

The Effect of Technology-Integrated Curriculum Dimensions on Student Engagement among Higher Education Students in Shandong, China

Song Juanjuan, Mohd Syaubari Bin Othman

Sultan Idris Education University

Corresponding Author Email: syaubari@fpm.upsi.edu.my

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Abstract

Digital technology is increasingly being incorporated into higher education, creating new ways to teach and interact with students. However, technology alone does not necessarily enhance student engagement. This study investigates the effects of four Technology-Integrated Curriculum dimensions on Student Engagement. A quantitative research design was adopted. A survey questionnaire was completed by 388 higher education students from Shandong Province in China. The four dimensions studied were Balance of Curriculum, Technology, and Pedagogy; Content Knowledge and Supports Meaningful Learning; Enables Differentiated Instruction; and Encourages Innovation. Data analysis using descriptive and inferential statistical techniques. The results showed significant positive effects of all four study dimensions on Student Engagement ($p < .001$). Enables Differentiated Instruction demonstrated the strongest effect ($\beta = .430$, $t = 12.358$), followed by Balance of Curriculum, Technology, and Pedagogy ($\beta = .408$, $t = 13.934$), Encourages Innovation ($\beta = .406$, $t = 12.237$), and Content Knowledge and Supports Meaningful Learning ($\beta = .364$, $t = 11.326$). All four alternative hypotheses (H_{a1} – H_{a4}) were supported. The findings reveal the significance of the integration of technology with appropriate pedagogy and curriculum rather than regarding technology as an independent educational medium. This study, therefore, provides empirical evidence of how technology-integrated curriculum influences Student Engagement within the context of Chinese higher education. More importantly, higher education institutions should focus more on strengthening technology-supported differentiated instruction and fostering meaningful learning, pedagogical alignment, and innovation in the Technology-Integrated Curriculum for future studies. Future studies should examine the relationships between various entities with diverse configurations.

Keywords: Technology-Integrated Curriculum, Student Engagement, Meaningful Learning, Higher Education, Shandong, China

Introduction

Technology-Integrated Curriculum in Higher education is more flexible, interactive and more student-centered to emphasis Student Engagement. This transition requires an appropriate balance of technology, pedagogy and content (Mishra & Koehler, 2006). Thus, the concept of Student Engagement here refers to students' behavioral, emotional and cognitive

participation in learning processes (Fredricks et al., 2004). By combining digital technologies with curricula and pedagogical approaches, technology-integrated curricula have the potential to create better learning opportunities and facilitate more effective learning (Bedenlier et al., 2020; Huang et al., 2024). The impact of technology use in higher education on Student Engagement has also been investigated in other countries including China (Teng & Wang, 2021).

However, more empirical evidence is required to verify the extent to which these dimensions can positively affect the Student Engagement of higher education students. The aim of this study is to examine the impact of four dimensions of a Technology-Integrated Curriculum, namely Balance of Curriculum, Technology, and Pedagogy; Content Knowledge and Supports Meaningful Learning; Enables Differentiated Instruction; and Encourages Innovation on Student Engagement of higher education students in Shandong, China.

Alternative Hypotheses

Ha1: Balance of Curriculum, Technology, and Pedagogy has a significant positive effect on student engagement.

Ha2: Content Knowledge and Supports Meaningful Learning have a significant positive effect on student engagement.

Ha3: Enables Differentiated Instruction has a significant positive effect on student engagement.

Ha4: Encourages Innovation has a significant positive effect on student engagement.

Literature Review

The importance of technology-integrated curricula in higher education is increasingly recognized. While this means more than just including tools and technologies in the curriculum, it also involves aspects of teaching and learning such as meaningful learning, differentiation, and innovation. Bedenlier et al. (2020) therefore emphasized the potential of educational technology to support student engagement in higher education. In addition to this, however, learning with technology can be designed to be more meaningful and more authentic, thus fostering higher levels of student participation in learning (Chang et al., 2024). Different forms of support can be provided by teachers by means of technology, such as by using personalized and adaptive technologies, for example, in order to support students with different learning needs (Du Plooy et al., 2024). Digital technologies as well as corresponding forms of innovation can also be used to create more interactive and flexible learning environments that are supported by adequate instructional design (Choi-Lundberg et al., 2023).

