VIỆN KHOA HỌC GIÁO DỤC VIỆT NAM

THE VIETNAM NATIONAL INSTITUTE OF EDUCATIONAL SCIENCES

GOOGLE SOLUTIONS IN VIETNAM

HOW TECHNOLOGY TRANSFORMS TEACHING AND LEARNING

Experimental School of Educational Science

Google for Education

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EXECUTIVE SUMMARY

The central question in the present research is how Vietnamese teachers and students use Google Solutions to motivate students' learning. By sampling 16 teachers and 38 students from a public school in Hanoi, the present research investigated students' and teachers' attitudes toward using technology in the classroom as well as their practices in using Chromebooks and Google Workspace for Education. The results show that:

(1) both students and teachers had positive attitudes toward using technology in the classroom for teaching and learning;

(2) teachers and students found Chromebooks and Google Workspace for Education valuable for teaching and learning;

(3) teachers expressed their interest in using Chromebooks mostly because the device consisted of many applications teachers can use for different purposes, such as online teaching, assessment, and classroom management. They were more comfortable to use Google Workspace for Education for their teaching after the pilot;

(4) teachers also recognised that the use of Google Solutions had a positive effect on students' learning;

(5) teachers saved time significantly when using Google Solutions for their teaching;

(6) students' comfort levels in using Google applications increased and students were more confident to use these applications after the pilot;

(7) students perceived that Chromebooks were suitable for their learning and they were willing to introduce Chromebooks for their friends;

(8) using Google applications gave students more opportunities to collaborate and communicate with their peers as well as to solve the problems during their learning;

(9) there were no differences in students' motivation on learning Math before and after the pilot;

Further research is needed by expanding the pilot in different school contexts, which will provide more evidence on the effectiveness of Google solutions for Education in Vietnam.

INTRODUCTION

Technology plays a significant role in bringing innovation to teaching and learning practices (Akram et al., 2022). Research shows that by using technology in education, students are more interested in their learning, lessons become more interesting, time is saved, and interaction and cooperation between students and teachers is developed (Alexiou-Ray et al., 2003; Hüseyin & Faruk, 2020). In terms of students' use, technologies can support students to engage collaboratively and become creative learners. These technologies can support the creation of new knowledge and the development of new skills (Voogt et al., 2018). To support schools, teachers and students with the use of technology for teaching and learning activities, various technological applications from different providers have been developed, such as applications for education from Microsoft or Google.

In Vietnam, researchers have also been interested in Information and Communications Technologies (ICT) applications. For example, Vu Thanh Dung (2018) proposed some methods to apply ICT in teaching at high school in Vietnam to meet the demand of the 4th industrial revolution. The author proposed that it is necessary to clearly define the contents of ICT application in the teaching process in high schools; train teachers well; and ensure information technology infrastructure is fully equipped. Teachers and students have also been guided to apply different types of technology for teaching and learning activities in various subjects, especially during the Covid-19 situation. For instance, applying ICT in teaching statistics to real-life problems in high schools using CASIO calculators and Microsoft Excel (Tran Trung & Nguyen Tien Manh, 2019), or using the "chemist by thix" software to build virtual chemistry experiments for high school students (Vu Thi Thu Hoai & Vu Thu Trang, 2020).

One way of applying technology into the classroom is to use tools such as Google Workspace for Education and Chromebooks. Many guidelines for them were published to help teachers and students easily approach using these tools (Hart-Davis, 2018; Hart-Davis, 2021; Iyer, 2022). Researchers were also interested in investigating the effectiveness of using Google Workspace for Education and Chromebooks in the classrooms. For example, Alia and Hamtini (2019) measured the learners' and teachers'

satisfaction level with Google Classroom. The findings show that most of the learners are satisfied with Google Classroom, indicating its effectiveness as a learning management system. Google Solutions were also applied in Korea, and the pilot results showed that Google Solutions helped teachers in terms of time efficiency in work and teaching activities, brought positive changes to students' learning activities, and effectively supported class management, feedback and communication. The potential of Google Solutions in classes was proved, and the direction for improvement was suggested to overcome the barriers to using technology in classes (Center for Innovation of Future Education Seoul National University, 2021).

