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Factors Influencing Student Loyalty in Online Physical and Health Education: Engagement and Satisfaction Effects

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Abstract: While online learning offers increased accessibility and flexibility, it presents unique challenges in traditionally hands-on subjects like physical education. Understanding the factors that influence student loyalty in online physical and health promotion education has become crucial for educational institutions seeking to maintain student engagement and retention in virtual learning environments. A quantitative research design employing Structural Equation Modeling (SEM) was conducted with 501 full-time undergraduate students from Heilongjiang International Studies University enrolled in online physical and health promotion courses. Data were collected using a validated 32-item Likert scale questionnaire measuring all six constructs. The study utilized purposive sampling and applied rigorous reliability and validity testing procedures, including exploratory and confirmatory factor analyses. The SEM analysis revealed significant positive relationships between Student Engagement and multiple factors: Student Technological Readiness ($\beta = 1.141$, $p = 0.003$), Self-regulated Efficacy ($\beta = 1.897$, $p < .001$), and Student Autonomy ($\beta = 2.837$, $p < .001$). Both Student Engagement ($\beta = 0.991$, $p < .001$) and Student Satisfaction ($\beta = 1.003$, $p < .001$) demonstrated strong direct effects on Student Loyalty. findings highlight the critical importance of fostering student engagement and satisfaction to enhance loyalty in online physical and health promotion education. The strongest relationship observed was between engagement and student autonomy, emphasizing the role of engagement in developing independent learning capabilities. These results provide valuable insights for educators and administrators to design more effective online physical education programs that prioritize interactive learning experiences and student-centered approaches to enhance retention and loyalty.

Keywords: Online physical education, student loyalty, student engagement, technological readiness, self-regulated efficacy

1. Introduction

The basis for this study is the dynamic nature of the contemporary educational environment, which is characterized by a significant trend towards virtual learning environments. The use of technology in the classroom has had a significant impact on the way students learn material, and Internet education has become increasingly common in academic settings (Azzi et al., 2022). Nonetheless, with this paradigm shift comes a need for greater clarity in understanding and enhancing student satisfaction, engagement, and retention in online physical education and health promotion education. As technology develops, outdated educational models are broken and opportunities for innovative teaching strategies are provided. Virtual classrooms and digital resources have become an important part of the learning environment. The COVID-19 pandemic has increased the popularity of online learning, which is now a necessity for educational continuity (Centeio et al., 2021). As educational institutions strive to adapt to the digital age, it is critical to pay attention to trends in online physical education and health promotion and its impact on the student experience.

The transition to online learning is not without its difficulties. While the virtual world offers students unprecedented learning opportunities, it also presents limitations that prevent people from participating and enjoying it. It is essential for students to understand how to use and respond to online delivery in physical education and health promotion, as the application of learning to real-life situations is crucial. This study analyses these issues and identifies factors that influence students' commitment to online education, with a focus on physical education and health education. This recognition underlies this study, that information and communication technologies (ICT) alone cannot guarantee classroom outcomes (Daud & Mohd, 2023). Furthermore, Bandura's concept of self-efficacy had an influence on this study, especially on

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teachers and students. According to (Elshami et al,.2022), TSE was studied as a predictor of how well they would deal with students, use computers, manage classrooms, develop teaching methods, and ensure students were happy. Similarly, SSE was studied in relation to one's ability to manage challenging assignments, take control of one's own education, and participate in extracurricular activities. STR decided to expand the scope of the survey. The degree to which students feel free and confident influences both their ability to learn independently and the effectiveness of online education. SA emphasizes autonomy, stressing how important it is to remain independent when making choices and finding answers to questions in an online learning environment.

These factors include learner control, self-directed learning, computer/Internet self-efficacy, motivation, and online communication. SS and SE were considered as mediating factors in this study. In the study of SS, SE was defined as the amount of time and effort students put into academic pursuits. SS includes students' objective evaluations of various educational outcomes and experiences (Centeio et al., 2021). As a result, SL emphasizes the importance of understanding these aspects and strengthening them. Student loyalty is one of the important factors driving the continuous expansion of universities. Loyal students who are willing to help produce educational materials are valuable. The purpose of this study is to reveal the complex relationship between these factors and provide important information for the rapidly developing field of virtual learning, especially in sports and health. In the context of research studies, it is important to recognize the interdependence of the issues being studied. The successful integration of technology and education depends on the efficiency and preparedness of both teachers and students. Teachers who possess technological skills and a strong sense of self-efficacy are essential to establishing a friendly and supportive online learning environment (González-Calvo et al., 2022). Their ability to change their teaching methods, effectively manage their classrooms, and utilize technology can impact how engaged and enjoyable their students are, as well as the level of education they receive.

