



A Causal Model of Learning Loss in the Midst of COVID-19 Pandemic Among Thai Lower Secondary School Students

Ittipaat Suwathanpornkul 

Srinakharinwirot University, THAILAND

Orn-uma Charoensuk* 

Srinakharinwirot University, THAILAND

Panida Sakuntanak 

Srinakharinwirot University, THAILAND

Manaathar Tulmethakaan 

Srinakharinwirot University, THAILAND

Chawapon Sarnkhaowkhom 

Mahidol University, THAILAND

Received: October 22, 2023 • Revised: December 17, 2023 • Accepted: January 19, 2024

Abstract: It is known that the COVID-19 pandemic led to learning losses among students both domestically and internationally. Therefore, situational and causal factors were examined to discover and understand them so that learning loss could be reduced or recovered from. This research aimed to: (a) study learning loss situation; and (b) develop and examine the causal model of learning loss among lower secondary school students affected by the pandemic. The sample included 650 Grade 7-9 students selected by multi-stage random sampling. The data was collected using a self-developing questionnaire as a research instrument. The data was analyzed using descriptive statistics, independent samples t-test, ANOVA, and structural equation modeling (SEM) through the LISREL program. The findings were: (a) Lower secondary school students had an average academic achievement learning loss at the moderate level with the highest mean of learning loss in mathematics ($M=3.012$, $SD=1.074$), and an average learning characteristics learning loss at the medium level ($M=2.824$, $SD=0.842$). Several situational factors had a different effect depending on the school size with a statistical significance of .05.; and (b) the causal model showed the learning loss of grade 7-9 students was consistent with the empirical data ($\chi^2=46.885$, $df=34$, $p=.069$, $GFI=0.991$, $AGFI=0.964$, $CFI=0.999$, $RMSEA=0.024$, $SRMR=0.014$).

Keywords: COVID-19, learning loss, pandemic, student, structural equation modeling.

To cite this article: Suwathanpornkul, I., Charoensuk, O., Sakuntanak, P., Tulmethakaan, M. & Sarnkhaowkhom, C. (2024). A Causal Model of Learning Loss in the Midst of COVID-19 Pandemic Among Thai Lower Secondary School Students. *European Journal of Educational Research*, 13(3), 1155-1170. <https://doi.org/10.12973/eu-jer.13.3.1155>

Introduction

The situation of COVID-19 forced schools at all levels both domestically and internationally around the world to temporarily suspend learning (Office for Civil Right, 2021; World Bank et al., 2021). Therefore, students could not manage their learning and follow the curriculum offered by their school under completely normal circumstances (Alam et al., 2022; Hammerstein et al., 2021; Pal et al., 2022; Takács et al., 2023). The suspension of learning and the subsequent situational change due to the COVID-19 pandemic situation caused teachers to change their teaching style, the way they measured and evaluated their students, the manner in which the students' education was managed, and the platform through which they taught as they moved to online learning or more virtual classrooms to support the learning of their students (Dayagbil et al., 2021; Pal et al., 2022; Selvaraj et al., 2021). Additionally, school directors and teachers had to either devote or dedicate all of their time, talents and abilities to meet the needs of their learners and allocate appropriate resources to support the learning of the students (Parker & Alfaro, 2022). Moreover, parents, guardians, and related family members played an essential role in supporting the learning of the students due to the changes caused by the pandemic (Parker & Alfaro, 2022; Rousoulioti et al., 2022; Tye, 2023).

Learning loss from school closures during the COVID-19 pandemic was found to have predominantly occurred among primary and secondary school students (Engzell et al., 2021; Hammerstein et al., 2021; Office for Civil Right, 2021). It was found that students experienced learning loss in math and language courses at a high level due to the lack of learning resources at home, as they did not possess various communication devices, such as mobile phones, televisions, and radios (Office for Civil Right, 2021). In addition, they did also not to get any support to learn from home as many students were unable to manage their time, get answers to their questions from parents, or find a quiet place to study as they often had

* Corresponding author:

Orn-uma Charoensuk, Department of Educational Measurement and Research, Faculty of Education, Srinakharinwirot University, Thailand.

✉ o_charoensuk@hotmail.com



to do activities to help out in their home (Alam et al., 2022; Office for Civil Right, 2021; Rousoulioti et al., 2022; Smith et al., 2023). This was also caused by the problem of reduced household income, leading to learning loss as students had to do jobs at home to help earn money and a high dropout of students (Kasradze & Zarnadze, 2021; Khan & Ahmed, 2021; Moscoviz & Evans, 2022). To alleviate the problem of learning loss of students due to school closures caused by the COVID-19 pandemic, effective distance education was needed for students at all levels (Azim Premji University, 2021; Engzell et al., 2021; Khan & Ahmed, 2021; Locke et al., 2021; Sabates et al., 2021), yet studies on the causes of learning loss during distance learning in the context of Thailand were limited. It was believed that research on the learning loss circumstances and the causes or antecedents of learning loss in Thailand could lead to greater understanding so that ways could be produced to reduce learning loss to enhance the learning quality for Thai students. Moreover, a study on these issues under the context of Thailand is important to understand the learning loss situation during the COVID-19 epidemic more clearly.

Regarding the study and synthesis of documents and research related to learning loss's definitions and components, it was found that learning loss could be divided into two components: academic achievement learning loss and desirable learning characteristics learning loss (Engzell et al., 2021; Glossary of Education Reform, 2013; Harmey & Moss, 2023). The factors causing the learning loss of learners were said to be related to race and ethnicity (DiPietro et al., 2020; Dorn et al., 2020; Saliccioli, 2021), gender (Engzell et al., 2021), the age of the learners (Zierer, 2021), the parents' education (Azim Premji University, 2021; Blaskó et al., 2022; Engzell et al., 2021; Fitzpatrick et al., 2022), the parents' socioeconomic status (Asian Development Bank, 2021; Blaskó et al., 2022; Conto et al., 2020; Dorn et al., 2020; Gouédard & Pont, 2020; Jæger & Blaabæk, 2020; Kasradze & Zarnadze, 2021; Kuhfeld et al., 2020; Locke et al., 2021; Saliccioli, 2021), grade level (Azim Premji University, 2021; Conto et al., 2020; Locke et al., 2021), and former academic performance (Engzell et al., 2021). In this research, the researchers selected relevant factors consisting of five main variables according to the context of learning management arrangement of basic education students in the situation of the COVID-19 epidemic, namely (a) information, media, and technological skills (DiPietro et al., 2020; Kasradze & Zarnadze, 2021), (b) self-regulated learning (Cho et al., 2021; Cleary & Kitsantas, 2017; Dent & Koenka, 2016; Pelikan et al., 2021; Trias et al., 2021), (c) teachers' skills (DiPietro et al., 2020; Fitzpatrick et al., 2022; Ikeda & Yamaguchi, 2021; Kaffenberger, 2021; Kuhfeld et al., 2020; Raymond, 2021), (d) home-based parental involvement (Blaskó et al., 2022; Cardinal, 2020; DiPietro et al., 2020; Fitzpatrick et al., 2022; Gouédard & Pont, 2020; Sabates et al., 2021), and (e) learning environment management (Asian Development Bank, 2021; Azim Premji University, 2021; Blaskó et al., 2022; Gouédard & Pont, 2020; Kasradze & Zarnadze, 2021; Office for Civil Right, 2021; Zierer, 2021). These factors directly and indirectly influenced learning loss as can be explained by the social cognitive theory of Bandura (1986) which was used as a theoretical conceptual framework for this research. Learning according to Bandura's social cognitive theory was focused on the internal changes that happened to the individual at the interpersonal level based on the behavioral science theory and believed that an individual's behavior did not only arise from or change because of environmental factors since there were also internal factors at play based on reciprocal determinism, such as the person, the person's behavior, and the person's environment (Bandura, 1986). This was seen as one of the reasons why the learning behavior of lower secondary school students had changed during the COVID-19 situation, and why there was learning loss among the learners. Thus, it is important to realize that learning depends on intrapersonal factors, behavioral factors, and environmental factors. For this research, several factors that affected the learning process during the COVID-19 pandemic were included, such as a lack of information, media, and technological skills, the inability to perform self-regulated learning, and insufficient teacher skills, home-based parental involvement, and learning environment management. This theoretical knowledge of the factors led to a theoretical framework to study the causal factors of learning loss among basic education learners in this study.

Therefore, due to the importance of being able to understand the concept of learning loss including its impact, this study aimed to study the learning loss among students at the lower secondary level during the COVID-19 pandemic situation by taking a closer look at the causal factors that led to learning loss in order to fully understand the situation so that the causal factors of learning loss could be determined. This data could then be used to propose ways so that learning loss could be reduced or recovered from, and to improve the learning quality of lower secondary learners if another pandemic was to occur in the future.

