



Exploring factors determining the Online Learning Effectiveness of Primary Students

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ARTICLE INFO

Article History:

Received: 07 March 2024

Received in Revised Form: 22 May 2024

Accepted: 28 June 2024

DOI: 10.14689/ejer.2024.111.03

Keywords

Online learning, Technology competence, Effectiveness, Family Support, Engagement

ABSTRACT

Purpose. Online teaching was adopted in Hong Kong and many other places worldwide in compliance with the lockdown protocol during the COVID-19 pandemic. This research explores factors affecting the effectiveness of primary students' online learning as measured by students' responses to a questionnaire designed for this study. **Method.** 1,810 students from primary schools in Hong Kong from 15 out of 18 districts in Hong Kong completed the questionnaire in 2023. A Questionnaire was developed for this study to measure four factors, namely, family support in providing hardware and software to students, students' technology competence in using computers or iPads for learning, students' engagement in online learning, and online learning effectiveness. Confirmatory Factor Analysis showed that the questionnaire was reliable and valid. Structural Equation Modeling was used to test the hypotheses.

Findings. The findings showed that family support in providing hardware and software and students' technology competence significantly affect students' engagement during online learning, and students' engagement significantly positively affects online learning effectiveness. **Implications for Research and Practice.** The study can cast light on the important relationships of family support and students' technology competence on students' learning engagement and online learning effectiveness. Furthermore, online teaching can be effective for primary students if sufficient support can be available.

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Introduction

The COVID-19 pandemic necessitated the use of online teaching in Hong Kong and many other places worldwide due to lockdown protocols. The transition from face-to-face

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teaching in primary and secondary schools introduced a range of challenges for teachers and students. However, the transition also offered an excellent opportunity to investigate whether online learning can be effective and what factors can enhance online learning effectiveness. Several studies were published during this time that examined challenges, obstacles and factors affecting the outcomes of students' online learning. These initial challenges and obstacles faced by teachers and students have been identified and discussed extensively in the literature. These challenges which later emerged as areas for improvement included hardware and software support (Ferri et al., 2020), family support and parental engagement (Novianti & Garzia, 2020; Setiawan et al., 2022), student motivation and engagement (Ferri et al., 2020), and students' interactions with teachers and peers (Ferri et al., 2020). Among various factors mentioned in previous studies that posed challenge to the teachers and students of primary levels also comprised parental support, students' competence, engagement and online learning effectiveness. These factors helped examine the significant relations between variables and online learning effectiveness.

There are some studies conducted during the early stage of primary students' online learning in Hong Kong and China (Zheng et al., 2022) and other countries (Fauzi et al., 2021; Liao et al., 2021; Widikasih et al., 2021). However, there is little or no research on the effect of various demographic data, family support, students' technology competence, and students' engagement on online learning effectiveness for primary students. This study was designed to fill the research gap by finding out the influence of various demographic data, family support, technology competence, and engagement on online learning effectiveness. This study was conducted in 2023, after the completion of online teaching in Hong Kong, offering an opportunity to analyze the effects with a more comprehensive view of the whole online learning process from the primary students involved.

The current study sets out to study some of these factors affecting the effectiveness of online learning in Hong Kong primary students. In the current context of examining the factors that posed challenges to primary/elementary schools, this study proposed to study the relationship among four factors: family support, students' technology competence, students' engagement, and perceived online learning effectiveness. The term "primary schools" in Hong Kong refers to schools offering formal education to students from 6 to 12 years old. Online teaching in primary schools was usually conducted with the support of the internet, hardware including computers or iPads, and applications such as Zoom and Microsoft Teams so that teachers can deliver their teaching with visual and audio communication with students at home.

Literature Review

Online Learning Effectiveness

Online learning effectiveness is a multi-dimensional concept with different variables measured (Darkwa & Antwi, 2021). Different dimensions or variables are used to measure the concept of learning effectiveness such as achieving learning outcomes, satisfaction, and interaction (Darkwa et al., 2021). Online learning effectiveness in this study is defined as outcomes related to students' perception of successfully achieving the online learning objectives with satisfaction, interest, and interaction. There is no dearth of studies about online learning experience related to primary school students during COVID-19

(Abdurrahmansyah et al., 2022; Andarwulan et al., 2021; Cui et al., 2021; Fauzi et al., 2021; Rasmitadila et al., 2020; Setiawan et al., 2022; Zanon et al., 2021). These studies show that there are various factors associated with the effectiveness of online learning; namely, technology and facilities support (Abdurrahmansyah et al., 2022; Fauzi et al., 2021; Rasmitadila et al., 2020), family and parental support (Setiawan et al., 2022; Zanon et al., 2021), students' technology competence, engagement (Pramana, 2021), and difficulty in achieving learning objectives (Lubis & Dasopang, 2021).