Virtual education provides new opportunities and challenges for students. The study acknowledges that there are many factors that influence student autonomy, such as course design, prior knowledge and experience, and interaction with classmates and teachers (González-Calvo et al., 2022). Students' comfort with technology, independent learning ability, and motivation are all important to their independence in online learning environments. Choosing appropriate learning strategies and taking appropriate actions are also crucial, especially in important subjects with practical applications such as physical education and health promotion education. This study also examines engagement, a critical component of online learning, in detail. Engagement is determined by the amount of time and effort students put into their academic endeavors. The dynamic relationship between students and institutional policies and programs influences student engagement. Student satisfaction is also influenced by the relationship between technology readiness, self-efficacy, and satisfaction (Jang et al., 2021). The instructor, the type of activity involved, and the student's cognitive ability also influence student engagement. Assessing student satisfaction adds complexity to virtual learning environments.

Student satisfaction is more than just the delivery of course material; it encompasses the entire learning process, including interaction with the instructor and classmates, course scheduling, instructor coaching, instructor expertise, and the learning outcomes they see (Idris et al., 2021). To understand the factors that influence student loyalty, it is necessary to understand how they perceive and evaluate the online learning environment. The last section summarizes these factors, namely the basic concept of student loyalty: Student loyalty in educational institutions is both a result and a catalyst for sustainable development. Actively participate in improving the classroom environment and provide constructive criticism.

1.1 Research Gap and Significance

Even though there is a growing body of research on SL in online learning environments, there are still many unanswered questions about its complex working dynamics, especially regarding how online education can promote physical fitness and health. While previous studies have explored various factors influencing SL, such as teacher and student characteristics, there is a lack of comprehensive models that integrate these variables and examine their interplay. Moreover, the mediating roles of student engagement and satisfaction have not been thoroughly investigated in relation to the specific challenges and opportunities of online physical and health promotion education. The goal of this study was to reduce these discrepancies by creating and evaluating a framework that included STR, SSE, and SA as independent variables, and by examining the mediating effects of SE and SA on SL. This study adds to the body of knowledge by explaining the specific factors that influence SL in this educational setting and quantitatively assessing their relative impact, and provides useful insights for educators and organizations to increase student fidelity in online physical education and health promotion programs. This research is critical to online learning, especially when advocating for positive learning environments. As technology continues to transform education, it is imperative that educators, institutions, and governments understand the factors that influence student loyalty (Azzi et al., 2022). This study provides important insights into the various factors that influence online learning activities, enabling teachers and students to better prepare for online physical education and health courses. First, this is crucial because it can help in planning educational programs.

By understanding the factors that influence STR, SSE, and SA, learning-centered programs can be developed that encourage student engagement and independence in online learning environments. As more educational institutions move to online learning, these findings may influence how to ensure the teaching strategies and support networks needed for

online physical education and health promotion. Second, this study extends beyond the education sector and contributes to the current discussion on the feasibility and level of virtual learning. As the global education community grapples with the challenges posed by technological developments, the findings can provide multiple perspectives on how student loyalty is affected by technology adoption, self-efficacy, and autonomy (Centeio et al., 2021). In addition to the physical and health-related implications, this research may have implications for the design and implementation of online learning programs in many academic fields. Overall, the purpose of this research is to improve teaching methods, encourage student success, and promote the continued improvement of online learning environments.

1.2 Research Objectives

a. To determine whether Student Technological Readiness significantly influences Students' Loyalty.
b. To investigate whether student self-Efficacy significantly affects Students' Loyalty.
c. To examine the significant impact of Student Autonomy on Students' Loyalty.
d. To assess whether Students' Engagement significantly mediating the relationship between Student Technological Readiness and Students' Loyalty.
e. To evaluate whether Students' Satisfaction significantly mediating the relationship between Self-Regulated Efficacy and Students' Loyalty.
f. To develop and validate a comprehensive model that integrates Student Technological Readiness, Self-Regulated Efficacy, Student Autonomy, Students' Engagement, and Students' Satisfaction to predict Students' Loyalty in online physical and health promotion courses.