Literature Review

Learning Loss

Learning loss reflects the decline or recession in learners' forgotten knowledge over time and can be divided into two main types: academic achievement learning loss and desirable learning characteristic learning loss (Engzell et al., 2021; Glossary of Education Reform, 2013; Harmey & Moss, 2023). In addition, learning loss is caused due to the learners missing out on learning opportunities during a school year that should have occurred under normal circumstances. Some consider long semester breaks during the academic year as periods of learning loss as these breaks may cause learners to lose specific knowledge, general knowledge, and even their skills (Angrist et al., 2021; Coe et al., 2020). As for the summer break, schools are usually closed for a period of two months or two and a half months, and various strategies may be used to reduce learner loss, such as by opening summer classes or encouraging the learners to review the materials taught during the course of the semester (Glossary of Education Reform, 2013). Learning loss could also be

occurred by other situations and circumstances, such as natural disasters or social phenomenon. Examples of natural disasters and social phenomenon include heavy rain, floods, tsunamis, teachers' strikes, ineffective teaching and learning, and a formal education interruption caused by social unrest, e.g., revolutions and protests which can lead to students being unable to go to school (Harmey & Moss, 2023; Kaffenberger, 2021; Kuhfeld et al., 2020; Zhdanov et al., 2022). Block scheduling also limits the opportunity to meet the learning needs of the students due to the students having fewer classes per day (Angrist et al., 2021; Glossary of Education Reform, 2013). Moreover, students who are returning after taking academic leave or previously dropping out for a long period may display a loss of knowledge or a learning gap. In this event, the school may require students to repeat the previous class or enroll in additional classes. This learning loss could occur among students in either high-, middle- or low-income countries, so in other words this can be seen as a worldwide phenomenon (Angrist et al., 2021; Glossary of Education Reform, 2013).

Information, Media and Technological Skills

Information, media, and technological skills are crucial for learners in the 21st century, including information literacy, media literacy, and information and communication technology (ICT) literacy (Hazar et al., 2021). Information, media, and technological skills are seen as part of the individuals' digital abilities. ICT literacy, digital literacy, and digital skills cover the skills and abilities related to the use of digital technology by individuals (Ilomäki et al., 2011). Information, media, and technological skills were divided into 3 areas based on the concept of the Partnership for 21st Century Skills (P21), which were: information literacy, media literacy, and ICT literacy skills which were believed to assist students with gaining knowledge through reading and the use of media and technology and putting that knowledge into practice by writing and further developing their media and technological skills (Kivunja, 2015). Not possessing these information, media and technological literacy skills is seen as one of the main causes of learning loss among students (Kivunja, 2015).

Self-Regulated Learning

Self-regulated learning among learners is crucial and one of the key variables in being successful when learning (Cleary & Kitsantas, 2017; Dent & Koenka, 2016; Trias et al., 2021; Zimmerman & Schunk, 1989). As self-regulated learners know their strengths and weaknesses, they become proactive in seeking and accessing information to facilitate their learning on their own since they have the confidence, perseverance, strategies, and flair to complete their educational work as well as the academic ability (Brenner, 2022; Salmani Nodoushan, 2012). During the COVID-19 epidemic situation, educational institutions in the country have been greatly affected by the change in learning management models, forcing learners to change themselves to be more proactive learners since they had to study more by themselves to understand the lessons, set goals for learning, and control their mind and own learning behavior. Self-regulated learning is therefore considered an important factor that pushes learners to better support themselves with their learning. Self-regulated learning is a behavior based on the concept of the social cognitive learning theory and is made up of the words "self-regulation" and "learning" (Bandura, 1986). Self-regulation refers to the behavioral control of one's thoughts, feelings, and actions with the intention of practicing the process of self-regulation. Self-regulation consists of three sub-processes: self-observation, self-judgment, and self-reaction. These subprocesses interact with each other (Bandura, 1986, 1991). Self-regulated learning consists of the following key components: cognition or metacognition, motivation, and behavior of the learners (Salmani Nodoushan, 2012; Wolters et al., 2003; Zimmerman, 1990).

Teacher Skills

Teacher skills are key when designing learning programs to provide quality learning experiences for learners (Moreno Rubio, 2009). Instructors or teachers should consider four key teaching perspectives when wanting to improve the skills of the students: (a) the subject knowledge taught, (b) the instructional design, (c) student interaction, and (d) course management when organizing and preparing for potential situations in the classroom, assignments, examinations, and grading (Fink, 2003). This research aimed to delve more closely into the teacher skills related to online learning management, namely learning management skills and information technology and communications skills. Learning management skills can be considered as the ability of the teacher to organize learning activities for students, create teaching hour plans, plan activities that cover the curriculum content, determine the ways and techniques the content can be presented in, adjust the learning activities to suit the situation, know what advice and answers to give to the learners, provide the appropriate care to the students, communicate positively, set up appropriate interactions between the teachers and learners, and use information technology and communication skills appropriately (Akyürek, 2019; Ghavifekr & Rosdy, 2015). However, the application of certain equipment and digital technologies (such as computers, tablets, and mobile phones) to increase the learners' learning appropriately depends on the ability and experience of teachers (Akyürek, 2019; Ghavifekr & Rosdy, 2015; Moreno Rubio, 2009; Nguyen et al., 2022).

Home-Based Parental Involvement

Parents' participation in promoting home learning directly affected the learners' academic achievement and often pushed learners to meet or exceed their parents' expectations (Gonzales-DeHass et al., 2005). Parents' participation in learning promotion can be divided into two forms: school-based parental involvement and home-based parental involvement (Zellman & Waterman, 1998). This research examined the learning loss among learners during the COVID-19 pandemic during which most schools provided learning through an online model. Therefore, parents' participation was deemed to be minimal. Nevertheless, in Asian cultures, parents were found to be more involved in promoting learning at home than at school, and they were at times even sat with their children while they studied (Toren & Seginer, 2015). It was found that parents' participation in learning at home had a greater effect on student achievement than participation at school (Toren & Seginer, 2015). Therefore, this study focused on only 3 forms of home-based parental involvement or parents' participation in promoting learning at home, namely (1) talking about learning, (2) assisting with homework, and (3) ensuring that the student under their supervision is achieving the learning outcomes (DiPietro et al., 2020; Đurišić & Bunijevac, 2017; Epstein, 2010; Toren & Seginer, 2015; van Gelder-Horgan, 2016).

Learning Environment Management

The learning environment plays an important role when learning as it impacts the morality and ethics of learners both directly and indirectly (Begum et al., 2021; S. Li et al., 2023; Nadelson, 2006). Moreover, the development of quality learning resources and appropriate learning environments by educational institutions and teachers could boost the motivation of the students (Hafizoğlu & Yerdelen, 2019; Hanrahan, 1998; Rusticus et al., 2023). Thus, the learning environment management is one of the important aspects that school directors and teachers should focus on as it contributes to the provision of a learning environment that is suitable for learners, especially throughout the COVID-19 epidemic situation during which many of the educational institutions' learning was conducted online. As classes went online, the online learning environment became another key factor in this study that might have contributed to learning loss. A successful learning environment management depends on three factors, namely (a) the physical learning environment management, (b) the learning environment context, and (c) the learning environment culture (Bates, 2015). This means the learning environment had to be based on Bates (2015) clearly defined elements and learning techniques and be consistent with the various and different contexts of the learning environment during the COVID-19 epidemic situation.

Social Cognitive Theory

Learning loss is an issue related to three related theories: behavioral theories, cognitive theories, and social cognitive learning (Bandura, 1986). For this research, the social cognitive theory of Bandura was applied as a theoretical conceptual framework as it focuses on the internal shift of a person's behavior that was not only caused by environmental factors, but also internal factors based on reciprocal determinism, such as the person, the person's behavior, and the person's environment. This was seen as one of the reasons why the learning behavior of learners had changed during the COVID-19 epidemic situation, and why there was learning loss among the students. Therefore, it is important to realize that learning depends on intrapersonal factors, behavioral factors, and environmental factors (Bandura, 1986). The research hypothesized model is depicted in Figure 1 below.

