a positive relationship between taking privacy issues into AI application implementation in the online learning environment and students' class engagement.

However, we also understand the limitation of data privacy transparency. In this research, participants were simply given consent to collect their data and know the data would be used for the specific course learning analytics. Yet, when using third-party AI platforms which are open-sourced, the vendors might store their data somewhere and use it for other reasons. The data ownership control and data security remain concerns that some participants might have. Thus, the study herein gives grounds for further research into the institutional and organizational level factors that facilitate addressing the privacy issue concerns associated with AI application in Education. Together with these, we can further investigate students' perspectives and their class engagement following up and how their decision-making would be over the use of their data for AI in Education.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Each author has contributed valuable parts to this work. Cheng Fang conducted the research, analyzed the data, and wrote the paper; Alex W.C. Tse provided constructive feedback on data analysis, and proofread the paper; all authors had approved the final version.

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