1.3 Research Questions

a. Does Student Technological Readiness significantly influence Students' Loyalty?
b. Does Student Self Efficacy significantly affect Students' Loyalty?
c. Does Student Autonomy have a significant impact on Students' Loyalty?
d. Does Students' Engagement significantly mediate the relationship between Student Technological Readiness and Students' Loyalty?
e. Does Students' Satisfaction significantly mediate the relationship between Self-Regulated Efficacy and Students' Loyalty?
f. Can a comprehensive model integrating Student Technological Readiness, Self-Regulated Efficacy, Student Autonomy, Students' Engagement, and Students' Satisfaction accurately predict Students' Loyalty in online physical and health promotion courses?

1.4 Theoritical Framework

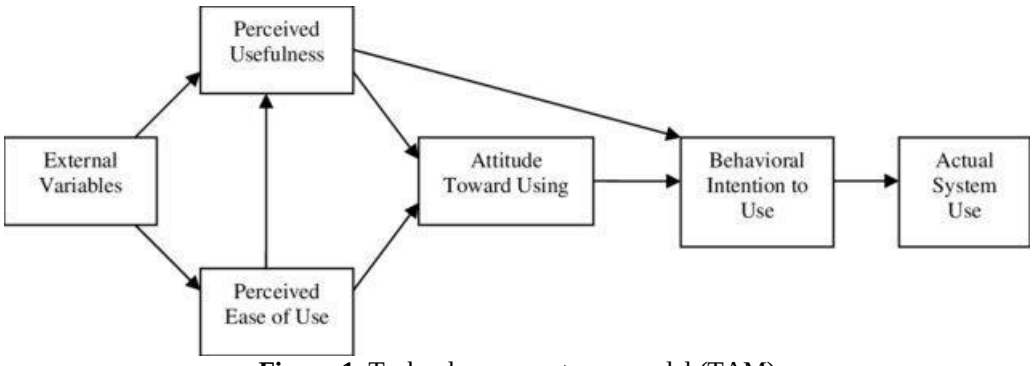

Figure 1. Technology acceptance model (TAM)

Davis's Technology Acceptance Model (TAM) in 1989 was designed to help educators understand how technology is used, especially in online education (Centeio et al., 2021). TAM states that perceived utility and usability have a strong influence on people's attitudes toward technology and willingness to use it. In this study, the TAM framework encompasses many factors required for successful use of technology. These include technology proficiency, previous teaching experience, perceptions of online learning, and efficient time management. Using TAM. This study aims to examine the attitudes and perceptions of teachers toward these preparation factors and the relationships between these attitudes and perceptions. This concept highlights how important personal perspectives and opinions are in influencing how technology can be effectively incorporated into online teaching environments. It provides a theoretical foundation to examine the complex links between teacher preparation and their propensity to use new technologies. The Technology Acceptance Model (TAM) is a popular theoretical framework that can explain and predict user acceptance of new technologies. The TAM can be used to assess how faculty members' attitudes and perspectives on various elements of preparation influence their ability to embrace and use technology in online educational environments. According to TAM, the two main factors that influence people's use of technology are perceived utility (PU) and perceived ease of use

(PEOU). The degree to which a technology can improve job performance is called PU, and the degree to which another technology can improve job performance is called PEOU.

In the context of teachers' readiness for online education, PU and PEOU can be influenced by various readiness components, such as technical skills, self-efficacy, and attitudes towards technology. For example, a teacher who perceives themselves as having strong technical skills and high self-efficacy in using technology may view online teaching tools as more useful and easier to use, leading to a higher intention to adopt and use these tools in their teaching practice. Moreover, TAM considers external variables that can influence PU and PEOU, such as system characteristics, training, and support. In the case of teachers' readiness for online education, factors such as the availability of professional development opportunities, technical support, and institutional policies can shape teachers' perceptions of the usefulness and ease of use of online teaching technologies (Jang et al., 2021). By applying TAM to the study of teachers' readiness for online education, researchers can gain valuable insights into the complex interactions between various readiness components and teachers' attitudes and perceptions towards technology. This understanding can help design targeted interventions and support systems, improve teacher preparedness, and successfully integrate technology into online teaching and learning environments.