In Vietnam, researchers also proposed different aspects of exploring Google products to apply in teaching, learning, classroom management and other educational activities. However, most of research has focused on education activities in higher education, such as using Google Forms in teaching English to second-year non-language major students at Hoa Lu University (Duong Thi Ngoc Anh et al., 2019), or Google Documents tool in writing a self-assessment report on the quality of educational institutions (Cai Quang Kien & Nguyen Thu Ha, 2016). Little is known on applying these tools for students in K-12 level – how they aid teaching and studying, how they influence teachers and students' attitudes towards using technology, and what impacts they have on student's motivation to learn certain subjects. Further, with the advocacy of the Vietnamese government for digital transformation, the questions above become more and more urgent (Vietnamese Government News, 2022).

This research focuses on the influence of Google products for Education, called Google Solutions, on teaching, learning, and attitudes towards technology as well as how it changes students' motivation for learning. Next section covers the introduction of Google Solutions and the MUSIC model of motivation that were used for the present research.

THEORETICAL FRAMEWORKS

Google Solutions

Within the scope of the pilot program, Google Solutions include the hardware Chromebooks and the system Google Workspace for Education. Chromebook is a

low-cost portable computer powered by Google's Chrome OS, an operating system inspired by and designed around the Chrome web browser. Instead of a hard drive, Chromebook relies on cloud-based storage. And instead of resident applications, Chromebook uses web-based applications that are accessed and bookmarked through the Google Play store. This provides a faster, more simplified and more secure computing environment than with traditional Windows or Mac computers. Almost everything working on the Chromebook happens in the Chrome web browser (LaFay, 2015).

The services of Google Workspace for Education allow users to access information from any device, at any time and from anywhere (Hart-Davis, 2021). Google Workspace for Education contains a list of applications. The core services in Google Workspace for Education include the following: Google Drive, Gmail, Google Calendar, Google Cloud Search, Google Docs, Google Sheets, Google Slides, Google Forms, Google Chat, Google Meet, Google Jamboard, Google Classroom, Google Sites, Google Tasks. Other Google services, such as YouTube, DoubleClick, Google Scholar, Google Contacts and Google News, are also available.

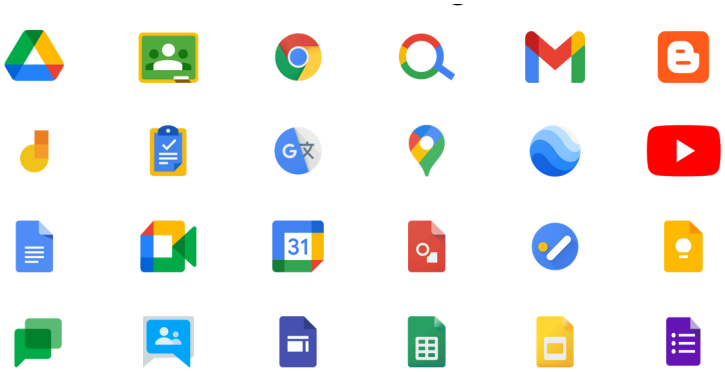

Figure 1. Applications from Google Workspace for Education

Students' Learning Motivation

B. D. Jones (2009) stated: "Motivation is the extent to which one intends to engage in an activity.". Research shows that children who are motivated tend to be engaged, persist longer, have better learning outcomes, and perform better than other children on standardized achievement tests (Pintrich, 2003). Many researchers have been interested in students' learning motivation. Jones (2009) also introduced The MUSIC Model of

Motivation (B. D. Jones, 2009, 2018). This Model is considered as a research-based model to explain the relationships among factors that affect people's motivation to engage in activities, such as courses and class assignments. Researchers around the world have identified many principles and theories of motivation. However, what was lacking was an updated model of motivation designed for instructors that could be tied to concrete strategies and measurable outcomes. The MUSIC model has met this challenge by combining the most important research ideas into a multidimensional model that is understandable to teachers, professors, and instructional designers.