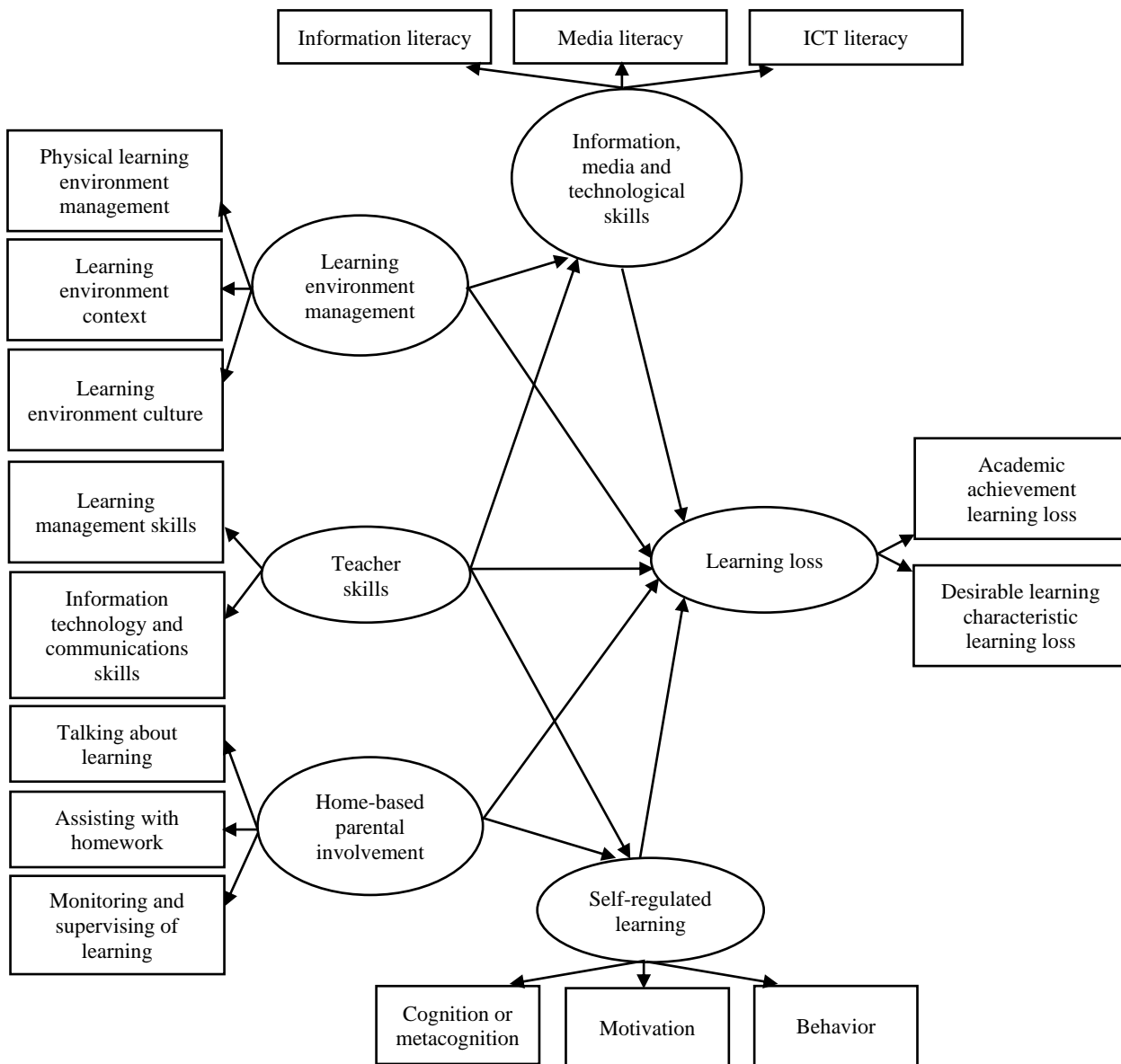


Figure 1. Research Hypothesized Model

Methodology

Population and Sample

The research sample consisted of students at the lower secondary level, Grade 7-9, who fell under the Office of the Basic Education Commission (OBEC), Bangkok Metropolitan Administration (BMA), and under the Provincial Administrative Organization (PAO) across the Thai nation during the 2021 academic year between February and March 2022. The sample consisted of 650 lower secondary students and this sample size was established by applying the rules of thumb proposed by Hair et al. (2010) who argued that when using linear structural equation modeling, the size of a sample should be indicated more than 10-20 times than the appearing parameters in the causal model. The researchers of this project used multistage random sampling, consisting of stratified random sampling and simple random sampling classification. The following criteria were set to determine the sample size (a) areas which were heavily hit by the spread of COVID-19, namely the Bangkok Metropolitan Region and provinces in 4 determined regions, which were located across the North, East, West, and South of Thailand), (b) institutions need to be affiliated with the Office of the Basic Education Commission and the Local Administrative Organizations and (c) the size of the educational institutions, such as small, medium and large ones.

Data Collection

For this research, before the data was collected from the lower secondary students, the researchers studied documents and relevant research from the ERIC, ScienceDirect, Scopus, PsycINFO, ThaiJo, and Web of Science databases to define the terms of learning loss and to determine the causal variables of learning loss. Then, questions were developed based on the definition of the learning loss term, and a questionnaire was prepared for 5 experts to check for content validity

and find the Index of the Item Objective Congruence (IOC). The research instrument was a questionnaire which looked into the situations in which learning loss occurred and the causes of the learning loss among students at the basic education level in the midst of COVID-19 outbreak. The questionnaire consisted of closed-ended questions in the form of a checklist for respondents to provide their basic information and a total of 73 questions with a 5-level rating scale of which 13 were general information questions, 14 were learning loss questions while 46 questions focused on the factors affecting learning loss. Examples of questions were "During the COVID-19 pandemic, I think I have the recession of learning in Math"; "I have less attempt and dedication in learning during the COVID-19 pandemic"; "I know the information resources to use for doing my assignments"; "I plan and control myself in learning to achieve my goals"; "My teachers can use the technology in their teaching fluently"; "My parents ask me about my daily learning activities"; and "I arrange my home area for my learning". The questions were revised according to expert suggestions. Then, the questionnaire was tried out with test samples to analyze the quality of the questionnaire using a discrimination power research analysis tool through the Item-Total Correlation formula to explain the coefficient of correlation between the items and the total. Moreover, the reliability of the questionnaire or the whole questionnaire was also examined using Cronbach's Alpha Coefficient formula after which the questionnaire was improved, and the final version was established. The Index of the Item Objective Congruence - IOC was determined by selecting questions with an IOC index greater than .50. It was found that the IOC index was .80-1.00. The questionnaire was tried out with a research sample of 63 secondary school students to examine the quality of discrimination with the correlation coefficient formula by looking at the difference between the Item-Total Correlation and reliability of the whole questionnaire using Cronbach's alpha coefficient formula. The questionnaire was found to be highly reliable with Cronbach's alpha coefficient at .888 and discrimination power index at .332-.826. Then, the questionnaire was used to collect the data from the research samples using the following two methods: data collection with paper questionnaires and data collection through online questionnaires due to the situation of the COVID-19 outbreak. It was then checked whether all questions had been completed and the data was analyzed.

Data Analysis

The quantitative data was analyzed utilizing a statistical analysis package, which offered descriptive statistics, such as frequency, percentage, mean, and standard deviation, and inferential statistics. Examples of how inferential statistics were gained were through an independent samples t-test, one-way analysis of variance (ANOVA), and a post hoc comparison. The equal variance was obtained through Bonferroni's formula and the equal variance not assumed was obtained using Dunnett T3. The causal model was analyzed utilizing structural equation modeling (SEM) through the LISREL program.

Results

Demographic Characteristics of Samples

As mentioned before, 650 students from grades 7-9 were the sample subjects for this study. 52.6% of the students were in grade 9. The number of female and male learners was more or less equal (55.1% and 44.9% respectively). Most of them lived in the Bangkok Metropolitan Region (30.6%) and studied in schools under the Office of the Basic Education Commission (OBEC) (73.2%), in medium, large, and small sized schools (46.9%, 43.1%, and 9.8% successively). Most of the parents lived together and were not separated (62.3%), and 80.8% of the learners lived with their parents. Out of the parents, 28.5% had completed secondary school, followed by 28.3% who had finished lower secondary education and 19.1% who possessed a bachelor's degree. Their parents' occupations were self-employed (41.1%), followed by trades/businesses and farmers, with 25.2% and 11.2% respectively. 46.5% of the parents had a monthly household income of 10,000 – 30,000 baht, while 43.5% earned below 10,000 baht. Most parents played the main role in the learners' learning care (86.5%) with 32.3% of them spending more than 4 hours with their children, 26.5% spending 1-2 hours with them and 23.5% spending less than 1 hour helping their children study. Most of them had experienced no COVID-19 infection in their family (91.8%). More details can be found in Table 1.