1.5 Self-Efficacy Theory

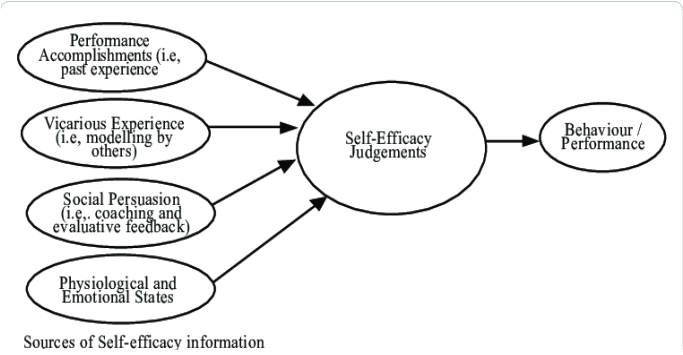

Figure 2. Self-Efficacy Theory (Bandura, 1997)

In 1977, Albert Bandura proposed that understanding the theory of self-efficacy is necessary to understand the psychological mechanisms behind people's perceptions of their ability to perform specific activities and produce desired outcomes (Azzi et al., 2022). This study applies self-efficacy theory to teachers and students and finds that teachers and students have important responsibilities in online learning. Teacher self-efficacy (TSE) is significantly affected by the design of online physical education and health promotion instruction. TSE has an impact on the development and implementation of instructional technology, student engagement, teacher satisfaction, effective classroom management, and student satisfaction. Teachers with higher self-efficacy are more likely to believe that they can cope with the challenges of a virtual work environment. This will lead to higher effectiveness and engagement in teaching methods.

Bandura's theory also encompasses the learner's perspective through Student Self-Efficacy (SSE). SSE refers to students' perceptions of their ability to effectively complete difficult assignments, self-regulate learning, Students are actively involved in extracurricular and academic activities. In this case, students are more likely to be motivated, proactive, and persistent when learning online. Bandura's theory provides a strong theoretical basis for studying the effectiveness of online physical education and health promotion education, which involves a complex connection between teachers and students' self-efficacy beliefs (Elshami et al., 2022). By observing how self-efficacy affects instructional strategies, classroom management, technology integration, and student engagement, as well as how teacher and student self-efficacy interact, this study demonstrates how these beliefs influence the learning environment. Additionally, it reveals how teachers and students interact to improve online learning effectiveness. As instructors and students work together to navigate the barriers of a virtual learning environment, building and maintaining self-efficacy is critical to establishing a successful online learning environment (González-Calvo et al., 2022).

2. Literature Review

2.1 Student Technical Readiness (STR) and Student Loyalty (SL)

Student technical readiness is crucial for effective online learning. Researchers like (Idris et al., 2021) have explored how students integrate technology and their psychological preparedness for online environments. However, these studies often lack sufficient detail regarding their methodologies and samples, limiting the broader applicability of their conclusions. (Azzi et al., 2022) emphasized the necessity of functional ICT infrastructure, technical skills, and student preparedness for online learning, though the study's context was not elaborated. (Laar et al., 2021) noted that some students face challenges in online learning due to deficiencies in independent learning, efficiency, and communication skills, but their

study's sample size and location were not specified. (Lee et al., 2021) found varying levels of online learning readiness across institutions, highlighting the need for more detailed methodological and sample information to strengthen these observations. (Mata et al., 2021) underscored the importance of student loyalty behaviors in sustaining online physical health education but did not provide contextual details.

2.2 Student Self-Efficacy (SSE0 and Loyalty (SL)

Student self-efficacy plays a significant role in online learning and, by extension, student loyalty. (Wang et al., 2023) linked struggles in online learning to a lack of autonomous learning, efficiency, and communication abilities, though details on their study's sample and location were missing. Students with lower technical readiness might self-select out of online courses, but the lack of methodological and contextual information limits these findings. (Centeio et al., 2021) noted differing comfort levels with online learning among educators and students, without disclosing their sample or location. (Jang et al., 2021) found that low self-efficacy can lead to unfavorable self-comparisons, hindering improvement, but the research context and methods were not fully provided. (Azzi et al., 2022) highlighted the impact of socioeconomic status on access to distance learning resources, yet lacked specific sample size and location data. (Daud & Mohd, 2023) emphasized the importance of student loyalty behaviors, such as course completion commitment and support for new students, and the role of positive faculty-student relationships in fostering loyalty. However, their study would benefit from more detailed methodological and sample information.