This study is underpinned by the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) and Student Engagement Theory (Fredricks et al., 2004). Technology-Integrated Curriculum, developed from these theoretical frameworks, consists of four distinct but related dimensions of the curriculum: i) Balance of Curriculum, Technology, and Pedagogy that refers to the alignment between curriculum, technology and pedagogy; ii) Content Knowledge and Supports Meaningful Learning that refers to the quality of teachers' content knowledge and how they use what they know to support students' meaningful learning; iii) Enables Differentiated Instruction that refers to the quality to which teachers are able to support individual differences in learning; and iv) Encourages Innovation that refers

to the extent to which teachers create and implement new and interesting instructional strategies. The study integrates these four curricular dimensions into a unified model to explore the combined and independent effects of four dimensions of Technology-Integrated Curriculum on the Academic Performance of university students from Shandong Province, China. Moreover, there are also positive and significant relationships between those four dimensions of Technology-Integrated Curriculum and Student Engagement.

Hypothesis Development 1. Since the study is designed to examine the influence of Balance of Curriculum, Technology, and Pedagogy on Student Engagement, hypotheses are described and conceptualized regarding Balance of Curriculum, Technology, and Pedagogy. The Balance of Curriculum, Technology, and Pedagogy refer to the effective integration of technology into teaching and learning with a balance of curriculum and pedagogy. In order to design a curriculum for teaching and learning, teachers need to plan a curriculum that is aligned with technology to be used for teaching and learning. The study thus explores the relationship between teachers' ability to make connections among teaching, learning, and technology, that is, TPACK (Backfisch et al., 2024), and Student Engagement. Hence, the following alternative hypothesis can be proposed: Ha1: Balance of Curriculum, Technology, and Pedagogy have a significant positive effect on Student Engagement.

Hypothesis Development 2 propose that Content Knowledge and Supports Meaningful Learning have a significant positive effect on Student Engagement. A positive relationship exists between Content Knowledge and Supports Meaningful Learning. Students learn about disciplinary content and go through meaningful learning experiences through technology integration in classroom settings. They apply what they learn and use technology in meaningful ways in learning environments. The connection between technological, pedagogical and content knowledge by TPACK (Mishra & Koehler, 2006) and constructive alignment between learning outcomes, teaching activities and learning processes by Biggs (1996) are two theoretical frameworks that are used in this study. As previously mentioned, studies have examined student engagement through technology supported learning such as studies that focused on authentic project-based learning (Chang et al., 2024) and studies that focused on interactive, constructive and active technology supported learning (Gao et al., 2024). Hence, Ha2: Content Knowledge and Supports Meaningful Learning have a significant positive effect on Student Engagement.

Hypothesis Development 3: Enables Differentiated Instruction. As technology is increasingly used to support students with different learning needs, students are able to learn in environments that are suited to their abilities, needs, progress and preferences. In this sense, the Technology-Integrated Curriculum can have a significantly positive influence on Student Engagement. Du Plooy et al. (2024) described the relevance of personalized adaptive learning for student engagement and academic performance. Langelaan et al. (2024) elaborated the key elements of Differentiated Instruction. Contrino et al. (2024) investigated Adaptive Learning as a form of personalized learning in educational settings and how learning experiences can be designed and supported by technology for individual students. Therefore, Ha3: Enables Differentiated Instruction has a significantly positive effect on Student Engagement.