Table 1. Demographic Data of the Samples (n=650)

| Demographic Characteristics | | Frequency (n = 650) | Percentage (%) |
|---|---|------------------------|-------------------|
| Grade | Grade 7 | 104 | 16.0 |
| | Grade 8 | 204 | 31.4 |
| | Grade 9 | 342 | 52.6 |
| Sex | Male | 292 | 44.9 |
| | Female | 358 | 55.1 |
| Region | North | 93 | 14.3 |
| | Northeast | 144 | 22.2 |
| | South | 129 | 19.8 |
| | Central, West, and East | 85 | 13.1 |
| School's Affiliation | Bangkok Metropolitan Region | 199 | 30.6 |
| | Office of the Basic Education Commission (OBEC) | 476 | 73.2 |
| | Provincial Administrative Organization (PAO) and Bangkok Metropolitan Administration (BMA) | 172 | 26.5 |
| Size of school | N/A | 2 | 0.3 |
| | Small | 64 | 9.8 |
| | Medium | 305 | 46.9 |
| | Large | 280 | 43.1 |
| Family living | N/A | 1 | 0.2 |
| | Living together | 405 | 62.3 |
| | Separated | 218 | 33.5 |
| | Death | 24 | 3.7 |
| Student living | N/A | 3 | 0.5 |
| | Living with parents | 525 | 80.8 |
| | Living with relatives | 120 | 18.5 |
| | Alone or etc. (temple, dormitory) | 2 | 0.3 |
| Parents' educational level | N/A | 3 | 0.5 |
| | Grade 1-6 | 119 | 18.3 |
| | Grade 7-9 | 184 | 28.3 |
| | Grade 10-12 | 185 | 28.5 |
| | Bachelor degree | 124 | 19.1 |
| | Master degree | 25 | 3.8 |
| | Doctoral degree | 12 | 1.8 |
| Parent's occupation | N/A | 1 | 0.2 |
| | Farmer | 73 | 11.2 |
| | Government officer / state enterprise employee | 49 | 7.5 |
| | Private company officer | 71 | 10.9 |
| | Trades/businesses | 164 | 25.2 |
| | Self-employed | 267 | 41.1 |
| | Unemployed | 25 | 3.8 |
| | etc. | 1 | 0.2 |
| Family income | N/A | 73 | 11.2 |
| | < 10,000 THB | 283 | 43.5 |
| | 10,000 – 30,000 THB | 302 | 46.5 |
| | 30,001 – 50,000 THB | 42 | 6.5 |
| | > 50,000 THB | 22 | 3.4 |
| Main role of parenting in learning | N/A | 1 | 0.2 |
| | Parents | 562 | 86.5 |
| | etc. | 86 | 13.2 |
| Hour of parenting in learning per day | N/A | 2 | 0.3 |
| | < 1 hour | 153 | 23.5 |
| | 1 – 2 hours | 172 | 26.5 |
| | 3 – 4 hours | 114 | 17.5 |
| | > 4 hours | 210 | 32.3 |
| COVID-19 infection history in household | N/A | 1 | 0.2 |
| | None | 597 | 91.8 |
| | Infected | 50 | 7.7 |
| | N/A | 3 | 0.5 |

Comparative Analysis of Mean Differences and Relationship Between Factors Related to Learning Loss

Overall, the lower secondary students were found to have suffered academic achievement learning loss at the medium level ($M=2.52-3.01$, $SD=0.92-1.14$) as they were shown to have the highest mean of learning loss for mathematics ($M=3.01$, $SD=1.08$), and an average desirable learning characteristic learning loss at the medium level ($M=2.82$, $SD=0.84$) while full score is 5.00.

The results of a comparative analysis of mean differences of factors related to learning loss of students in grades 7-9 classified by school size revealed that the factors influencing learning loss, such as information, media, and technological skills, self-regulated learning, the teacher skills, the home-based parental involvement, and the learning environment had a different mean depending on the size of the school. The samples in large schools had a significantly higher mean for factors, such as information, media, and technological skills, self-regulated learning, the parents' participation in promoting and enhancing learning at home, and the learning environment management than the samples in small and medium schools with a statistical significance of .05, and the teacher skills in large schools were also found to be at a higher level than those of teachers in medium schools with a statistical significance of .05. Further details are offered in Table 2.

Table 2. Factors Related to Learning Loss Among Students Classified by School Size

| Variables | Mean | SD | Results | | | | | | |
|--|------|-------|---------|--|---------|-----|-------|---------|---------------------|
| Learning loss | | | | | | | | | |
| - Academic achievement learning loss | | | | | | | | | |
| 1. Thai subject | 2.68 | 0.92 | Medium | | | | | | |
| 2. Mathematics subject | 3.01 | 1.08 | Medium | | | | | | |
| 3. Science and technology subject | 2.87 | 0.97 | Medium | | | | | | |
| 4. Social studies, religion and culture subject | 2.74 | 0.97 | Medium | | | | | | |
| 5. Health and physical education subject | 2.59 | 1.09 | Medium | | | | | | |
| 6. Art subject | 2.52 | 1.04 | Medium | | | | | | |
| 7. Works and Careers subject | 2.58 | 1.00 | Medium | | | | | | |
| 8. Foreign languages subject | 2.90 | 1.14 | Medium | | | | | | |
| - Desirable learning characteristic learning loss | 2.82 | 0.84 | Medium | | | | | | |
| Variables | n | Mean | SD | Sources of variance | SS | df | MS | F | Comparative results |
| Information, Media and Technological Skills (IMT) | | | | | | | | | |
| 1) Small | 64 | 3.196 | 0.565 | Between group | 14.248 | 2 | 7.124 | 15.318* | L > S, M |
| 2) Medium | 305 | 3.319 | 0.697 | Within group | 300.425 | 646 | 0.465 | | |
| 3) Large | 280 | 3.588 | 0.689 | Total | 314.672 | 648 | | | |
| Total | 649 | 3.423 | 0.697 | Levene's test: F = 3.207, df1 = 2, df2 = 646, p = .041 | | | | | |
| Self-regulated Learning (SRL) | | | | | | | | | |
| 1) Small | 64 | 3.231 | 0.595 | Between group | 9.349 | 2 | 4.674 | 10.764* | L > S, M |
| 2) Medium | 305 | 3.426 | 0.651 | Within group | 280.527 | 646 | 0.434 | | |
| 3) Large | 280 | 3.607 | 0.681 | Total | 289.875 | 648 | | | |
| Total | 649 | 3.485 | 0.669 | Levene's test: F = 3.231, df1 = 2, df2 = 646, p = .040 | | | | | |
| Teacher Skills (TS) | | | | | | | | | |
| 1) Small | 64 | 3.533 | 0.666 | Between group | 4.407 | 2 | 2.204 | 4.083* | L > M |
| 2) Medium | 305 | 3.578 | 0.724 | Within group | 348.628 | 646 | 0.540 | | |
| 3) Large | 280 | 3.735 | 0.760 | Total | 353.035 | 648 | | | |
| Total | 649 | 3.641 | 0.738 | Levene's test: F = 1.637, df1 = 2, df2 = 646, p = .195 | | | | | |
| Home-based Parental Involvement (HPI) | | | | | | | | | |
| 1) Small | 64 | 3.254 | 0.716 | Between group | 8.137 | 2 | 4.068 | 6.439* | L > S, M |
| 2) Medium | 305 | 3.443 | 0.784 | Within group | 408.131 | 646 | 0.632 | | |
| 3) Large | 280 | 3.608 | 0.823 | Total | 416.268 | 648 | | | |
| Total | 649 | 3.496 | 0.801 | Levene's test: F = 2.120, df1 = 2, df2 = 646, p = .121 | | | | | |
| Learning Environment Management (LE) | | | | | | | | | |
| 1) Small | 64 | 3.352 | 0.758 | Between group | 9.267 | 2 | 4.633 | 9.206* | L > S, M |
| 2) Medium | 305 | 3.435 | 0.695 | Within group | 325.120 | 646 | 0.503 | | |
| 3) Large | 280 | 3.657 | 0.713 | Total | 334.386 | 648 | | | |
| Total | 649 | 3.523 | 0.718 | Levene's test: F = .305, df1 = 2, df2 = 646, p = .737 | | | | | |

* $p < .05$

The analysis of the relationship between factors in the causal model affecting the learning loss of grade 7-9 students found that the causal factor had a positive correlation coefficient of between .332 and .820. Learning management skills (P_TS) with information and communication technological skills (ICT_TS) were determined to have the highest correlation coefficient of .820, while information and communication technological skills (ICT_TS) and homework assistance (H_HPI) had the lowest correlation coefficient of .332. All causal factors had a negative effect on student learning loss with correlation coefficients ranging from -.126 to -.338. Desirable learning characteristic learning loss (R_LL) had the highest negative correlation with self-regulated learning (C_SRL) with a correlation coefficient of -.338 and academic achievement learning loss (A_LL) had the lowest negative correlation with homework assistance (H_HPI) with a correlation coefficient of -.126.

After the examination of the basic assumption, the correlation matrix of all variables was not an identity matrix (Bartlett's test: $\chi^2=7524.302$, $df=120$, $p=.000$). The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) came out as .923, which was greater than .50, indicating that the causal factors affecting the learning loss of grade 7-9 students were sufficiently related based on the causal model analysis.