2.3 Student Anatomy (SA) and Student Loyalty (SL)

Student autonomy is also a critical factor influencing student loyalty. (Vilchez et al., 2021) defined SA as students' freedom to learn and discover their potential, but the study's context and sample were not provided. (Webster et al., 2021) suggested SA as a vital component of lifelong learning, with media characteristics enhancing learning and autonomy in online sports and health activities, although methodological and sample details were absent. Electronic media could increase student independence and ease learning compared to face-to-face instruction, but the research context was unclear. (Lee et al., 2021) found that student autonomy determines the achievement of learning goals, yet their study lacked detailed sample and methodology information. The importance of positive teacher-student interactions in influencing learning interests and loyalty, without providing context or sample details. (Ariantesa et al., 2022) indicated that graduate loyalty could facilitate online physical education and health instruction, but more information on the sample and methods would strengthen these findings.

2.4 The Relationship between Student Engagement, Student Statisfaction, and Student Loyalty

Student engagement (SE) and student satisfaction (SS) serve as key indicators linking mediating and dependent variables in online physical education and health promotion education. (Yu, 2022) emphasized the critical nature of SE as it reflects student investment in academic work. (Yang, 2021) suggested that SE mediates the relationship between various determinants (self-efficacy, technology readiness, and autonomy) and student loyalty, positing that more engaged students are more loyal. (Webster et al., 2021) noted that emotional involvement in activities fosters a strong sense of belonging, significantly impacting student loyalty

2.5 Student Engagement (SE) and Student Loyalty (SL)

Educational research has largely focused on the relationship between SE and learning outcomes (Laar et al., 2021). SE is typically measured across behavioral, cognitive, and emotional dimensions. The effort students invest in academic pursuits (Idris et al., 2021). This engagement is influenced by teaching strategies, motivation, teacher support, classroom interactions, and the overall learning environment. (Vilchez et al., 2021) indicated that more engaged students achieve higher academic results. (Jang et al., 2021) found that teachers' online presence and effective communication enhance student engagement. (Elshami et al., 2022) identified four key emotions influencing student engagement in online learning: anxiety, tension, positive views, and joy. Student loyalty behaviors encompass unwavering support and the ability to complete academic work. (Yu, 2022) highlighted the criticality of these behaviors for the ongoing development of online physical education. Effective communication between teachers and students increases interest and engagement (Yu & Jee, 2020). Student loyalty positively impacts school management and student physical health, leading to reduced recruitment costs, higher completion rates, and increased recommendations for the institution.

2.6 Student Satisfaction (SS) and Student Loyalty (SL)

With the growth of online learning, promoting social media use and providing adequate advice and technical training in online environments are essential (Centeio et al., 2021). Clear instructions and standards facilitate course completion. (Yang, 2021) introduced "Online Future Relevance" (OFR), referring to students' readiness for online course materials to meet future career goals. Despite these advancements, negative perceptions of online education persist due to issues

such as connectivity, glitches, concerns about teaching quality, unequal access to technology, and misunderstandings about the value of online degrees. (Wang et al., 2023) stressed that innovative technology is crucial for student and institutional success. Factors like facilities, teacher quality, support services, and class activities significantly influence student satisfaction. (Wang et al., 2023) identified challenges for teachers and students, including technology issues, communication barriers, time management, adapting to new methods, academic problems, and social isolation. Student loyalty includes persistence in studies and helping peers. The teacher-student relationship is crucial for fostering loyalty and enthusiasm. Strengthening online sports and health management programs can aid student retention. Increased student loyalty can enhance the desire for online health promotion and physical education, reducing recruitment costs, boosting revenue and completion rates, and increasing college recommendations (Webster et al., 2021).

2.7 Student Technical Readiness (STR) and Student Engagement (SE)

(Azzi et al., 2022) offered insights into how STR influences students' approach to integrating technology. Psychological readiness, shaped by past experiences and attitudes, contributes to readiness for online learning. The necessity of ICT infrastructure, technical knowledge, and student preparedness for successful online learning. (Jang et al., 2021) found that some students engage with online learning due to its perceived efficiency and personal freedom, noting a moderate level of STR for online learning. (Mercier et al., 2021) suggested that students lacking technological proficiency might self-isolate and perform poorly in online courses. (Daud & Mohd, 2023) observed varying levels of online learning preparedness across universities due to differences in infrastructure, faculty support, and organizational culture, noting that not all educators and students readily adopt online learning.