Prior studies have conducted qualitative research on several other factors associated with elementary students' online learning, including students' readiness, family support, student learning facilities and learning atmosphere (Setiawan et al., 2022); online learning facilities (Abdurrahmansyah et al., 2022); difficulty in achieving learning objectives, network disruption, and high cost (Lubis et al., 2021). All these studies are abound with definitions and measurement of effectiveness in e-learning and measurement of learning outcomes (Noesgaard & Ørngreen, 2015).

Factors related to online learning effectiveness

Family Support

Family support is defined as parental support to enhance students' online learning. It includes all hardware, internet, and software support facilities that students' need for their engagement in online learning (Domina et al., 2021; Ferri et al., 2020) specifically, family support includes variables like parental engagement, provision of support facilities and a learning environment at home. Parental engagement in children's online learning shows that most parents accompany and supervise children in online learning from the first and second grades of primary school (Novianti et al., 2020). Facilities support also affect online teaching and learning effectiveness (Abdurrahmansyah et al., 2022). Abdurrahmansyah et al. (2022); (Widikasih et al., 2021) found that almost half of the students of an elementary school in their study needed help with sufficient support such as online facilities and others facilities. Learning environment at home refers to the availability of physical space at home to attend online learning without disturbances. This is a factor that affects online learning effectiveness the most (Ferri et al., 2020; Setiawan et al., 2022). Distractions by noise and presence of other members at home may also affect students' concentration in online learning. Hence, summarizing the various factors of family support, the first hypothesis of this study was framed:

H1: *Family support positively affects primary students' engagement in online learning.*

Students' Technology Competence

In Hong Kong, online teaching in primary schools is usually conducted with the support of the internet, hardware including computers or iPads, and software applications such as Zoom and Microsoft Teams. Studies found that technical competence of students is an area of concern and challenge for them to engage in online learning (Ferri et al., 2020; Setiawan et al., 2022; Zheng et al., 2022). For students to engage in online learning effectively, they need the technical competence to use computer or iPad to listen to teacher's instruction, communicate with teacher, discuss with classmates using Zoom or Microsoft Teams, searching for learning materials and completing tasks during online learning. The whole learning process of learning requires technical competence (Kauffman,

2015). Hence the second hypothesis was proposed:

H2: *Technology competence positively affects online learning effectiveness.*

Family support including parental engagement, and provision of hardware and software facilities can enhance students' skills and competence needed in online learning. Better facilities provided by family will increase students' opportunities and self-efficacy to use technology in learning. For primary students who do not know how to overcome some technical problems during online learning, parental engagement may help them overcome their problems and acquire the technical competence required for learning. Hence, the third hypothesis was framed:

H3: *Family support positively affects students' technology competence.*

Students' Engagement

Student engagement has received attention from researchers for decades as an essential factor in improving students' learning (Fredricks et al., 2004; Martins et al., 2022; Schaufeli et al., 2002). Student engagement has different definitions and interpretations (Fredricks et al., 2004; Martins et al., 2022; Schaufeli et al., 2002). According to various researchers, student engagement is a multi-dimensional construct, and the dimensions of student engagement vary among the studies. Fredricks et al. (2004) suggested three dimensions of student engagement, namely, behavioral, emotional, and cognitive. Schaufeli et al. (2002) proposed that vigor, absorption, and dedication are the three critical dimensions of student engagement. However, for online learning, students' behavioral engagement depends on technology competence needed in following teacher's instruction, interacting with others and to complete learning tasks. Hence, the fourth hypothesis of the study was proposed:

H4 *Technology competence positively affects student engagement*

Students' engagement is significantly associated with learning effectiveness (Gunuc, 2014; Hughes et al., 2008; Martins et al., 2022). Elementary students' engagement is significantly associated with academic achievement (Galla et al., 2014; Martins et al., 2022). Hence, the fifth hypothesis is proposed thus:

H5: *Student engagement positively affects online learning effectiveness.*

Online Learning and Face-To-Face Learning

Research findings for primary schools show that 67.2% of students prefer face-to-face learning, and only 12.8% prefer online learning (Zheng et al., 2022). Lumbanraja and Purwanto (2021) also found that online learning is less effective for elementary schools. A study in China involving more than 28,000 students aged six to eight years found that most parents were unhappy with online learning, and 53% of students felt tired by the experience (Zhu et al., 2022). The above findings suggested that primary students prefer face-to-face to online learning.