Causal Model Analysis of Learning Loss

The analysis results of the causal factor model looking at the factors affecting the learning loss of grade 7-9 students revealed that the developed model was consistent with the empirical data ($\chi^2=46.885$, $df=34$, $p=.069$, GFI=0.991, AGFI=0.964, CFI=0.999, RMSEA=0.024, SRMR=0.014). The learning loss was directly influenced by self-regulated learning, followed by information, media, and technological skills and the teacher skills, respectively. All factors had a statistically significant influence of .05 with coefficients of -.514, -.313, and -.200, respectively. To clarify, self-regulated learners with a high level of information, media, and technological skills, who perceived that their teachers had a high level of skills saw themselves as having a low level of learning loss as a result. Teacher skills also indirectly and collectively influenced learning loss with a statistical significance of .05, with an indirect influence through self-regulated learning and information, media, and technological skills with coefficients of -.298 and -.498 indicating that learners who perceived that their teachers had a high level of skills could do so because they had a high level of self-regulated learning and information, media and technological skills, which resulted in them believing that they had a low level of learning loss. In addition, the learning environment management indirectly influenced learning loss through information, media, and technological skills with a statistical significance of .05 with a coefficient of -.134, while home-based parental involvement indirectly influenced learning loss through self-regulated learning with a statistical significance of .05 and a coefficient of .253.

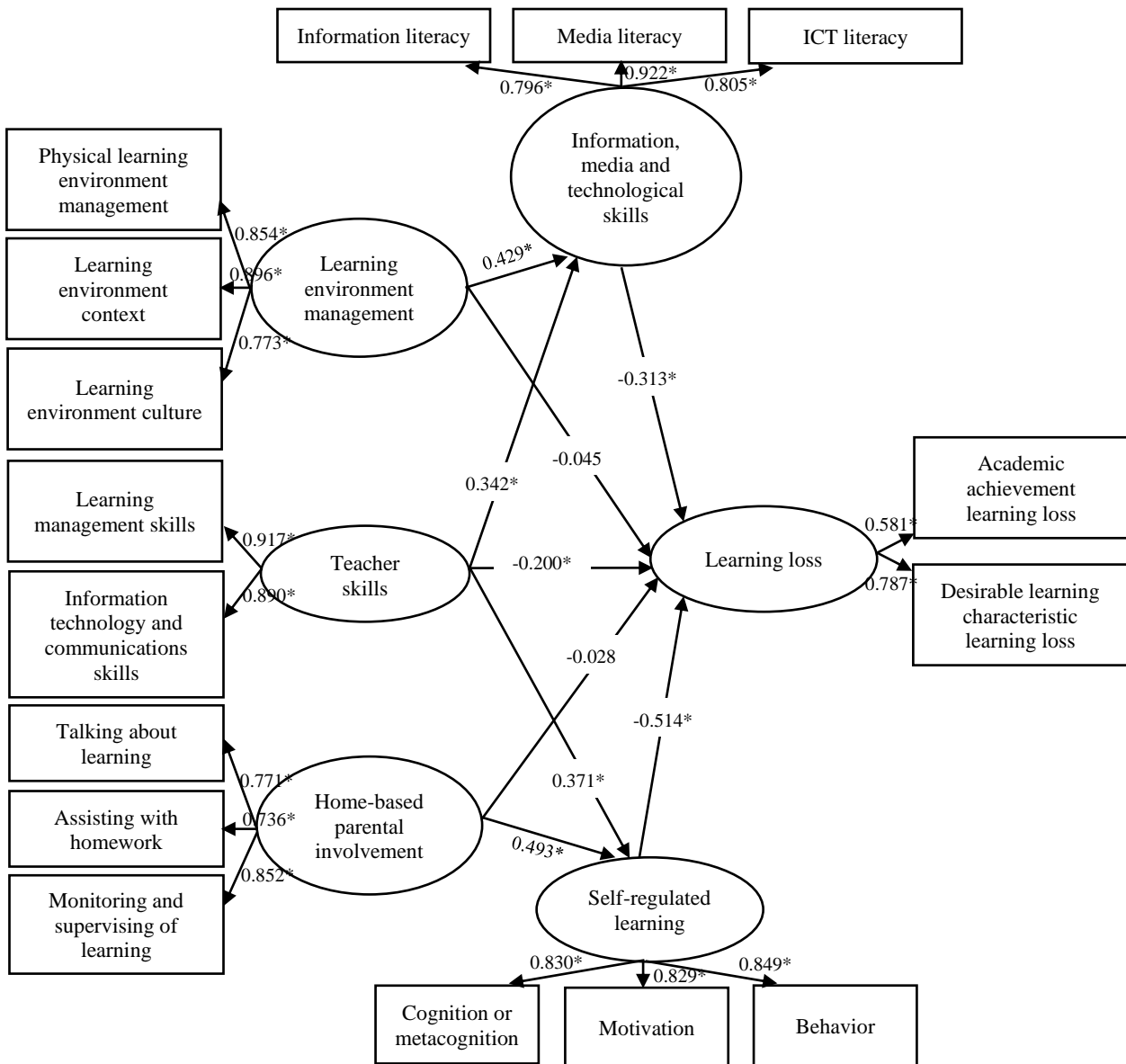
When considering the factors affecting the learners' self-regulated learning, it was found that home-based parental involvement and teacher skills directly influenced self-regulated learning with a statistical significance of .05 with coefficients of .493 and .371, respectively. In other words, learners who perceived that their parents offered a high level of participation by strongly promoting learning at home and those who perceived that their teachers had a high level of skills were able to show self-regulated learning well. As for factors affecting the information, media, and technological skills, it was found that the learning environment management and teacher skills directly influenced the information, media, and technological skills with a statistical significance of .05 and coefficients of .429 and .342, respectively. This showed that the learners who perceived the learning environment management or the teacher skills to be at a high level achieved a high level of information, media, and technological skills.

According to the study, it was found that the causal factors, including the learning environment management, teacher skills, home-based parental involvement, the information, media and technological skills, and self-regulated learning could explain the change in learners' perception of learning loss by 38.0%, while teacher skills and home-based parental involvement could explain the change in learners' perception of learning loss by 62.3%. Moreover, the learning environment management and teacher skills could explain the change in the learners' perception of learning loss by 50.0%. Further details are shown in Table 3 and Figure 2 below.

Table 3. Influence Coefficient of Causal Model of Learning Loss Among Students (n=650)

| Independent variables | Dependent variables | | | | | | | | |
|---|---|----|--------|-------------------------------|----|--------|--------------------|---------|----------|
| | Information, Media and Technological Skills (IMT) | | | Self-regulated Learning (SRL) | | | Learning loss (LL) | | |
| | DE | IE | TE | DE | IE | TE | DE | IE | TE |
| Learning Environment Management (LE) | 0.429* | - | 0.429* | - | - | - | -0.045 | -0.134* | -0.179 |
| Teacher Skills (TS) | 0.342* | - | 0.342* | 0.371* | - | 0.371* | -0.200* | -0.298* | -0.498* |
| Home-based Parental Involvement (HPI) | - | - | - | 0.493* | - | 0.493* | -0.028 | 0.253* | 0.225 |
| Information, Media and Technological Skills (IMT) | - | - | - | - | - | - | -0.313* | - | -0.313* |
| Self-regulated Learning (SRL) | - | - | - | - | - | - | -0.514* | - | -0.514* |
| | | | | | | | (-4.139) | | (-4.139) |
| R ² | 0.500 | | | 0.623 | | | 0.380 | | |

$\chi^2=46.885, df=34, p=.069, GFI=0.991, AGFI=0.964, CFI=0.999, RMSEA=0.024, SRMR=0.014, * p < .05$



$\chi^2=46.885, df=34, p=.069, GFI=0.991, AGFI=0.964, CFI=0.999, RMSEA=0.024, SRMR=0.014, * p < .05$

Figure 2. Causal Model of Learning Loss Among Grade 7-9 Students

Discussion

According to the results of the research of learning loss among lower secondary students, it was found that the students had experienced a medium to high level of perceived factors that had contributed to their learning loss, including the teacher skills, the learning environment management, and the home-based parental involvement. This shows that in the COVID-19 pandemic in the past, students perceived that teachers unsuccessfully making changes to their learning management arrangement methods might have affected their learning loss (Alam et al., 2022; Hammerstein et al., 2021; Harmey & Moss, 2023). Home-based parental involvement was second most perceived by the students to affect learning loss, which indicates that parents or guardians played a significant role in the supporting or promoting of the learners' learning management arrangement in the COVID-19 situation (Parker & Alfaro, 2022; Rousoulioti et al., 2022; Tye, 2023). However, the learners or students at this age should be at the stage when they start to become more mature and begin to develop their self-controlled or self-regulated abilities, leading to a reduced influence of parents in terms of learning, especially when they develop into adolescents who are psychologically and emotionally independent from their parents and guardians (Alam et al., 2022; Harmey & Moss, 2023). Nonetheless, lower secondary students perceived their self-regulated learning ability to gain more information, media, and technological skills to be insufficient and unnecessary, indicating that students should be encouraged in this area since research studies both in Thailand and abroad found that self-regulated learning was one of the key variables affecting academic achievement (Cleary & Kitsantas, 2017; Dent & Koenka, 2016; Trias et al., 2021).