SE is directly linked to learning outcomes and has been a focus in early education research. It encompasses behavioral, cognitive, and affective dimensions, defined as the effort students put into academic goals. SE is influenced by classroom interaction dynamics. (Mata et al., 2021) asserted that engaged students are more likely to achieve academically. (González-Calvo et al., 2022) found that active teacher-student interaction and teacher online presence enhance engagement. (Elshami et al,.2022) identified positive attitudes, happiness, tension, and anxiety as key emotions influencing emotional engagement.

2.8 Student Self-Efficacy (SSE) and Student Engagement (SE)

(Yang, 2021) indicated that some students struggle with online learning due to a lack of autonomy, efficiency, and communication skills, resulting in low SSE for online learning. Students lacking academic preparation might avoid independent study and perform poorly in online courses. (Vilchez et al., 2021) noted varying institutional preparedness and comfort levels for online learning among teachers and students. (Ariantesa et al., 2022) highlighted the impact of socioeconomic status on students' ability to benefit from remote learning and stressed the need for digital literacy and self-efficacy in online communication. Successful student engagement, directly related to learning outcomes, is a focus in early childhood education research. SE measures include behavioral, cognitive, and affective learning. Defined as the effort students invest in academic goals (Laar et al., 2021), SE is influenced by constructive interpersonal dynamics. That engaged students are more likely to succeed. High SE can be achieved through teachers' online presence and student-teacher communication. Students' emotional engagement is determined by positive attitudes, satisfaction, tension, and anxiety (Mercier et al., 2021).

2.9 Student Anatomy (SA) and Student Engagement (SE)

(González-Calvo et al., 2022) stated that students can maximize their learning potential by guiding their own learning processes. Student autonomy as a crucial component of lifelong learning, enabling students to participate freely in society. SA is believed to increase with the use of media applications in sports and health contexts (Elshami et al., 2022). Online learning is more accessible than face-to-face teaching, with personal electronic devices enhancing independent learning and giving students greater autonomy. (Lee et al., 2021) found that autonomous students are more motivated and skilled in online physical health education.

Active SE is directly related to learning outcomes and has been a focus in many early education studies (Laar et al., 2021). SE can be measured through behavioral, cognitive, and affective dimensions. Defined as the total effort students put into achieving academic goals and grades (Centeio et al., 2021), SE is influenced by constructive relationships in the classroom. (Idris et al., 2021) believed that engaged students are more likely to achieve academic success. Teachers' online guidance and active student-teacher interactions motivate students to participate. Students express positive attitudes, enjoyment, stress, and anxiety toward online learning (Azzi et al., 2022).

3. Research Methodology

This chapter introduces the methodological framework used in the study, including the design, implementation, and methods of collecting, analyzing, and interpreting data. It begins by detailing the study's overall design, including the rationale behind the random sampling approach chosen to ensure sample representativeness and validity. Furthermore, it elaborates on the characteristics of the sample and the recruitment process. Subsequently, the chapter delves into the data collection method, highlighting the utilization of a questionnaire to gather information on students' attitudes,

participation, and satisfaction with online health promotion education. It explains the principles of questionnaire design, ensuring reliability and validity, along with instructions for its implementation to ensure data accuracy and reliability. The chapter concludes with a discussion of data analysis techniques, including regression, correlation, and descriptive analysis using statistical software. In order to effectively address the research questions and hypotheses, explanations of each analysis method are intended to clarify the findings and conclusions.

3.1 Research Design

This study used quantitative research methods to investigate and evaluate factors that influence student fidelity in participating in physical education and health promotion courses. The research design will be structured to gather numerical data and conduct statistical analyses, allowing for objective and reliable conclusions to be drawn. Quantitative methods allow for objective measurement of variables related to student loyalty, enabling precise statistical analyses to reveal significant relationships and patterns. Using this approach makes it easier to test specific theories that influence student fidelity to health promotion and physical education courses. The use of numerical data enhances the generalizability of findings across diverse online learning environments and allows for easier comparison between different groups or time periods. Additionally, quantitative research provides a structured framework that increases replicability, potentially strengthening the reliability and validity of the results. This study uses a quantitative approach and aims to provide specific, statistically sound insights into the topic of online education. These insights will have a positive impact on academic research and practical implementation of policies. The research design will be initiated by clearly establishing the purpose and research questions. These will guide the selection of suitable data collection and analysis methods. The design will be tailored to address the specific nature of the problem being investigated and to ensure the feasibility of the study.