The dimension Technology-integrated curricula can foster innovative teaching and learning with a variety of resources, technologies, approaches and designs. Research on the use of digital innovations in technology-enhanced learning is provided by Choi-Lundberg et al. (2023). Crompton and Burke (2023) provide an overview of the potential of Artificial Intelligence in higher education. Gao et al. (2024) exemplify how generative AI can be used in interactive and constructive learning situations. Innovative teaching, however, has to be carried out in a pedagogically adequate way and thus can lead to an increased student involvement. Hence, Ha4: Encourages Innovation has a significant positive effect on Student Engagement.

The aforementioned studies in educational technology and student engagement were mostly conducted and reported by research studies of individual aspects of the use of technology in teaching and learning such as teachers' TPACK, teachers' and teachers' educational use of digital pedagogy, students' learning with adaptive technologies and the use of technological innovations. Little research has been conducted and reported on all four dimensions of Technology-Integrated Curriculum model within one empirical study. Furthermore, most of the previous studies on the relationships among the same variables of the current study were conducted with students at lower levels of education and in different geographical locations of the world. Thus, this study explores the relationships among four dimensions of Technology-Integrated Curriculum model and student engagement among higher education students in Shandong, China.

While much has been written on the topic of technology, in the context of education and student engagement, studies typically investigate one aspect of technology use, i.e. learning with technology, teachers' technological, pedagogical and procedural knowledge (TPACK), digital pedagogy, adaptive learning, and/or technological innovation, etc. There are very few studies that have investigated all four dimensions of a Technology-Integrated Curriculum within one theoretical framework. In addition, most of the previous studies were conducted with students from lower levels of education in different parts of the world. To this end, the current study investigated the four dimensions of Technology-Integrated Curriculum within one study model, aiming to determine the relative weight that each of the four dimensions has in predicting Student Engagement of higher education students in Shandong, China.

Methodology

The study is of a quantitative nature. By using study variables which can be measured in numbers, the four alternative hypotheses (Ha1–Ha4) can be tested for the positive effect that the four dimensions of the Technology-Integrated Curriculum have on the variable Student Engagement. A structured survey was administered to 388 students from higher education levels and schools in the Chinese province of Shandong. The survey contained a questionnaire which measured the four Technology-Integrated Curriculum dimensions as well as the variable Student Engagement. The means and standard deviations of the respondents as well as of the study variables are analyzed by means of path coefficients (β), t-values and p-values. The four alternative hypotheses Ha1–Ha4 are supported by significant positive effects of the respective paths at $p < .05$.

Findings and Discussion

This section presents results of the study's hypothesis testing on the four dimensions of Technology-Integrated Curriculum and their effects on Student Engagement. The section provides information regarding means and standard deviations of the variables studied, and also reports path coefficients (β), t-statistics and p-values in the model.