The research results of causal factors affecting learning loss of lower secondary students revealed that the causal model highlighting the factors affecting students' learning loss at the lower secondary school level was consistent with empirical data. In addition, this was in line with the social cognitive theory of Bandura (1986) stating that a person's behavior was caused or changed not only by environmental factors but also by internal factors based on reciprocal determinism, which included the person, the person's behavior, and the environment one found oneself in. The factors that could affect learning loss, which this piece of research was particularly focused on, included the level of information, media, and technological skills, self-regulated learning, teacher skills, home-based parental involvement, and the learning environment management.

Moreover, as for the causal model or factors affecting the perceived learning loss among lower secondary students, self-regulated learning was found to have a direct impact on students' perceptions of learning loss. The reason for this is that the learners who were able to regulate their learning well had a low level of perception of learning loss. This is in line with the research of Cho et al. (2021), Cleary and Kitsantas (2017), Dent and Koenka (2016), Pelikan et al. (2021), and Trias et al. (2021) indicating that self-regulated learning was one of the key variables affecting academic achievement.

Moreover, the level of information, media and technological skills directly influenced the learners' perceptions of learning loss as well. This is in line with DiPietro et al. (2020) and Kasradze and Zarnadze (2021) which identified a total and direct association between information, media, and technology skills and learners' learning loss. In this study, the influence of information, media, and technological skills on learning loss in lower secondary students was found to be different compared to the influence of information, media, and technology skills on primary level students as primary level students needed more guidance from teachers and parents to manage their learning so that they can gain and use these skills more (Carstens et al., 2021; Kivunja, 2015). Teacher skills also played a vital role in affecting the overall perceived learning loss of students at the lower secondary level. This is consistent with DiPietro et al. (2020), Fitzpatrick et al. (2022), Ikeda and Yamaguchi (2021), Kaffenberger (2021), Kuhfeld et al. (2020), and Raymond (2021) which identified a relationship between teacher skills and the learners' learning loss. Moreover, it was found that parents' participation in promoting home learning indirectly influenced learners' perceptions of learning loss. This is partly consistent with Núñez et al. (2015) who studied the relationship between the perceived parents' participation with homework and its effects on the homework behavior of students, and the academic achievement of primary, lower secondary, and upper secondary students. The study found that the perceived parents' participation in homework and its influence on the homework behavior of students offered a significant correlation between the parents' participation and the learning achievement of primary level students. Furthermore, Boonk et al. (2018) had conducted a literature review on the relationship between parents' participation and learning achievement and found that the parents' participation was correlated with learners' achievement all ages. This is also in line with Y. Li et al. (2019) which conducted a study of the relationship between parents' participation at home, parents' educational expectations, and the academic performance of lower secondary students and found that parents' educational expectations, teaching homework or tutoring, and homework oversight had the greatest impact on the learners' performance. However, this is inconsistent with Farooq and Asim (2020) which conducted a study on the causal relationship between parents' participation, self-regulated learning, and the academic achievement of secondary-level students and found that parenting had a high impact on academic achievement and self-regulated learning. Moreover, parenting was determined to have a significant influence on the learners' attitudes toward self-regulated learning. In this regard, the results of Thomas et al. (2019) that studied the relationship between perceived parents' participation, academic achievement, and self-regulated learning among adolescent students, highlighted that the perceived parents' participation was correlated with self-regulated learning and academic achievement.

Conclusion

The current findings of this research illustrate that the perceived learning loss among middle school students was at a medium to high level. The highest mean of perceived factors related to learning loss were attributed to the level of teacher skills, followed by the learning environment management, and home-based parental involvement, respectively. The causal model of perceived factors influencing the learning loss among lower secondary students revealed that a causal model affecting lower secondary students' learning loss was consistent with empirical data ($\chi^2=46.885$, $df=34$, $p=.069$, $GFI=0.991$, $AGFI=0.964$, $CFI=0.999$, $RMSEA=0.024$, $SRMR=0.014$). The teacher skills, home-based parental involvement, and learning environment had either a direct or indirect effect on the learning loss among middle school students, while the information, media, and technological skills and self-regulated learning were found to be the mediator variables which affected the learning loss among middle school students.

Recommendations

The instructional management for the lower secondary school students to prevent learning loss during a pandemic, the school directors and teachers should show more concern and support for developing the teaching skills of teachers, encouraging parents' participation in promoting home learning, and providing effective learning environment management in both schools and the students' houses. Moreover, the information, media, and technological skill development and self-regulated learning of students should be encouraged to be able enhance the interests, awareness, and learning enthusiasm of students to prevent learning loss among the students in any future pandemic. For further research, educational researchers should focus on designing and developing effective interventions to enhance learning achievement and recover the learning loss of students after the pandemic by applying this research finding as a basis for empirical evidence of educational intervention development, especially the self-regulated learning, information, media and technological skills, and teacher skills enhancement intervention which were found to have a significant direct impact on perceived learning loss among lower secondary school students amid COVID-19 pandemic.

Limitations

The researchers acknowledge some limitations on this study including the school affiliation of the sample which included only the government school into the study to explore and examine the casual factors of the learning loss among the lower secondary school students. It would be interesting in the further research to extend the research sample to the private school students to compare or examine the same research question within different school affiliation.

Ethics Statements

This research was certified by the Human Research Ethics Committee of Srinakharinwirot University (SWUEC/E-441/2564). This study was conducted after approval of human research ethical review committee. The research team showed concern about the human research ethics and protocols at all times in this project. The research team was committed to keeping and protecting the data of the samples confidential while the samples were also offered the possibility to withdraw from this research at any time.

Acknowledgements

This research and its findings are partially based upon the research project entitled: "A study of the learning loss of learners at the basic education level from the pandemic of COVID-19: situations, lessons learned and guidelines for improving the learning qualities". The researchers are grateful to all samples in this research and sincerely profuse thanks to the Office of the Education Council, Ministry of Education, Thailand for the research fund.

Conflict of Interest

The authors declare no conflict of interest.

Funding

This research was funded by Office of the Education Council, Ministry of Education, Thailand, grant number 328/2564.

Authorship Contribution Statement

Suwathanpornkul: Conceptualization, methodology, analysis, data curation, visualization, funding acquisition, project administration, writing, editing, principal investigator, first author. Charoensuk: Conceptualization, methodology, analysis, data curation, visualization, writing, editing, corresponding author. Sakuntanak: Conceptualization, methodology, analysis, writing, editing, essential intellectual contributor. Tulmethakaan: Conceptualization, methodology, analysis, writing, editing, essential intellectual contributor. Sarnkhaowkhom: Conceptualization, methodology, analysis, writing, editing, essential intellectual contributor.