3.2 Sampling

Determining the appropriate sample size involved considering several key statistical parameters to ensure both representativeness and the reliability of the findings. The study accounted for the number of students enrolled in online health and physical education courses at selected institutions, utilizing enrollment data. A 95% confidence level and a 5% margin of error, standard in social science research, were established. Anticipating high variability in student loyalty due to diverse influencing factors like demographics, program level, and attendance, the sample size calculation incorporated this variability. Furthermore, a desired statistical power of 0.80 was set to maximize the probability of detecting significant relationships. Adjustments were also made to ensure adequate representation across various subgroups based on demographics and program levels, allowing for meaningful comparisons. The final sample size was calculated using established statistical formulas, such as Cochran's formula, and tools like G*Power, with further adjustments for potential non-response and attrition to ensure the sufficiency of the sample for valid and generalizable results.

4. Finding and Discussion

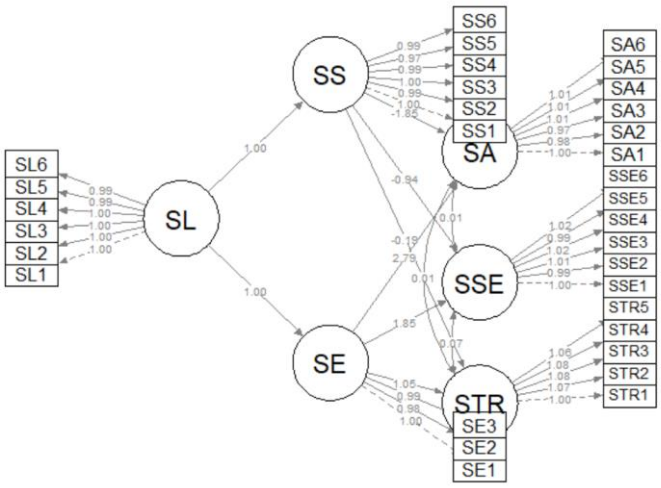

Figure 3. Path diagram

The Structural Equation Modeling (SEM) analysis conducted on data from students at Heilongjiang International Studies University revealed significant relationships among Student Loyalty (SL), Student Engagement (SE), Student

Satisfaction (SS), Student Technological Readiness (STR), Self-regulated Efficacy (SSE), and Student Autonomy (SA). The analysis showed a significant positive relationship between Student Engagement and Student Technological Readiness ($\beta = 1.141$, SE = 0.34979, $p = 0.003$), with a 95% confidence interval ranging from 0.363 to 1.7342. This substantial effect suggests that student engagement significantly influences students' technological readiness in online physical education courses.

A strong positive relationship was observed between Student Engagement and Self-regulated Efficacy ($\beta = 1.897$, SE = 0.52146, $p < .001$), with a 95% confidence interval from 0.832 to 2.8756. This large effect size underscores the critical role that student engagement plays in enhancing students' self-regulated efficacy in online physical education learning. The results also indicate a strong positive relationship between Student Engagement and Student Autonomy ($\beta = 2.837$, SE = 0.69943, $p < .001$), with a 95% confidence interval ranging from 1.420 to 4.1616. This substantial effect highlights the crucial role that student engagement plays in fostering student autonomy in online physical education courses. Interestingly, the relationship between Student Satisfaction and Student Technological Readiness was not significant ($\beta = -0.206$, SE = 0.35007, $p = 0.584$), with a 95% confidence interval from -0.878 to 0.4944. Similarly, Student Satisfaction showed a marginally negative relationship with Self-regulated Efficacy ($\beta = -0.951$, SE = 0.52759, $p = 0.074$). However, Student Satisfaction showed a significant negative relationship with Student Autonomy ($\beta = -1.854$, SE = 0.70444, $p = 0.009$), with a 95% confidence interval from -3.229 to -0.4680. This suggests that higher levels of student satisfaction might be associated with lower levels of student autonomy.

Both Student Satisfaction ($\beta = 1.003$, SE = 0.00699, $p < .001$) and Student Engagement ($\beta = 0.991$, SE = 0.00536, $p < .001$) showed very strong positive relationships with Student Loyalty, with confidence intervals of 0.981 to 1.0089 and 0.986 to 1.0072 respectively. These findings suggest that both satisfaction and engagement are crucial factors in developing student loyalty in online physical education courses. Regarding the research questions, the results support significant relationships between most variables, though some relationships showed unexpected directions. The structural model demonstrates good measurement properties, with factor loadings generally above 0.95 for most indicators.