In the MUSIC model, people's motivations to engage in activities are affected by five perceptions (eMpowerment, Usefulness, Success, Interest, and Caring), which work together synergistically to create a motivating climate. MUSIC is an acronym for these five perceptions. These five MUSIC perceptions work together to create a positive motivational climate, which has been defined as "the aspects of the psychological environment that affect students' motivation and engagement within a course" (Brett D. Jones et al., 2022).

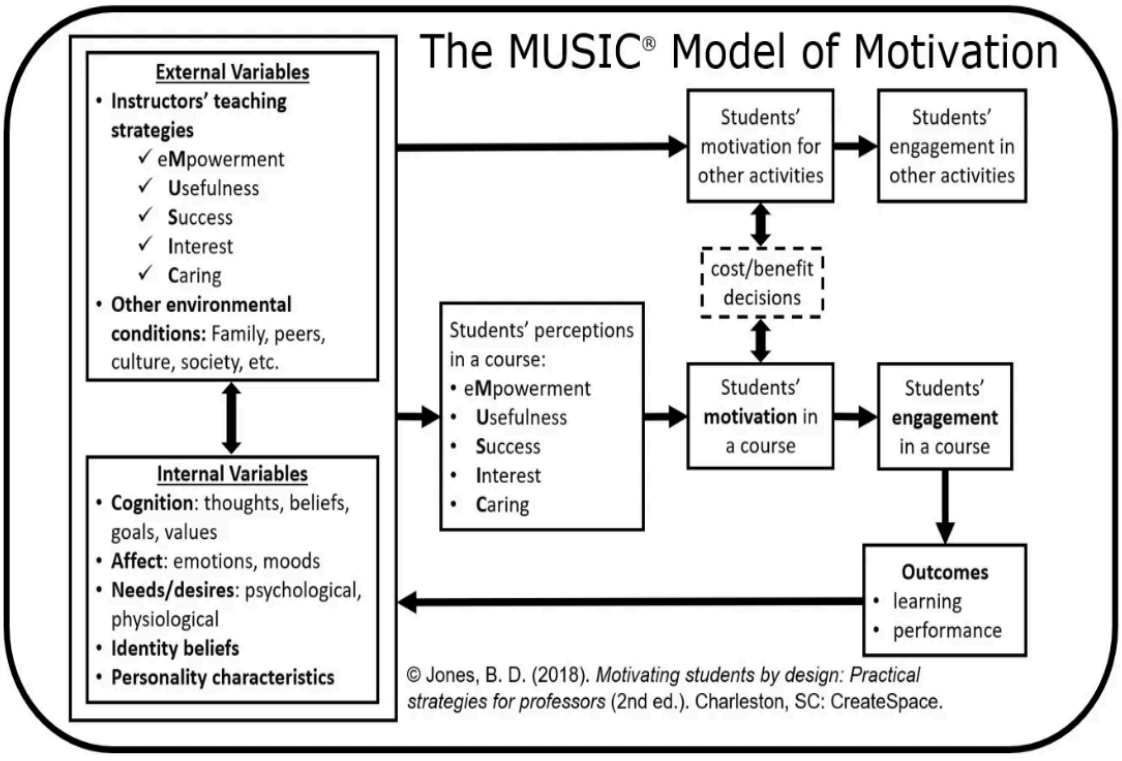

Figure 2. The MUSIC Model of Motivation

The author also developed a questionnaire to measure students' learning motivation that can be applied in different levels of education as well as different subjects. In this research, a questionnaire adapted from Jones's research was used to measure Vietnamese students' motivation to learn Math.

RESEARCH QUESTIONS

The purpose of this research is to explore the use of Google Workspace for Education and Chromebooks of students and teachers at Thuc Nghiem school to transform teaching and learning as well as to motivate students' Math learning. More specifically, the present research sought to answer three research questions:

(1) How does Google Solutions aid teaching and learning activities in classrooms in Vietnam?

(2) To what extent does students' motivation to learn Math change during the use of Google Solutions?