The report of the 2023 Territory-wide System Assessment (TSA) submitted by the Hong Kong Examinations and Assessment Authority (HKEAA) showed a drop in the attainment rates of the Primary Three and Primary Six students in the assessment of three subjects of Chinese Language, English Language and Mathematics. The drop resulting from three

years of pandemic seems to imply a drop in learning effectiveness due to online learning. Hence, hypothesis 6 was proposed

H6: Primary students perceived online learning effectiveness is lower than face-to-face learning effectiveness.

The hypotheses of the study can be summed up as follows:

Hypothesis 1: Family support positively affects primary students' engagement in online learning.

Hypothesis 2: Technology competence positively affects online learning effectiveness

Hypothesis 3: Family support positively affects students' technology competence.

Hypothesis 4: Technology competence positively affects student engagement.

Hypothesis 5: Student engagement positively affects online learning effectiveness.

Hypothesis 6: Primary students perceived online learning effectiveness is lower than face-to-face learning effectiveness.

Based on the extant literature review and the proposed hypotheses, a theoretical model was proposed for this study as shown in Figure 1, depicting the relationships among family support, students' technology competence, student engagement, and online learning effectiveness.

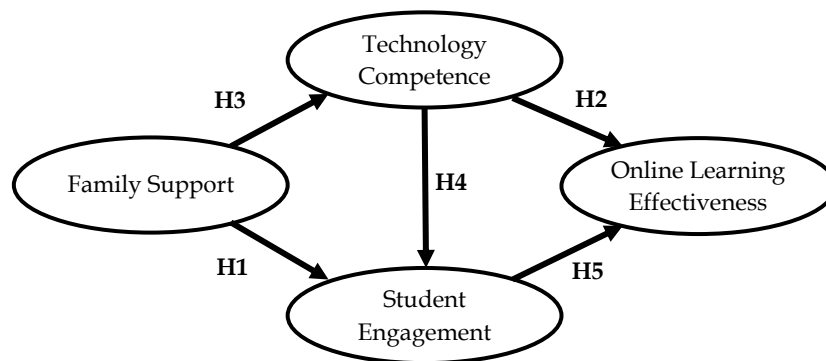


Figure 1: Theoretical Model.

Method

Research Design

A cross-sectional survey research design was adopted in this study, selecting school students of all districts in Hong Kong, and coming from different socioeconomic backgrounds. Demographic data related to age and sex were also collected. Statistics on the average household income of various districts can be found. Responses from different districts can shed light on the comparison of the effects of household income on online learning effectiveness, an area not well studied before. As no similar research has been conducted before which investigated the relationships between various factors related to online learning effectiveness and the effects of some demographic data on online learning effectiveness, this study can cast light on what affects online learning effectiveness and ways to improve online learning effectiveness.

Sampling

The sample was identified through random sampling technique. An email containing a questionnaire was sent to a few schools randomly selected in each of the 18 districts in Hong Kong requesting their support to arrange for students to respond to the questionnaire. Based on the responses, a sample size of 1810 students from 15 districts were finally obtained for the study. There were 904 boys and 906 girls from Primary One to Primary Six responding to the questionnaire. The sample size was adequate to develop the relationships between variables using structural equation modelling and the effects of various demographic data on online learning effectiveness.

Research Instruments

This study developed five scales according to the definition proposed in the study and literature review to measure the five variables using a 5-point Likert scale with one as strongly disagree and five as strongly agree. The five scales were on each variable namely family support, students' technology competence, students' engagement, student-perceived online learning effectiveness and comparison of online learning effectiveness with face-to-face learning effectiveness.