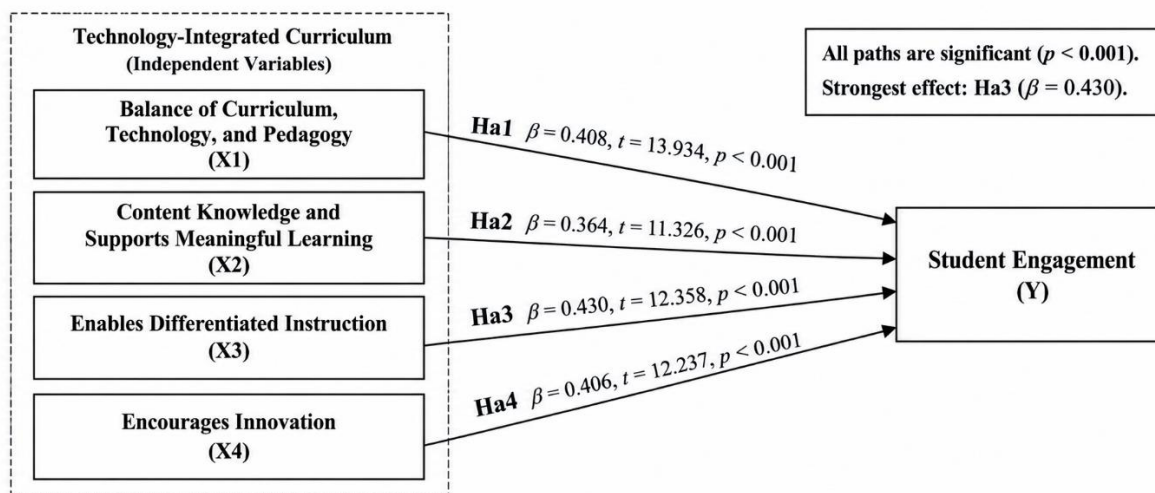


Figure 1

Figure 1 presents the impact of four different Technology-Integrated Curriculum dimensions on Student Engagement, and presents results for four alternative hypotheses (Ha1–Ha4). All four hypotheses were supported, as all four dimensions had a positive effect on Student Engagement, significant effect ($p < .001$). Results showed that the enabling of Enables Differentiated Instruction had the greatest impact, followed by the impact of the dimension Balance of Curriculum, Technology, and Pedagogy, Encourages Innovation, and then the impact of the two dimensions Content Knowledge and Supports Meaningful Learning. The findings of this research demonstrated that all four Technology-Integrated Curriculum dimensions had a positive and significant effect on Student Engagement.

Table 1

Hypothesis Testing Results for the Effects of Technology-Integrated Curriculum Dimensions on Student Engagement

Hypothesis	Path	Original Sample (β)	Sample Mean	SD	t Statistics	p Values	Decision
Ha1	Balance of Curriculum, Technology, and Pedagogy → Student Engagement	.408	.409	.029	13.934	< .001	Supported
Ha2	Content Knowledge and Supports Meaningful Learning → Student Engagement	.364	.363	.032	11.326	< .001	Supported
Ha3	Enables Differentiated Instruction → Student Engagement	.430	.430	.032	12.358	< .001	Supported
Ha4	Encourages Innovation → Student Engagement	.406	.406	.032	12.237	< .001	Supported

	Student Engagement Enables Differentiated Instruction	→	.430	.430	.035	12.358	< .001	Supported
Ha3	Student Engagement Encourages Innovation	→	.406	.406	.033	12.237	< .001	Supported
Ha4	Student Engagement							

Table 1 indicates that all four dimensions contribute positively and significantly to Student Engagement; therefore, all four alternative hypotheses (Ha1–Ha4) were supported.

Description and Discussion of Hypothesis 1

The results revealed that the variable Balance of Curriculum, Technology, and Pedagogy had a significant positive effect on the variable Student Engagement ($\beta = .408$, $t = 13.934$, $p < .001$). According to the results, students are more engaged in learning when technological tools are used in accordance with the content of the curriculum and corresponding pedagogical strategies. The results of the present study also concur with those of Backfisch et al. (2024) who examined the integration of technological and pedagogical knowledge. The results of the current study also align with those of Dinçer and Çengel-Schoville (2022) regarding effective use of technology in learning and the importance of a curriculum. In line with Bedenlier et al. (2020), findings of the current study illustrate how the use of educational technology in higher education settings promotes student engagement. In summary, findings of this study were in line with TPACK framework (Mishra & Koehler, 2006). Hence, in higher education settings in Shandong Province, technology needs to be used in ways that are pedagogically relevant to the learning objectives as stated in the curriculum, as using more technology does not necessarily enhance teaching and learning. Thus, Ha1 is supported.

Description and Discussion of Hypothesis 2

The effects of two independent variables, Content Knowledge and Supports Meaningful Learning, on the dependent variable Student Engagement were significant and positive ($\beta = .364$, $t = 11.326$, $p < .001$). The positive coefficient for support for content and meaningful learning indicates that there is a positive relationship between these two variables and student engagement. As previously mentioned, this is consistent with findings of other studies (Chang et al. 2024; Gao et al. 2024; Ní Shé et al. 2023). These findings are in line with the principles of TPACK and Constructive Alignment and thereby reveal connections between content and pedagogy on the one hand and technology, learning outcomes and learning activities on the other hand. Thus, universities can offer students a variety of digital learning resources in order to foster in-depth understanding of subject matter and to create meaningful learning situations for students. Thus, Ha2 is supported.