Due to limited time, researchers only chose Math as the subject for research question (2). Math is chosen because it is best in developing logical reasoning - the key component for many 21st century skills such as critical thinking, problem solving, and creativity. Students being more motivated to learn Math can be an indicator of the increased likelihood of them acquiring these skills.

METHODOLOGY

Participants

Students and teachers from Thuc Nghiem school (Experimental School of Educational Science), under the Vietnam National Institute of Educational Sciences participated in the present research. This school was established on September 19, 2018 on the basis of merging three Experimental Primary School, Experimental Lower Secondary School and Experimental Higher Secondary School. The school is a public education institution in the national education system and in the system of high schools of Hanoi city. The school uses the national curriculum of the Vietnam Ministry of Education and Training, and at the same time, the school conducts different experiments with advanced teaching, assessment models and methods, as well as with scientific research of the

Vietnam National Institute of Educational Sciences. As a result, the school's educational plan is quite open and diverse, with many options suitable for different types of students. 16 teachers (14 females and 2 males) and 38 students (19 females and 19 males) from grade 6B in this school participated in the pilot. All teachers in the sample participating in teaching grade 6B covered all subjects in school including Math, Vietnamese Literature, Science, English, Art, Music, Physical Education, History, Geography.

Instruments

To achieve the purpose of the research, different types of instruments have been developed. They were pre-survey questionnaires, observation sheets for lessons in the classroom, interview questions used in biweekly meetings and post-survey questionnaires. All these instruments have been developed by the Research Team from the Vietnam National Institute of Educational Sciences to make sure they covered different aspects of implementing Google Solutions (including Chromebooks and Google Workspace for Education) in the Vietnam education context.

Pre-survey

Pre-survey was designed for teachers and students. Students' pre-survey focused on their background, their attitudes toward the use of technology in learning; frequency of using Google Workspace for Education applications and their views on motivation to learn Math. Teachers' survey consisted of items on their background, their attitudes toward the use of technology in the classroom, their views on school readiness when piloting new technology products and frequency of using Google applications. The pre-survey questionnaire's detailed content is presented in the Appendix.

Observation sheets

The purpose of the classroom observations was to explore the use of Google Solutions products from teachers and students within grade 6B classroom through specific subjects. The classroom observations focus on five different areas:

+ *Ease of use for teachers:* Observation by answering two following questions: (i) How easy it is for the teacher to use the Google product(s) during instruction; (ii) How challenging it is for the teacher to use the Google product(s) during instruction;

+ *Ease of use for students:* Observation by answering two following questions: (i) How easy it is for the student to use the Google product(s) during instruction; (ii) How challenging it is for the student to use the Google product(s) during instruction;

+ *Connection to teacher practice*: Describing how the teacher uses the Google product(s) as part of her/his teaching activities;

+ *Student engagement:* Describing the level of student engagement as they are working with the Google product(s), or as they working on activities that include the Google product(s);

+ *Critical questions:* Any questions that may need to follow-up on with the teachers, Google or relevant teams;

Interviews in biweekly meetings

In order to support teachers and students during the pilot program, a set of questions related to the teachers' use of Chromebooks and Google Workspace for Education has been developed. These questions focus on students' and teachers' difficulties in using Google Solutions applications, the changes in using these applications and students' interactions during lessons using Google Solutions applications.

Post- survey

Post-survey was also designed for teachers and students. Some items from the pre-survey were replicated to explore the changes during the pilot program. In addition, other items were also added in the post-survey. Specifically, students' post-survey included items on their experiences of using Chromebooks and Google Workspace for Education applications in learning; their awareness when using different devices (smartphones, tablets, laptops) for learning and other activities. Teachers' post-survey consisted of items measuring the impact of Google Solutions on their timetable, the impacts of Google Solutions teaching and learning activities, teachers' overall satisfaction with Google Solutions and Chromebooks as part of Google's pilot program,

the frequency of using Google Workspace for Education in the classroom, the impact of Chromebooks and Google Workspace for Education on the shift from face to face to online teaching, and the level of security and safety when teaching via Chromebooks.