The family support scale comprised four items related to components like parental support given to enhance students' online learning, providing hardware and software facilities and a physical environment conducive to learning. For technology competence, a scale of five items was developed to measure students' interest and ability in using technology to learn, to improve learning outcomes and to solve problems. For student engagement, a scale of five items measured learning effectiveness during online learning with items related to students' effort, persistence, attention, participation, interaction with teachers and peers, following teachers' instructions, concentrating on learning and completing the task of learning without disruption. The online learning effectiveness scale was based on two scales, one measuring e-learning effectiveness (Noesgaard et al., 2015) and another measuring students' perception of achieving the online learning outcome and learning objectives with satisfaction, interest, interaction with others, and focus on the teacher's instructions. (Darkwa et al., 2021). A scale comprising five items was developed to measure the perceived learning effectiveness of primary students during online learning. Finally, a scale of three items was developed to measure students' comparison of the learning effectiveness between online and face-to-face learning.

Data analysis

Statistical analyses of the data were conducted using IBM SPSS version 28 and Amos version 28. The measures were calculated to examine all variables family support, students' technology competence, student engagement, online learning effectiveness, and comparison of learning effectiveness between online and face-to-face learning. The analyses was conducted through the following stages: (1) reviewing related literature and instruments already developed; (2) proposing constructs related to this study and defining the constructs to be measured; (3) developing instruments according to the proposed constructs, the situation of primary schools in Hong Kong, and instruments used in other studies; (4) seeking comments from focus groups and professionals who have relevant

experience and expertise to refine the proposed instruments; (5) collecting data to validate the instruments; (6) conducting confirmatory factor analysis to validate the instruments; (7) using structural equation modelling to investigate the relationships among variables as proposed in the conceptual model.

Results

Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) was conducted for the five factors to confirm the validity and reliability of the questionnaire. The analyses showed that the model had excellent goodness of fit (CFI: 0.968; TLI: 0.963; RMSEA: 0.045). The standardized regression weights on the respective factor of all items, except one with 0.569, were larger than 0.7. There were no crossing loadings of any item on two factors and no correlation between error terms. To test whether the factor model was valid for different age groups, CFA was conducted for the following three different age groups: 8-9 years, 10-11 years, and 12 years and above. The sample size for the three groups varied as 418, 1072 and 320 respectively. The goodness of fit indices is reported in Table 1 below. The results show that the model fit of different age groups of students is excellent.

Table 1

Goodness of fit for CFA of different age groups

Age Group	CFI	TLI	RMSEA	Sample size
8-9 years	.942	.933	.033	418
10-11 years	.963	.957	.050	1072
12 years and above	.949	.941	.061	320
All age group	.968	.963	.045	1810

Structural Equation Model

Structural equation modelling was conducted to test the theoretical model. The results had already showed an excellent model fit between the data and the theoretical model for the whole sample as revealed in Table 1. The Invariant model analyses was next conducted for the model for different genders and two different age groups, senior students and junior students, respectively. The results showed that data with different gender and different age groups also fit the model with constraints of having same measurement weights, intercepts, structural weights, structural covariances, structural residuals and measurement errors. The CFI ranged from 0.965 to 0.971, TLI from 0.966 to 0.969 and RMSEA from 0.033 to 0.035 for both analyses. These results show that the relationship between variables was the same for different genders and different age groups.

Table 2 reports the Cronbach Alpha Reliability, Composite Reliability and correlations among the constructs. The Cronbach Alpha reliability ranged from 0.797 to 0.904. The Composite Reliability ranged from 0.811 to 0.904. The correlations between constructs ranged from .572 to .837 and were all significant at the .001 level. These analyses show that the constructs were distinct and had discriminant validity (Taherdoost, 2016). They were

also assumed to show content validity, as a review of relevant literature and input from education experts developed the items.

Table 2

Average Variance Extracted (AVE), Composite Reliability (CR), Cronbach Alpha Reliability (Alpha), Correlations among the Four Constructs (N=1,810)

Construct	AVE	CR	Alpha	1	2	3
Family Support (1)	.521	.811	.797			
Technology Competence (2)	.655	.904	.904	.577*		
Students' Engagement (3)	.621	.891	.890	.572*	.837*	
Perceived Effectiveness (4)	.570	.868	.867	.663*	.722*	.768*

*p<.001

Table 3 shows the standardized direct effects and standardized total effects between variables.