References

- Akyürek, E. (2019). Impact of using technology on teacher-student communication/interaction: Improve students learning. *World Journal of Education*, 9(4), 30-40. <https://doi.org/10.5430/wje.v9n4p30>
- Alam, M., Al-Mamun, M., Pramanik, M. N. H., Jahan, I., Khan, M. R., Dishy, T. T., Akter, S. H., Jothi, Y. M., Shanta, T. A., & Hossain, M. J. (2022). Paradigm shifting of education system during COVID-19 pandemic: A qualitative study on education components. *Heliyon*, 8(12), Article e11927. <https://doi.org/10.1016/j.heliyon.2022.e11927>
- Angrist, N., de Barros, A., Bhula, R., Chakera, S., Cummiskey, C., DeStefano, J., Floretta, J., Kaffenberger, M., Piper, B., & Stern, J. (2021). Building back better to avert a learning catastrophe: Estimating learning loss from COVID-19 school shutdowns in Africa and facilitating short-term and long-term learning recovery. *International Journal of Education and Development*, 84, Article 102397. <https://doi.org/10.1016/j.ijedudev.2021.102397>
- Asian Development Bank. (2021). *Learning and earning losses from COVID-19 school closures in developing Asia: Special Topic of the Asian Development Outlook 2021*. <https://bit.ly/4cpANs4>
- Azim Premji University. (2021, February). *Loss of learning during the pandemic*. <https://bit.ly/3Tl6fPH>
- Bandura, A. (1986). *Social foundation of thought and action: a cognitive theory*. Prentice-Hall, Inc.
- Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes*, 50(2), 248-287. [https://doi.org/10.1016/0749-5978\(91\)90022-L](https://doi.org/10.1016/0749-5978(91)90022-L)
- Bates, T. A. W. (2015). *Teaching in a digital age: Guidelines for designing teaching and learning*. Tony Bates Associates Ltd.
- Begum, A., Jingwei, L., Haider, M., Ajmal, M. M., Khan, S., & Han, H. (2021). Impact of environmental moral education on pro-environmental behaviour: Do psychological empowerment and Islamic religiosity matter? *International Journal of Environmental Research and Public Health*, 18(4), Article 1604. <https://doi.org/10.3390/ijerph18041604>
- Blaskó, Z., da Costa, P., & Schnepf, S. V. (2022). Learning loss and educational inequalities in Europe: mapping the potential consequences of the COVID-19 Crisis. *Journal of European Social Policy*, 32(4), 361-375. <https://doi.org/10.1177/09589287221091687>
- Boonk, L., Gijsselaers, H. J. M., Ritzen, H., & Brand-Gruwel, S. (2018). A review of the relationship between parental involvement indicators and academic achievement. *Educational Research Review*, 24, 10-30. <https://doi.org/10.1016/j.edurev.2018.02.001>
- Brenner, C. A. (2022). Self-regulated learning, self-determination theory and teacher candidates' development of competency-based teaching practices. *Smart Learning Environments*, 9, Article 3. <https://doi.org/10.1186/s40561-021-00184-5>
- Cardinal, J. (2020). "Lost Learning": What does the research really say? International Baccalaureate Organization. <https://bit.ly/3TGkrnA>
- Carstens, K. J., Mallon, J. M., Bataineh, M., & Al-Bataineh, A. (2021). Effects of technology on student learning. *Turkish Online Journal of Educational Technology*, 20(1), 105-113. <http://www.tojet.net/volumes/v20i1.pdf>
- Cho, Y., Kataoka, S., & Piza, S. (2021). *Philippine basic education system: strengthening effective learning during the COVID-19 pandemic and beyond: Philippines COVID-19 Monitoring Survey Policy Notes*. World Bank Group. <https://doi.org/10.1596/35649>
- Cleary, T. J., & Kitsantas, A. (2017). Motivation and self-regulated learning influences on middle school mathematics achievement. *School Psychology Review*, 46(1), 88-107. <https://doi.org/10.1080/02796015.2017.12087607>
- Coe, R., Weidmann, B., Coleman, R., & Kay, J. (2020). *Impact of school closures on the attainment gap: Rapid evidence assessment*. Education Endowment Foundation. <https://files.eric.ed.gov/fulltext/ED612885.pdf>
- Conto, C. A., Akseer, S., Dreesen, T., Kamei, A., Mizunoya, S., & Rigole, A. (2020, October). *COVID-19: Effects of school closures on foundational skills and promising practices for monitoring and mitigating learning loss*. United Nations Children's Fund Office of Research. <https://bit.ly/4clL1K8>
- Dayagbil, F. T., Palompon, D. R., Garcia, L. L., & Olvido, M. M. J. (2021). Teaching and learning continuity amid and beyond the pandemic. *Frontiers in Education*, 6, Article 678692. <https://doi.org/10.3389/educ.2021.678692>
- Dent, A. L., & Koenka, A. C. (2016). The relation between self-regulated learning and academic achievement across childhood and adolescence: a meta-analysis. *Education Psychology Review*, 28, 425-474. <https://doi.org/10.1007/s10648-015-9320-8>
- DiPietro, G., Biagi, F., Costa, P., Karpinski, Z., & Mazza, J. (2020). *The likely impact of COVID-19 on education: Reflections based on the existing literature and international datasets*. Publications Office of the European Union. <https://doi.org/10.2760/126686>

- Dorn, E., Hancock, B., Sarakatsannis, J., & Viruleg, E. (2020, June 1). *COVID-19 and student learning in the United States: the hurt could last a lifetime*. McKinsey & Company. <https://mck.co/3IGBa47>
- Durišić, M., & Bunijevac, M. (2017). Parental involvement as an important factor for successful education. *Center for Educational Policy Studies Journal*, 7(3), 137-153. <https://doi.org/10.26529/cepsj.291>
- Engzell, P., Frey, A., & Verhagen, M. D. (2021). Learning loss due to school closures during the COVID-19 pandemic. *Proceedings of the National Academy of Sciences*, 118(17), Article e2022376118. <https://doi.org/10.1073/pnas.2022376118>
- Epstein, J. L. (2010). School/family/community partnerships: Caring for the Children We Share. *Phi Delta Kappan*, 92(3), 81-96. <https://doi.org/10.1177/003172171009200326>
- Farooq, M. S., & Asim, I. (2020). Parental involvement as predictor for self-regulated learning and academic achievement of students at secondary school level. *Journal of Educational Sciences and Research*, 7(1), 14-32. <https://jesar.su.edu.pk/article/168>
- Fink, L. D. (2003). *Creating significant learning experiences: An integrated approach to designing college courses*. Jossey-Bass.
- Fitzpatrick, R., Korin, A., & Riggall, A. (2022, August 19). *An international review of plans and actions for school reopening*. Education Development Trust. <https://bit.ly/497aFPP>
- Ghavifekr, S., & Rosdy, W. A. W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. *International Journal of Research in Education and Science*, 1(2), 175-191.
- Glossary of Education Reform. (2013, August 29). *Learning loss*. <https://www.edglossary.org/learning-loss/>
- Gonzales-DeHass, A. R., Willems, P. P., & Holbein, M. F. D. (2005). Examining the relationship between parental involvement and student motivation. *Educational Psychology Review*, 17, 99-123. <https://doi.org/10.1007/s10648-005-3949-7>
- Gouëdard, P., & Pont, B. (2020). *Education and COVID-19: focusing on the long-term impact of school closures*. OECD Publishing. <https://bit.ly/3IHNF91>
- Hafizoğlu, A., & Yerdelen, S. (2019). The role of students' motivation in the relationship between perceived learning environment and achievement in science: A mediation analysis. *Science Education International*, 30(4), 251-260. <https://doi.org/10.33828/sei.v30.i4.2>
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis* (7th ed.). Pearson.
- Hammerstein, S., König, C., Dreisörner, T., & Frey, A. (2021). Effects of COVID-19-related school closures on student achievement—a systematic review. *Frontiers in Psychology*, 12, Article 746289. <https://doi.org/10.3389/fpsyg.2021.746289>
- Hanrahan, M. (1998). The effect of learning environment factors on students' motivation and learning. *International Journal of Science Education*, 20(6), 737-753. <https://doi.org/10.1080/0950069980200609>
- Harmey, S., & Moss, G. (2023). Learning disruption or learning loss: Using evidence from unplanned closures to inform returning to school after COVID-19. *Educational Review*, 75(4), 637-656. <https://doi.org/10.1080/00131911.2021.1966389>
- Hazar, E., Akkutay, U., & Keser, H. (2021). Information, media and technology skills in terms of curricula, process and product in middle and high schools. *International Journal of Technology in Education and Science*, 5(3), 288-310. <https://doi.org/10.46328/ijtes.252>
- Ikeda, M., & Yamaguchi, S. (2021). Online learning during school closure due to COVID-19. *The Japanese Economic Review*, 72, 471-507. <https://doi.org/10.1007/s42973-021-00079-7>
- Ilomäki, L., Kantosalo, A., & Lakkala, M. (2011). *What is digital competence?* EUN Partnership AISBL. <https://hdl.handle.net/10138/154423>
- Jæger, M. M., & Blaabæk, E. H. (2020). Inequality in learning opportunities during COVID-19: evidence from library takeout. *Research in Social Stratification and Mobility*, 68, Article 100524. <https://doi.org/10.1016/j.rssm.2020.100524>
- Kaffenberger, M. (2021). Modelling the long-run learning impact of the Covid-19 learning shock: Actions to (more than) mitigate loss. *International Journal of Educational Development*, 81, Article 102326. <https://doi.org/10.1016/j.ijedudev.2020.102326>
- Kasradze, T., & Zarnadze, N. (2021). Learning losses caused by the Covid-19 pandemic – a significant threat to economic development. *European Journal of Education Articles*, 4(1), 45-57. <https://doi.org/10.26417/175nzz76a>