Procedures

Table 1 shows the timeline for main activities in the pilot at the Experimental School of Educational Science during the second semester of school year 2021-2022. The pilot program started with the pre-survey for students and teachers. The main purpose of the pre-survey was to collect the information of participants about their understanding and their awareness of Google Solutions, along with their attitudes toward using technology in teaching and learning before implementing the pilot program.

No	Main activity	Jan	Feb	Mar	Apr	May	June
1	Pre-survey: students/teachers						
2	Feedback for school on pre-survey						
3	Classroom observations						
4	Biweekly teachers' meeting						
5	Innovation Challenge Contest						
6	Post-survey: students/teachers						
7	Feedback for school on results						

Table 1. Timeline for main activities in the pilot at the Experimental School of Educational Science

Then, the training workshops for teachers were organised by AI Education to provide teachers information about the pilot program, as well as the products from Google Solutions that teachers and students could use for their teaching and learning. Some basic applications were introduced to teachers in detail such as Google Meet, Google Docs, Google Sheet, Google Slides. After the training, the AI Education team kept their support for teachers and students during the pilot in terms of technical problems. In May 2022, AI Education also organised the Innovation Challenge Contest to encourage teachers applying their knowledge and skills on using Google Solutions in practice. Participants were also encouraged to use as many Google applications as they can during the pilot.

All teachers and students in the pilot program were provided with new non-touch screen Chromebooks from Samsung. They were encouraged to use their Chromebooks for teaching and learning activities instead of using their personal laptops or computers at school and at home. At the Experimental School of Educational Science, teachers were provided 14" screen Chromebooks with material of XE340XDA-KA1US, and students were provided 11" screen Chromebooks with material of XE310XDA-RSI.

In order to support and promote teachers and students to use Google Solutions, biweekly meetings and interviews were organised to help them update and share their uses as well as their difficulties during the pilot. During biweekly meetings, experts from AI Education also introduced to teachers other useful Google applications/add-ons and tips to apply them in their teaching practice. Classroom observations in different subjects were also conducted during the pilot to collect relevant information from teachers and students. Weekly meetings with school managers were also organised to ensure the smooth operation of the pilot. At the end of the pilot, the post-survey was delivered to all participants.

Statistical analysis techniques

Descriptive statistics

Descriptive statistics are brief descriptive coefficients that summarize a given data set. Descriptive statistics are broken down into measures of central tendency and measures of variability. Measures of central tendency include the mean, median, and mode, while measures of variability include standard deviation, variance variables. Descriptive statistics, in short, help describe and understand the features of a specific data set by giving short summaries about the sample and measures of the data. In this research, descriptive statistics have been used to describe variables related to teachers' and students' characteristics, their attitudes toward using technology, their perceptions of using Google Solutions, students' motivation on learning Math.

Reliability analysis

Reliability refers to the extent to which a scale produces consistent results, if the measurements are repeated a number of times. Cronbach's alpha gives us a simple way

to measure whether or not a score is reliable. In this research, reliability analysis has been used for students' motivation on learning Math.

t-test

Hypothesis testing uses sample data to evaluate a hypothesis about a population. A t-test is a type of inferential statistic used to determine if there is a significant difference between the means of two groups, which may be related in certain features. In the present research, paired sample t- test was used to examine the differences in students' motivation between pre- and post- results.

RESULTS AND DISCUSSION

Attitudes toward Using Technology

At the beginning of the pilot program, teachers stated that their schools support them to apply new technologies in the classroom. Specifically, apart from 25% of neutrals, 75% of teachers believed that the school leaders will do whatever it takes to try new Edtech tools and they will support teachers' use of new Edtech tools in the classroom. Further, apart from 23% of neutrals, 77% of teachers agreed that teachers at their school were motivated to try new Edtech tools. 83% of teachers also thought that their schools encourage them to incorporate technology in the lessons. In this section, attitudes toward using technology in the classroom from teachers' and students' perspectives is presented.