Table 3

Standardized Direct Effect (Standardized Total Effect) of Family Support, Technology Competence and Engagement on Other Variables

	Family support	Technology competence	Engagement
Technology competence	.642* (0.642*)	.000	.000
Students' Engagement	.077* (0.642*)	.880* (.880*)	.000
Perceived effectiveness	.329* (0.743*)	.000 (.556*)	.739* (.739*)

*p<.001

These results show that Family Support had a significant standardized direct effect of .077 and a total effect of 0.642 on engagement, supporting Hypotheses 1, which states that family support positively affects primary students' engagement in online learning. Family Support also showed a significant standardized direct and total effect of .642 on students' technology competence, supporting Hypothesis 3, which states that Family support positively affects students' technology competence. Likewise, Students' technology competence had a significant direct and total effect of 0.880 on student engagement. These result support Hypothesis 4, which states that technology competence positively affects student engagement.

Student engagement also showed a significant direct and total effect of 0.739 on online learning effectiveness, supporting Hypothesis 5, which states that student engagement positively affects online learning effectiveness. However, students' technology competence showed no significant direct effect but a significant total effect of 0.556 on online learning effectiveness, which supports Hypothesis 2. This suggests states that technology competence positively affects online learning effectiveness. These results show that technology competence positively affects online learning effectiveness through the intervening variable of engagement. Likewise, Family support showed a significant standardized total effect of 0.743 on online learning effectiveness. Considering the relationship between family support and online learning effectiveness, family support accounted for 55.2% of the variance of online learning effectiveness. Similarly, technology competence had a standardized total effect of 0.556 on online learning effectiveness,

implying that 30.9% of the variance of online learning effectiveness was affected by students' technology competence. Engagement had a total effect of 0.739 on effective online learning, representing an influence of around 54.6% on online learning effectiveness. Various studies have proposed the relationships between the variables, and the results of this study supported the findings of other studies. All these results show that relationships proposed among the variables are supported by data and support the predictive validity of the measurement scales and conceptual model (Taherdoost, 2016).

Table 4 reports the mean, standard deviation and one sample t-test of all five constructs. The t-test results show that the mean value of family support, technology competence, engagement, and learning effectiveness was significantly above 0.001 on a five-point Likert scale, with 1 as Strongly Disagree and 5 Strongly Agree. The results show that primary students had significant positive views on family support, technical competence, engagement and learning effectiveness, as the means are all higher than 3.0 on a 5-point Likert Scale. Students rated face-to-face teaching effectiveness as higher than online learning effectiveness, with a mean of 3.463, significantly higher than 3. Hence, Hypothesis 6, which states that students perceived face-to-face learning as more effective than online learning, is supported.

Table 4

Means, Standard Deviation (SD), and One Sample T-test of the Five Factors Measured on a 5-point Likert Scale (N = 1810)

	Mean	SD	Standard error	t-value	df
Family support	3.794	.906	.022	36.699*	1753
Technical competence	3.530	1.016	.024	21.863*	1753
Students' Engagement	3.479	1.012	.024	19.865*	1753
Learning effectiveness	3.465	.986	.024	19.771*	1753
Face-to-face better than online	3.463	1.065	.025	18.228*	1753

*p<.001

Effects of Demographic Data

The CFA and SEM analyses showed that the relationships between variables were the same for different genders and different age groups. These results confirm that the association between variables was the same for different genders and age groups. To test whether there were differences for the four variables between genders, age groups and family income, t-tests were performed. T-tests showed that there were no significant differences for the four variables between male and female. Among the four variables, only family support had a significant difference between senior and junior students, with senior students perceiving higher support from family. However, the effect size was 0.176, suggesting that the difference was practically very small.

According to government statistics, students' family incomes were divided into higher and lower incomes. T-tests were conducted between the two income groups. Students from the lower income group rated significantly higher than students from the higher income groups for online learning effectiveness, engagement, and technology competence. However, the effect sizes for the differences were small, at 0.170, 0.126, and 0.180, respectively. Considering the large sample and small effect sizes, the differences could be

considered practically very small. There was no significant difference between the two groups for family support.

