

Learner Engagement and Satisfaction in the Online Mathematics Course: The Experience of a Private Philippine University

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Abstract

Institutions of higher learning had to adopt a flexible learning delivery due to the threat of the global health crisis in 2020. Taking advantage of the technological affordances, many universities and colleges implemented the online learning modality. However, teachers and students found themselves overwhelmed with issues of quality assurance and outcomes of online teaching and learning. In this descriptive research study, the university students' feedback on their engagement and satisfaction in the online mathematics courses was analyzed to get a perspective on successful online learning implementation. The mediation analysis on the responses of 512 university students on a 35-item researcher-made questionnaire showed that the university students were engaged and satisfied with their online mathematics courses. The design factor had a significant effect on learner engagement and satisfaction. The human factor has a significant impact on learner engagement but no significant effect on learner satisfaction. The structural equation model further revealed that learner engagement fully mediates the relationship between human factor and learner satisfaction while partially mediating the relationship between design and learner satisfaction. The results strongly assert the need for efficient and effective instructor knowledge and facilitation, more significant class interaction, and engaging use of technology in online mathematics courses to increase learner satisfaction.

Keywords: education, learner's engagement and satisfaction, online mathematics courses, mediation analysis, structural equation modeling, Philippines

1. Introduction

Technology has significantly redefined instructional delivery and consequently, supports the ubiquitous use of virtual or online teaching and learning (Lockee, 2021; Madhushree et al., 2020; Thomas, 2020). With the threat of global health pandemic and natural calamities, online teaching and learning proved to be not just a temporary but a long-term solution to the pressing challenges (Adedoyin & Soykan; Li & Lalani, 2020).

Several studies confirm the positive impact of online teaching and learning which includes cost and time-effectiveness, improved participation and engagement, better study habits, and academic performance (Hussein & Badawi, 2020; Paulsen & McCormick, 2020; Tareen et al., 2020). However, studies also show that the online learning modality caused boredom, anxiety, and dissatisfaction (Irawan, et al., 2020; Syauqi et al., 2020). Some students preferred face-to-face learning over online learning (Aguilera-Hermida, 2020; Garris & Fleck, 2020; Rahman et al., 2020) due to workload and technology problems (Hussein & Badawi, 2020; Adnan & Anwar, 2020). Due to these opposing perceptions about online learning, teachers and educators must investigate the different aspects of online learning; more specifically, in the aspect of learner engagement and satisfaction with the online mathematics courses. As a key in assessing online courses, learner engagement and satisfaction should be taken into consideration by educators and teachers (Alqurashi, 2019; Nambiar, 2020).

The online teaching of mathematics is a different experience than when conducted in a regular face-to-face class. This is even more challenging for the learners who struggle in mathematics, both offline and online (Francis et al., 2019; Yang, 2017). Due to these issues and concerns, this study has been conducted to analyze university students'

feedback on their engagement and satisfaction in an online mathematics course. In particular, the study aims to:

1. determine the learners' level of engagement to the online mathematics courses;
2. assess the learners' level of satisfaction with the online mathematics courses;
3. identify the human and design factors that are associated with the learners' engagement and satisfaction; and
4. ascertain if the relationship between the human and design factors and the learner satisfaction is mediated by their engagement.

1.1 Conceptual Framework and Hypotheses Development

Recent studies have shown that the human factor, which includes instructor knowledge, facilitation, and feedback mechanism, and the design factor, which includes systems design, course structure, alignment of activities, and lesson presentation, affect learner satisfaction (Gopal et al., 2021; Baber, 2020; Hew et al., 2020; Liu & Pu, 2020, Chen et al., 2018). Learner engagement, enhanced by learner-instructor and learner-technology interactions, also served as an important benchmark and indicator of the quality of students experience and significantly contributes to the increased learner satisfaction with online courses (Adnan & Anwar, 2020; Alquarashi, 2019; Halverson & Graham, 2019; Landrum et al., 2020; Purarjomandlangrudi & Chen, 2020; Park & Kim, 2020; Redmonf et al. 2018).