Teachers' Attitudes

The information of teachers' attitudes toward using technology was collected during the pre- and post-survey. In general, they had positive views on the use and the role of technology in teaching and learning. This result was consistent with the findings from other researches (Center for Innovation of Future Education Seoul National University, 2021; Khokhar & Javaid, 2016; Mahdum et al., 2019).

Regarding the use of technology, it could be seen that many teachers were familiar and ready to use technology in the classroom. Specifically, apart from 33.4% of teachers who had neutral opinions, over 56.3% of teachers agreed with the statement "I feel

comfortable navigating most of the technology that I encounter at my job" and "I often explore and assess new technology for use in my classroom". This indicates that many of the teachers were eager to learn to use technology in teaching and they wanted to explore new technology applications. However, only 25% of teachers agreed with the statement "I frequently experiment with new technology and I am usually the first of my colleagues to try a new digital tool or resource", which indicates that they were hesitant to take the initiative to try new technologies. Teachers also had the desire to choose the most appropriate and best tools for students; therefore, it was necessary to have clear criteria for evaluating the quality of technology products (59.4% of teachers agree or strongly agree with this point of view). Figure 3 shows the results for teachers' use of technology in the classroom.

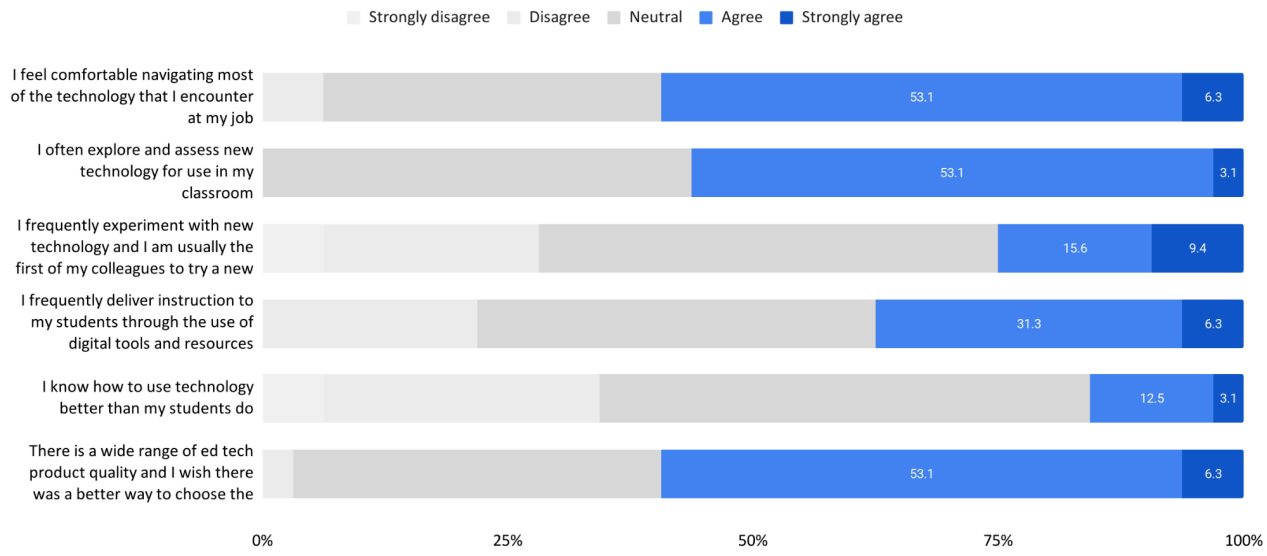

Figure 3. Teachers' opinions on using technology in the classroom

Most teachers believed that technology has many roles in the teaching process, especially during the epidemic period (from 56.3% to 75% of teachers agree with the statements about the role of technology). In which, most teachers agreed that "To prepare students for the 21st century, they must be digitally literate"; and "I think technology has many benefits and I try to use it when possible". Figure 4 shows teachers' opinion on the role of technology in the classroom.