Discussion

The study revealed a number of findings based on responses obtained from primary data collected from school students in Hong Kong. Not only the findings support the theoretical model of this study but also provided enough evidence to accept all six hypotheses. For instance, Confirmatory Factor Analysis and Structural Equation Modeling supported the five measurement scales used in this study, which exhibited reliability as well as content and predictive validity. Regarding the students' perception about variables of the study, it was revealed that students positively view family support. Almost every young Hong Kong child is provided quality education as well as Internet and technology access, which is evident of a good family support in place. The government also provides special financial support to needy families, enabling all families to provide Wi-Fi and iPads to their children during online learning.

In addition, students also showed positive perceptions about online learning's effectiveness, though they perceived it less effective than face-to-face learning. This result is in line with other studies and can also explain the findings of the 2023 Territory-wide System Assessment (TSA) report showing a decline in students' achievement during the pandemic. From a developmental perspective, students need to acquire all-around development in intellectual, spiritual, moral, social, physical, and other aspects. Online learning may successfully achieve some curriculum objectives, but it may not provide other opportunities for the all-round development of a child under 12 years age. However, the results of this study suggest that online teaching cannot replace face-to-face teaching in primary schools in the present situation.

The variable of students' technology competence also showed a significant association with students' engagement, and online learning effectiveness. However, it was felt that improving students' technological competence would be a crucial element in supporting students' online learning. Under the context of the rapid development of technology, such as artificial intelligence and other technical applications, technology will play a more critical role in enhancing students' learning effectiveness. Classrooms are likely to show an increase in the use of information technology. Hence, schools and teachers should emphasize developing students' technology competence. The government should also provide more support to schools and families in enhancing students' development in technology competence.

The effects of demographic data including gender, age group and family income on students' perception of their family support, technology competence, students' engagement and online learning effectiveness showed some interesting results. There is no significant difference between different genders in all variables, implying that females are not handicapped by adopting technology in learning. There is also no significant difference between senior and junior students in online learning effectiveness, technology competence and students' engagement. Senior students perceive significant higher support from family than junior students with a small effect size of 0.176. Due to the large sample size and small effect size, one can interpret that the difference is in practice very small. The difference may be explained in the context of the education system in Hong Kong.

Examination results of primary 5 and primary 6 students are used to assess students' academic achievement which will affect their ranking in the Secondary School Places Allocation. The Chinese culture of emphasizing the importance of getting into a high-ranking school will push parents to give more support and encouragement to senior students to study. Hence, it is unexpected to find senior students receiving higher family support in such a situation.

With respect to income levels, the findings reveal that students from the lower income groups rated significantly higher than those from the higher income groups for online learning effectiveness, engagement, and technology competence. These findings do not align with previous findings that students from families of higher socioeconomic status have better academic achievement. Due to the large sample size and small effect size, one may interpret that the difference is very small practically. The results can also be interpreted in the light of the perception of some primary school principals, who felt that students coming from lower income groups usually cannot afford to have an iPad/computer and good Wi-Fi facilities. However, due to government support, they can have a new experience of learning with adequate facility support. This change might motivate them to engage in learning, solve problems with the use of technology and enhance their perception of learning effectiveness.

Conclusion

This research attempted to explore factors affecting the effectiveness of primary students' online learning through students' first-hand responses to a questionnaire. The primary data was collected to measure four factors, namely, family support in providing hardware and software to students, students' technology competence in using computers or iPads for learning, students' engagement in online learning, and online learning effectiveness. A theoretical framework was designed to show the relationship between all the variables. The findings revealed that family support and students' technology competence positively affected students' engagement and online learning effectiveness. Furthermore, students revealed positive perception on all four variables as reflected in the average ratings, which were all significantly higher than three in a 5-point Likert scale. One may conclude that online learning in Hong Kong is quite successful under the financial and policy support of the government and the efforts of schools in facing the challenge of lock down. This study's findings further support the reliability and validity of using a questionnaire for measuring primary students' perception of their learning effectiveness and other variables.

This study finds no significant difference between gender and age groups of primary school students in online learning effectiveness. Students from lower income groups were not found handicapped in online learning as compared to students from higher income groups. They even showed a better perception of online learning effectiveness due to the government's adequate financial support for them to have adequate hardware support. These findings will provide insights and directions for future research and policy of encouraging the application of technology in education and improving learning effectiveness, especially online learning effectiveness. The findings in this study will aid teachers, parents, and educational stakeholders (such as government officials, non-governmental institutions, and investors) in maximizing the benefits of technology for primary students across Hong Kong and improving learning effectiveness.

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