Several limitations should be noted when interpreting these results. The complex interrelationships between variables suggest that the influence of some factors (such as student satisfaction) might be more nuanced than initially hypothesized. The negative relationships with student autonomy warrant further investigation to understand the underlying mechanisms. In conclusion, the SEM results provide valuable insights into the relationships between student engagement, satisfaction, technological readiness, self-regulated efficacy, autonomy, and loyalty in online physical education courses at Heilongjiang International Studies University. The findings highlight the importance of student engagement and satisfaction in fostering loyalty, while also revealing unexpected relationships that merit further research. These results can inform educational policies and practices aimed at improving online physical education programs in higher education institutions.

5. Conclusion and Recommendation

This research investigated the relationships between Student Technological Readiness, Self-regulated Efficacy, Student Autonomy, Student Engagement, Student Satisfaction, and Student Loyalty in online physical and health promotion education at Heilongjiang International Studies University. The study also examined the mediating roles of student engagement and satisfaction in these relationships. The study employed a structural equation modeling (SEM) approach to analyze the relationships between variables. Data were collected from students at Heilongjiang International Studies University who participated in online physical and health promotion education courses. The analysis utilized various statistical techniques within the SEM framework, including path analysis and mediation analysis. The model demonstrated good measurement properties, with factor loadings generally above 0.95 for most indicators.

The results revealed significant relationships between the studied variables, particularly highlighting the role of student engagement as a mediator. Strong positive relationships were found between student engagement and several key variables, including technological readiness, self-regulated efficacy, and student autonomy. Both student engagement and satisfaction showed strong direct effects on student loyalty, though some relationships, particularly those involving student satisfaction, showed unexpected negative associations. These findings provide valuable insights into the complex interplay between technological readiness, self-regulation, autonomy, engagement, satisfaction, and loyalty in the context of online physical and health promotion education. The results offer both theoretical contributions to the field of online education and practical implications for enhancing student loyalty in specialized educational contexts.

5.1 Implication

The significant effects of Student Engagement on multiple factors underscore the multifaceted nature of engagement in online educational settings. This supports the view that effective online learning is a complex phenomenon influenced by technological readiness and self-regulatory practices. The study contributes to the literature by providing empirical evidence of these relationships in the context of online physical education, an area that has been relatively underexplored. The complex relationship between satisfaction and self-regulated efficacy provides new insights for self-regulated learning theory in online contexts. It suggests that the benefits of satisfaction may have unexpected interactions with self-regulation, pointing to the need for more nuanced models of how these processes influence student loyalty. The significant role of Student Engagement in mediating relationships between various factors highlights its importance as a key

educational process that translates into improved student loyalty. The findings suggest that institutions should invest in developing effective engagement strategies to fully leverage their online learning capabilities for enhancing student loyalty. The study provides valuable insights for educational administrators in online physical education contexts. The findings suggest that to enhance student loyalty, institutions should focus on developing engaging learning experiences that promote both technological readiness and autonomous learning. Moreover, the strong effects of engagement and satisfaction on loyalty underscore the importance of fostering supportive online learning environments.

5.2 Future Research

The cross-sectional nature of this study limits our ability to establish causal relationships and capture the dynamic nature of student loyalty development. Future research should employ longitudinal designs to provide a more nuanced understanding of how the relationships between engagement, satisfaction, and loyalty evolve over time. Specifically, multi-wave longitudinal studies could track students throughout their program duration, examining how these relationships develop and change across different stages of online education.While focusing on Heilongjiang International Studies University provided valuable insights into a specific educational context, it limits the generalizability of the findings. Future research should extend to other universities and institutions offering online physical education programs. Comparative studies across different institutional contexts could reveal how the relationships between technological readiness, engagement, satisfaction, and loyalty are moderated by various institutional factors.

While quantitative methods provide valuable insights, they may not capture the full complexity of student loyalty development in online physical education. Future research should employ mixed-methods approaches that combine quantitative analyses with qualitative case studies. This could provide a richer understanding of how students experience engagement and develop loyalty in online physical education programs.

Given the central role of technology in online education, future research should examine how different technological tools and platforms affect student engagement and loyalty. This could include investigating how various learning technologies impact the relationships between technological readiness, engagement, and loyalty, as well as exploring innovative approaches to delivering online physical education content.

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Conflict of Interest

The authors declare no conflicts of interest.

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