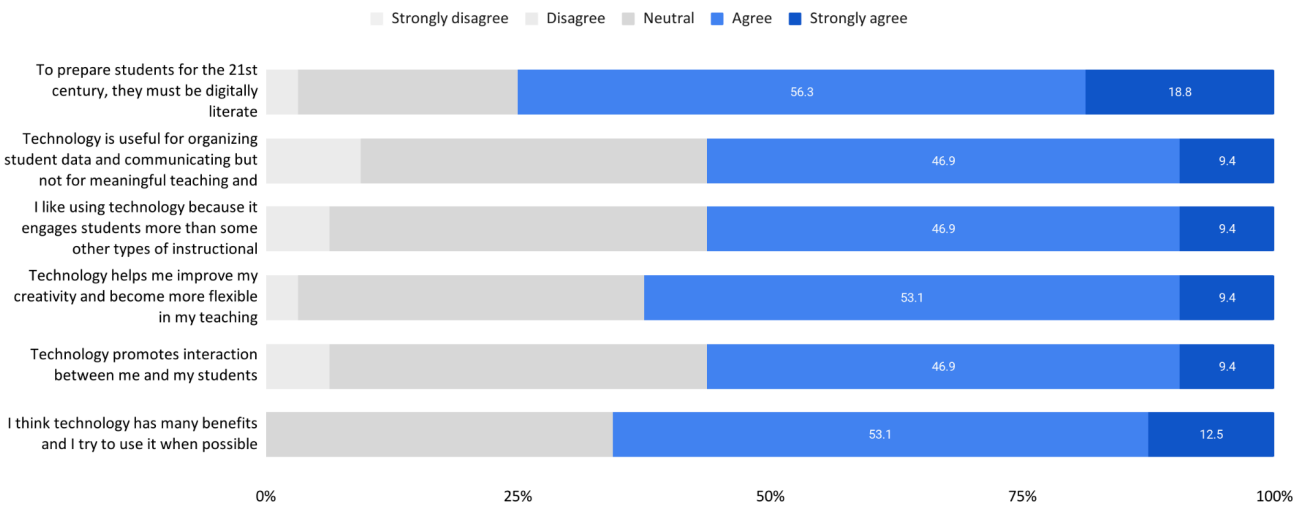

Figure 4. Teachers' opinions on the role of technology in the classroom

Figure 5 shows the results about teachers' opinion on the harm of technology. Teachers saw several benefits of technology for teaching and learning, they still expressed some concerns. Nearly 50% of teachers said that technology has many benefits but also has barriers. Also, nearly a third of teachers believed that technology was harmful. They did not see the benefits of technology or believed that technology can cause distraction at school.

However, after the survey, the teacher's attitudes toward technology became more positive. Before, 71.4% of them kept a neutral opinion about the statement "I think technology is distracting at school" but after the pilot, the neutrals reduced to 40% and another 40% disagree or strongly disagree with the statement, indicating their positive attitude toward technology as a tool for learning. Further, 78.6% agreed with the statement "Technology helps me to be more creative and resourceful in teaching" in the pre-survey. After the pilot, this number increased to 86.7%. Before the pilot, only 64.3% teachers agreed with the statement "I like using technology because it attracts students more than other methods". This number rose to 73.3% after. The difference pre and post pilot of the two statements above shows that the more they are exposed to it, the more teachers realize technology's potential to aid them in teaching.