Description and Discussion of Hypothesis 3

Results for Enables Differentiated Instruction had a significant positive effect on Student Engagement ($\beta = .430$, $t = 12.358$, $p < .001$). This effect was even larger than the effect of Enables Personalized Learning, and therefore we accept the alternative hypothesis Ha3. The results especially show that technology-supported learning environments, that enable

different types of students (different in ability, learning style, progress etc.) to learn in different ways, are very effective in stimulating student engagement. The results of this study are in line with Du Plooy et al. (2024) who described in a review how personalized adaptive learning is related to academic performance and student engagement. Also, Langelaan et al. (2024) described the key elements of enabling differentiated instruction. Contrino et al. (2024) studied adaptive learning in order to provide more personalized learning. Our results align with the theoretical underpinnings of the TPACK metacognitive framework and Student Engagement Theory. In line with these theories adaptive technology-supported pedagogy can support different types of students to achieve their learning goals and therefore is highly engaging for them. Thus, universities in Shandong would benefit from adopting adaptive and differentiated technology-supported learning environments and designs. Thus, Ha3 is supported.

Description and Discussion of Hypothesis 4

There was a significant positive effect of Encourages Innovation on Student Engagement ($\beta = .406$, $t = 12.237$, $p < .001$). The positive sign of the coefficient for this variable indicates that as the level of Encourages Innovation increases, Student Engagement also increases. Thus, Ha4 is supported. Innovation in higher education can be encouraged by using emerging digital tools, interactive teaching and learning methods and designs for teaching and learning. While there are studies on technology-enhanced learning from a digital innovation perspective (Choi-Lundberg et al., 2023), an interactive and constructive learning perspective using generative AI (Gao et al., 2024), and from various perspectives including students' performance, satisfaction and motivation (Liang et al., 2024), innovation using technology for teaching and learning is most effective when technology is used in ways that are compatible with pedagogical approaches and are supported by both TPACK and Student Engagement Theory. Thus, higher education institutions in Shandong should encourage the use of innovative technology-supported teaching and learning designs that are consistent with the curriculum objectives and the needs of students for effective learning. Thus, Ha4 is supported.

Conclusion

All four dimensions of the Technology-Integrated Curriculum significantly and positively affect Student Engagement. The dimension of Enables Differentiated Instruction has the largest positive effect on Student Engagement, followed by the dimension of Balance of Curriculum, Technology and Pedagogy, Encourages Innovation, and finally the dimension of Content Knowledge and Supports Meaningful Learning. All four alternative hypotheses (Ha1–Ha4) were also supported. Therefore, in order to increase Student Engagement in higher education, it is necessary to implement technology-integrated teaching approaches that combine appropriate pedagogy with meaningful content, enable students to engage in learning in a differentiated manner, and encourage students to be innovative in their approach to learning.

The findings of this study can contribute to higher education teaching and learning practices by providing empirical evidence for the application of the TPACK framework, as well as for the Student Engagement Theory. Moreover, findings from this study can inform higher education teachers in selecting technology-integrated approaches for teaching and learning that enable technology-supported Differentiated Instruction, and utilize digital technologies in a way that

aligns with the learning objectives of the curriculum and supports meaningful learning and innovative pedagogy.

There are several limitations for this study. The participants are mainly the higher education students from a few higher education institutions in Shandong Province, China. Therefore, the results cannot be generalized to other contexts. The cross-sectional survey with self-reported data also cannot guarantee the causal relationships between variables. There might also be some response bias.

Future studies can involve students from other higher education institutions in different provinces and countries. These studies can adopt a longitudinal study design or a mixed-methods study design. The mediating or moderating effects of variables including students' motivation to learn, students' digital literacy, teachers' instructional practices, and students' self-efficacy can also be examined in future studies.

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