- Khan, M. J., & Ahmed, J. (2021). Child education in the time of pandemic: Learning loss and dropout. *Children and Youth Services Review*, 127, Article 106065. <https://doi.org/10.1016/j.childyouth.2021.106065>
- Kivunja, C. (2015). Unpacking the Information, media, and technology skills domain of the new learning paradigm. *International Journal of Higher Education*, 4(1), 166-181. <https://doi.org/10.5430/ijhe.v4n1p166>
- Kuhfeld, M., Soland, J., Tarasawa, B., Johnson, A., Ruzek, E., & Liu, J. (2020). Projecting the potential impact of COVID-19 school closures on academic achievement. *Educational Researcher*, 49(8), 549-565. <https://doi.org/10.3102/0013189X20965918>
- Li, S., Tang, Y., & Zheng, Y. (2023). How the home learning environment contributes to children's social-emotional competence: A moderated mediation model. *Frontiers in Psychology*, 14, Article 1065978. <https://doi.org/10.3389/fpsyg.2023.1065978>
- Li, Y., Hu, T., Ge, T., & Auden, E. (2019). The relationship between home-based parental involvement, parental educational expectation and academic performance of middle school students in mainland China: A mediation analysis of cognitive ability. *International Journal of Educational Research*, 97, 139-153. <https://doi.org/10.1016/j.ijer.2019.08.003>
- Locke, V. N., Patarapichayatham, C., & Lewis, S. (2021). *Learning loss in reading and math in U.S. schools due to the COVID-19 pandemic*. Istation. <https://bit.ly/3wXZAn8>
- Moreno Rubio, C. (2009). Effective teachers-professional and personal skills. *ENSAYOS: Revista de la Facultad de Educación de Albacete*, 24, 35-46.
- Moscoviz, L., & Evans, D. K. (2022). *Learning loss and student dropouts during the COVID-19 pandemic: A review of the evidence two years after schools shut down* (Center for Global Development Working Paper 609). Center for Global Development. <https://bit.ly/4agX0H4>
- Nadelson, S. (2006). The role of the environment in student ethical behavior. *Journal of College and Character*, 7(5), 1-9. <https://doi.org/10.2202/1940-1639.1195>
- Nguyen, L. T., Kanjug, I., Lowatcharin, G., Manakul, T., Poonpon, K., Sarakorn, W., Somabut, A., Srisawasdi, N., Traiyarach, S., & Tuamsuk, K. (2022). How teachers manage their classroom in the digital learning environment - experiences from the University Smart Learning Project. *Heliyon*, 8(10), Article e10817. <https://doi.org/10.1016/j.heliyon.2022.e10817>
- Núñez, J. C., Suárez, N., Rosário, P., Vallejo, G., Valle, A., & Epstein, J. L. (2015). Relationships between perceived parental involvement in homework, student homework behaviors, and academic achievement: Differences among elementary, junior high, and high school students. *Metacognition and Learning*, 10, 375-406. <https://doi.org/10.1007/s11409-015-9135-5>
- Office for Civil Right. (2021). *Education in a pandemic: the disparate impacts of COVID-19 on America's students..* <https://bit.ly/490itmC>
- Pal, I., Sukwanchai, K., Bhuridatpong, A., & Pal, A. (2022). Impacts of pandemic on education sector in Thailand. *Pandemic Risk, Response, and Resilience*, 29, 457-469. <https://doi.org/10.1016/B978-0-323-99277-0.00016-4>
- Parker, M., & Alfaro, P. (2022). *Education during the COVID-19 pandemic: Access, inclusion and psychosocial support, Studies and Perspectives*. United Nations - Economic Commission for Latin America and the Caribbean (ECLAC). <https://hdl.handle.net/11362/47741>
- Pelikan, E. R., Lüftenegger, M., Holzer, J., Korlat, S., Spiel, C., & Schober, B. (2021). Learning during COVID-19: The role of self-regulated learning, motivation, and procrastination for perceived competence. *Zeitschrift für Erziehungswissenschaft*, 24, 393-418. <https://doi.org/10.1007/s11618-021-01002-x>
- Raymond, M. M. (2021, May 5). *Learning losses—what to do about them*. Hoover Institution. <https://hvr.co/4coeLWU>
- Rousoulioti, T., Tsagari, D., & Giannikas, C. N. (2022). Parents' new role and needs during the COVID-19 educational emergency. *Interchange*, 53, 429-455. <https://doi.org/10.1007/s10780-022-09464-6>
- Rusticus, S. A., Pashootan, T., & Mah, A. (2023). What are the key elements of a positive learning environment? Perspectives from students and faculty. *Learning Environments Research*, 26, 161-175. <https://doi.org/10.1007/s10984-022-09410-4>
- Sabates, R., Carter, E., & Stern, J. M. B. (2021). Using educational transitions to estimate learning loss due to COVID-19 school closures: The case of complementary basic education in Ghana. *International Journal of Educational Development*, 82, Article 102377. <https://doi.org/10.1016/j.ijedudev.2021.102377>
- Salciccioli, M. (2021). *Understanding and addressing disruptions to learning during the COVID-19 pandemic*. CSBA Research and Policy Brief. <https://bit.ly/4ahD7Q1>

- Salmani Nodoushan, M. A. (2012). Self-regulated learning (SRL): Emergence of the RSRLM model. *International Journal of Language Studies*, 6(3), 1-16. <https://bit.ly/3VoEx75>
- Selvaraj, A., Vishnu, R., KA, N., Benson, N., & Mathew, A. J. (2021). Effect of pandemic based online education on teaching and learning system. *International Journal of Educational Development*, 85, Article 102444. <https://doi.org/10.1016/j.ijedudev.2021.102444>
- Smith, C., Tani, M., Yates, S., & Dickinson, H. (2023). Successful school interventions for students with disability during Covid-19: Empirical evidence from Australia. *The Asia-Pacific Education Researcher*, 32, 367-377. <https://doi.org/10.1007/s40299-022-00659-0>
- Takács, R., Takács, S., Kárász, J. T., Oláh, A., & Horváth, Z. (2023). The impact of the first wave of COVID-19 on students' attainment, analysed by IRT modelling method. *Humanities and Social Sciences Communications*, 10(1), Article 127. <https://doi.org/10.1057/s41599-023-01613-1>
- Thomas, V., De Backer, F., Peeters, J., & Lombaerts, K. (2019). Parental involvement and adolescent school achievement: The mediational role of self-regulated learning. *Learning Environments Research*, 22, 345-363. <https://doi.org/10.1007/s10984-019-09278-x>
- Toren, N. K., & Seginer, R. (2015). Classroom climate, parental educational involvement, and student school functioning in early adolescence: A longitudinal study. *Social Psychology of Education*, 18, 811-827. <https://doi.org/10.1007/s11218-015-9316-8>
- Trias, D., Huertas, J. A., Mels, C., Castillejo, I., & Ronqui, V. (2021). Self-regulated learning, academic achievement and socioeconomic context at the end of primary school. *Interamerican Journal of Psychology/ Revista Interamericana De Psicología*, 55(2), Article e1509. <https://doi.org/10.30849/ripij.v55i2.1509>
- Tye, N. (2023). Engaging families after Covid: Reconnecting in the classroom. *Bridging Research to Practice*, 18(1), 61-69. <https://doi.org/10.1108/PDSP-01-2023-0003>
- van Gelder-Horgan, K. (2016). Parental involvement in home-based education. *Journal of Initial Teacher Inquiry*, 2, 21-23. <https://ir.canterbury.ac.nz/handle/10092/12844>
- Wolters, C. A., Pintrich, P. R., & Karabenick, S. A. (2003, March 12-13). *Assessing academic self-regulated learning*. [Conference presentation]. ChildTrends, National Institutes of Health Conference, Washington, DC, United States. <https://bit.ly/43wiIVl>
- World Bank, United Nations Educational, Scientific and Cultural Organization, & United Nations Children's Fund. (2021). *The state of the global education crisis: A path to recovery*. The World Bank, United Nations Educational, Scientific and Cultural Organization, and United Nations Children's Fund. <https://bit.ly/48OpU0j>
- Zellman, G. L., & Waterman, J. M. (1998). Understanding the impact of parent school involvement on children's educational outcomes. *The Journal of Educational Research*, 91(6), 370-380. <https://doi.org/10.1080/00220679809597566>
- Zhdanov, S. P., Baranova, K. M., Udina, N., Terpugov, A. E., Lobanova, E. V., & Zakharova, O. V. (2022). Analysis of learning losses of students during the COVID-19 pandemic. *Contemporary Educational Technology*, 14(3), Article ep369. <https://doi.org/10.30935/cedtech/11812>
- Zierer, K. (2021). Effects of pandemic-related school closures on pupils' performance and learning in selected countries: A rapid review. *Education Sciences*, 11(6), Article 252. <https://doi.org/10.3390/educsci11060252>
- Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist*, 25(1), 3-17. https://doi.org/10.1207/s15326985ep2501_2
- Zimmerman, B. J., & Schunk, D. H. (Eds.). (1989). *Self-regulated learning and academic achievement: Theory, research, and practice*. Springer. <https://doi.org/10.1007/978-1-4612-3618-4>