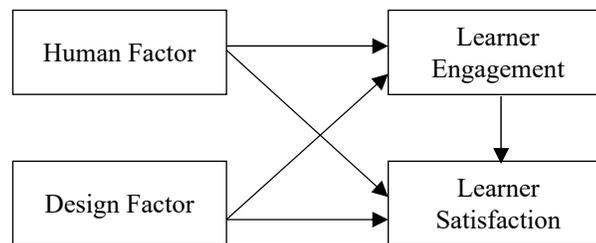


Figure 1. Hypothesized Model

In this paper, the following hypotheses based on the premises stated above were tested.

- H1a: Human factor affects learner engagement in online mathematics courses.
 H1b: Human factor affects learner satisfaction with the online mathematics courses.
 H2a: Design factor affects learner engagement in online mathematics courses.
 H2b: Design factor affects learner satisfaction with the online mathematics courses.
 H3: Learner engagement affects their satisfaction with online mathematics courses.
 H4a: The relationship between the human and the learner satisfaction is mediated by their engagement
 H4b: The relationship between the design factors and the learner satisfaction is mediated by their engagement

2. Method

2.1 Research Design and Method

The study used the descriptive research design employing the questionnaire method. A random sample of 512 university students, who were enrolled in any mathematics course in the current academic year, were asked to rate a 35-item researcher-made questionnaire with a scale ranging from 1 (strongly disagree/not fully engaged or satisfied) to 4 (strongly agree/fully engaged or satisfied). The four-part questionnaire consisting of items that asked for personal information, the level of engagement and satisfaction with online mathematics courses, and the human and design factors, was sent electronically via email and the learning management system (LMS).

2.2 Participant Characteristics and Sampling Procedures

The study participants were composed of university students who were mostly female (N = 322, 62.90%) than male (N = 190, 37.10%) with an average age of 19.24 years old (SD = 1.33 years). Majority were taking accountancy-business-related programs (N = 169, 33.00%) or engineering-related programs (N = 134, 26.20%) and were enrolled in 1-2 mathematics courses in the current academic year. The participants were recruited using

convenience sampling via their student emails and LMS account.

2.3 Research Ethics

Following the university research ethics standards, the background and purposes of the study, benefits/risk of participation, and privacy and confidentiality issues were discussed with the university students involved in the study. There were no incentives given for participation nor negative effects to student's academic standing for non-participation. Participation of the university students were voluntary. All collected data were de-identified of personal information (name and email address) before processing, handling, analysis, and storage.

3. Results

3.1 Recruitment

Data from the university students were collected in the last two months of the academic year. Electronic survey was sent only to students who are enrolled in any mathematics courses. Data were screened for any incomplete or inappropriate responses and there were no such cases being recorded.

3.2 Statistics and Data Analysis

Analysis of data and the reporting of the results of those analyses are fundamental aspects of the conduct of research. The data were analyzed using mediation analysis using AMOS (IBM Version 22, 2013). The structural analysis followed the following steps: model specification, identification, parameter estimation, model evaluation, and model modification (Fan et al., 2016, Kline, 2016). Mean and standard deviation were also employed in the analysis.

3.3 Level of Engagement and Satisfaction with the Online Mathematics Courses

Table 1 shows that the university students were engaged in the online mathematics courses ($M = 3.06$, $SD = 0.53$). The engagement in the online mathematics courses was increased because of the effective learner-instructor ($M = 3.07$, $SD = 0.55$) and learner-technology ($M = 3.06$, $SD = 0.56$) interactions.

Table 1. University Students' Level of Engagement in the Online Mathematics Course

Constructs	Mean	SD	Remarks
Learner-Instructor Interaction	3.07	0.55	Engaged
Learner-Technology Interaction	3.06	0.56	Engaged
Overall	3.06	0.53	Engaged

In general, as shown in Table 2, the university students were satisfied with the online mathematics courses ($M=3.16$, $SD = 0.53$). In particular, the students were satisfied with the online assessment ($M = 3.19$, $SD = 0.55$) and their online learning experience ($M = 3.16$, $SD = 0.55$). The students were also satisfied with how they perform in the online mathematics courses; thus, showing an increased level of self-efficacy ($M = 3.15$, $SD = 0.61$). One of the critical elements affecting the quality of online education is the need to ensure that learners are effectively and adequately engaged in the educational process (Sinclair et al., 2017).

Table 2. University Students' Level of Satisfaction with Online Mathematics Courses

Constructs	Mean	SD	Remarks
Online Learning Experience	3.16	0.55	Satisfied
Self-Efficacy	3.15	0.61	Satisfied
Assessment	3.19	0.55	Satisfied
Overall	3.16	0.53	Satisfied

On the other hand, as presented in Table 3, the university students considers both human ($M = 3.34$, $SD = 0.54$) and design ($M = 3.34$, $SD = 0.62$) factors important in increasing their engagement and satisfaction with the online mathematics courses.

Table 3. Factors Associated with Learner Engagement & Satisfaction with Online Mathematics Courses

Constructs	Mean	SD	Remarks
Human Factors	3.34	0.54	Agree
Design Factors	3.34	0.62	Agree

3.4 Reliability, Validity, & Model Fit Indices

The questionnaire used for gauging the constructs was found to have acceptable validity ($0.41 \leq AVE \leq 0.70$) and remarkably high reliability ($0.86 \leq \text{Cronbach's Alpha} \leq 0.93$, $0.76 \leq CR \leq 0.92$). This suggests that the questionnaire provided good measures for determining the overall learner engagement and satisfaction with online mathematics courses. This is also indicative that the constructs can be used to assess the factors that affects the successful implementation of online mathematics courses (Fallon et al., 2013).

Table 4. Measurement Model for the Constructs

Constructs	Alpha	AVE	CR
Learner-Instructor Interaction	0.86	0.41	0.76
Learner-Technology Interaction	0.88	0.65	0.90
Online Learning Experience	0.91	0.65	0.90
Self-Efficacy	0.93	0.66	0.91
Assessment	0.91	0.58	0.87
Human Factors	0.91	0.70	0.92
Design Factors	0.92	0.68	0.91

Note: alpha = Cronbach's alpha,

AVE = average variance extracted, CR = composite reliability

It can be gleaned from Table 5, that the hypothesized (initial) model is not a good fit ($X^2/df = 3.22$, $RMSEA = 0.07$, $CFI = 0.92$, $GFI = 0.85$, $TLI = 0.91$). After the modification, four of the five fit indices ($X^2/df = 2.24$, $RMSEA = 0.05$, $CFI = 0.95$, $GFI = 0.87$, $TLI = 0.95$) showed an acceptable model fit.

Table 5. Model Fit Indices

Indices	Rule of Thumb*	Initial	Final
X^2/df	$0 \leq X^2/df \leq 3$	3.216	2.244
RMSEA	$0 \leq RMSEA \leq 0.10$	0.066	0.049
CFI	$0.95 \leq CFI \leq 1$	0.918	0.954
GFI	$0.90 \leq GFI \leq 1$	0.846	0.871
TLI	$0.90 \leq TLI \leq 1$	0.911	0.950

Source: *Kline (2016), Fan (2016)

3.5 Model Quality Assessment

In the hypothesized model, the human factor had no direct effect on learner satisfaction in the online mathematics course ($r = -0.01$, $SE = 0.03$, $C.R. = -0.18$, $p = 0.86$), as shown in Table 6. The relation between the two constructs was deleted in the final model to improve the overall model fit.

Table 6. Model Quality Assessment (Initial Model)

Hypothesis	r	SE	C.R.	p	Remarks
H1a	0.32	0.04	7.95	<0.001	Significant
H1b	-0.01	0.03	-0.18	0.86	Not Significant
H2a	0.39	0.04	9.04	<0.001	Significant
H2b	0.33	0.04	0.19	<0.001	Significant
H3	0.93	0.09	10.17	<0.001	Significant

Note: r = unstandardized regression weights; SE = standard error;

C.R. = critical ratio of regression weights

The final model indicated that human factor affects the learner engagement in the online mathematics courses ($r = 0.25$, $SE = 0.08$, $C.R. = 3.26$, $p = 0.001$). Furthermore, the final model revealed that the design factor affects both the learner engagement ($r = 0.43$, $SE = 0.08$, $C.R. = 5.36$, $p < 0.001$) and satisfaction ($r = 0.34$, $SE = 0.04$, $C.R. = 7.64$, $p < 0.001$) with the online mathematics courses. Finally, a significant positive association between learner engagement and satisfaction with the online mathematics courses ($r = 0.91$, $SE = 0.08$, $C.R. = 11.14$, $p < 0.001$) had been established.

Table 7. Model Quality Assessment (Final Model)

Hypothesis	r	SE	C.R.	p	Remarks
H1a	0.25	0.08	3.26	0.001	Significant
H2a	0.43	0.08	5.36	<0.001	Significant
H2b	0.34	0.04	7.64	<0.001	Significant
H3	0.91	0.08	11.14	<0.001	Significant

Note: r = unstandardized regression weights; SE = standard error; C.R. = critical ratio of regression weight

As shown in Figure 2, All path coefficients were statistically significant ($p < 0.05$) that indicates support o the relationship between constructs. The structural model explained 95% of the variance in learner satisfaction. Furthermore, the learner engagement is fully mediating the relationship between human factor and learner satisfaction (H4a) and partially mediating the relationship between design factor and learner satisfaction (H4b). Note that the human factor has no direct effect on learner satisfaction with the online mathematics courses while the design factor has an indirect effect on learner satisfaction.

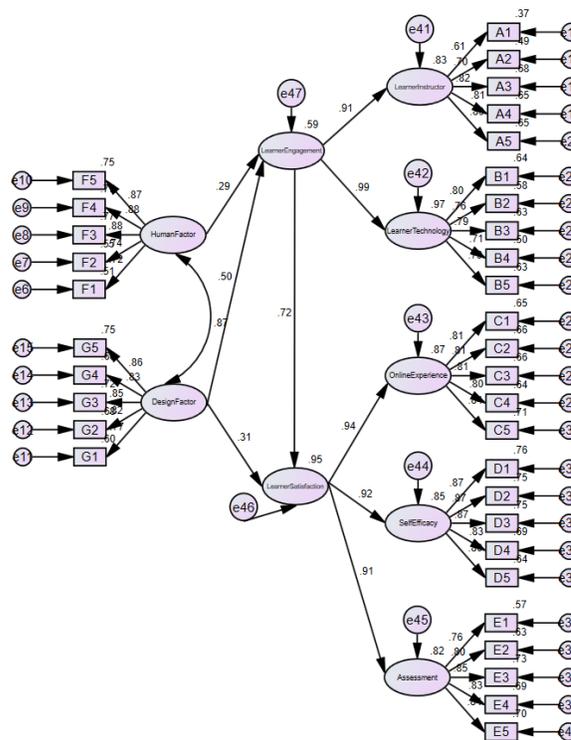


Figure 2. The Final Structural Model with Standard Estimates

4. Discussion

The study provides insights on how learner satisfaction with mathematics courses in the online environment can be

increased substantially through the effective use of human and design factors. Effective learner-instructor and learner-technology interaction can likewise increase student satisfaction; thus, the implementation of an engaging online mathematics course for university students is highly recommended. These can be further achieved with appropriate course design, appropriate course assessment, interactive tasks, integrated assessment guides, and constructive feedback mechanisms. The variety of meaningful online experiences with appropriate technologies can also improve students' self-efficacy and performance in an online mathematics course.

The results were suggestive that the consistent learner-instructor interaction and the variety of instructional materials provided to students employing appropriate technologies foster effective learner engagement (Alquarashi, 2019; Lane et al., 2021; Park & Kim, 2020). One of the critical elements affecting the quality of online education is the need to ensure that learners are effectively and adequately engaged in the educational process (Sinclair et al., 2017). The consistency and persistence in learning activities lead to better learner engagement and successful performance (Greller et al., 2017). As key indicators of successful online learning, psychological motivation, peer collaboration, cognitive problem solving, interaction with tutors and peers can help improve student engagement and ultimately assist instructors in effective curriculum design (Lee et al., 2019). In addition, good online course design can bring higher satisfaction level of satisfaction as it supports the relationship between students and instructors and complements the overall learning experiences in the online classes (Topal, 2016; Yang, 2017). course design elements, such as engaging learning activities, interactive engagement strategies, and outcomes-based assessment design are to be considered important elements in the implementation of the online mathematics courses (Chen et al., 2018). Likewise, the appropriate instructional methods and strategies and understanding of students' individual needs could potentially improve student engagement (Halverson & Graham, 2019; Rios et al., 2018).

For the improvement of the learner interaction and satisfaction model, other variables such as students' readiness and preparedness, technological and technical skills, and attitudes may be added to the model.

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