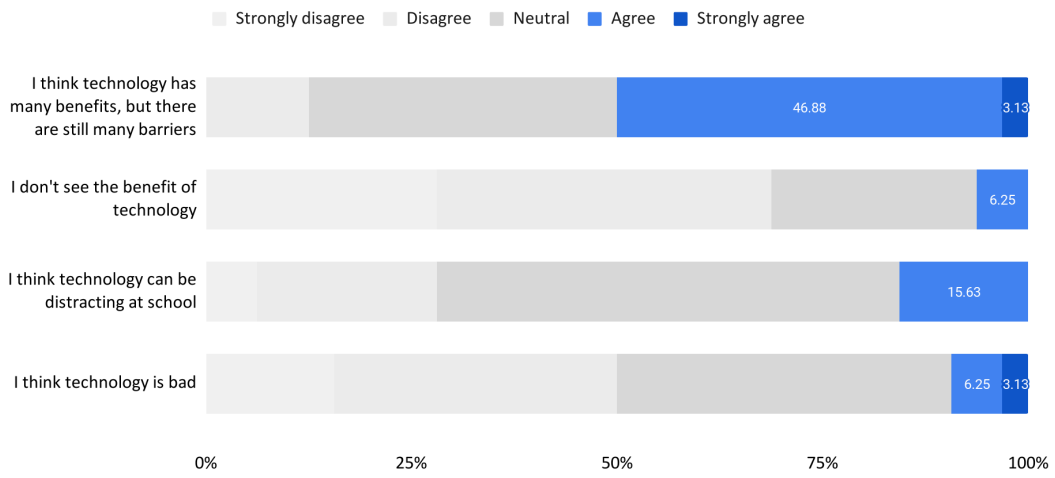

Figure 5. Teachers' opinion on the harm of technology

Students Attitudes

The information about students' attitudes toward using technology was collected in both pre-survey and post-survey. The following figures show that there were positive changes in their views on the interest in technology and the role of technology during the pilot program. From Figure 6, the number of students agreed with the statement "I enjoy using books, paper, and pen/pencil to learn" decreased from 52.8% to 41.7%. Figure 7 shows that more students agreed with the positive statements after the pilot. For example, before the survey, only 47.2% of students in the pilot believed that "the more often teachers use computers, the more I will enjoy school". However, the number went up to 58.3% after the pilot. In terms of students' views on the role of technology as indicated in Figure 8, students tended to acknowledge the importance of technology in learning after they experienced Google Solutions.

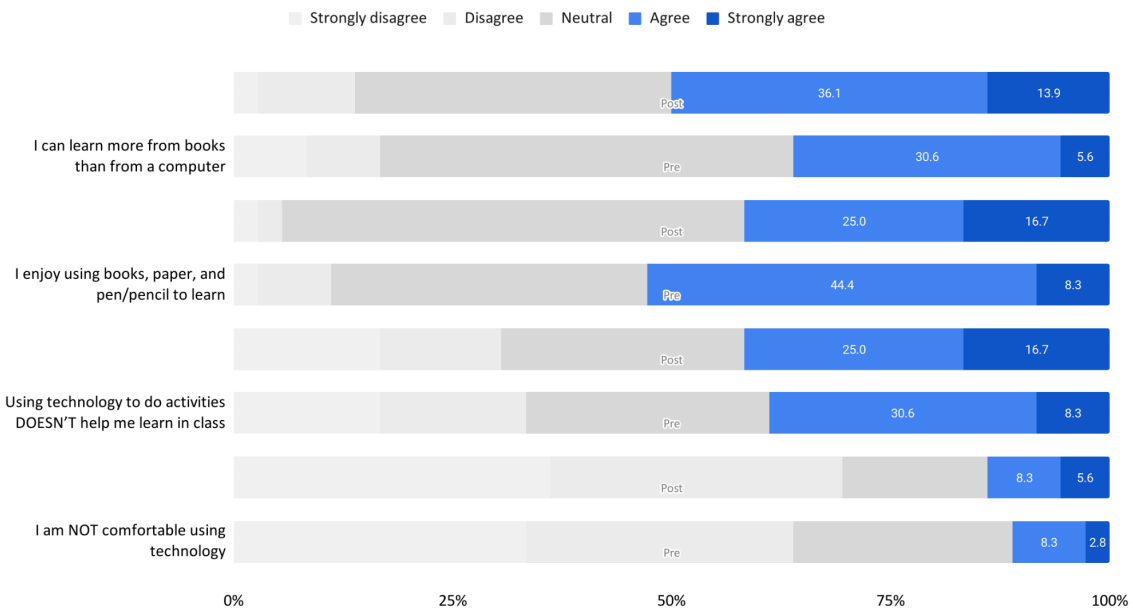

Figure 6. Students' opinions on traditional use of technology

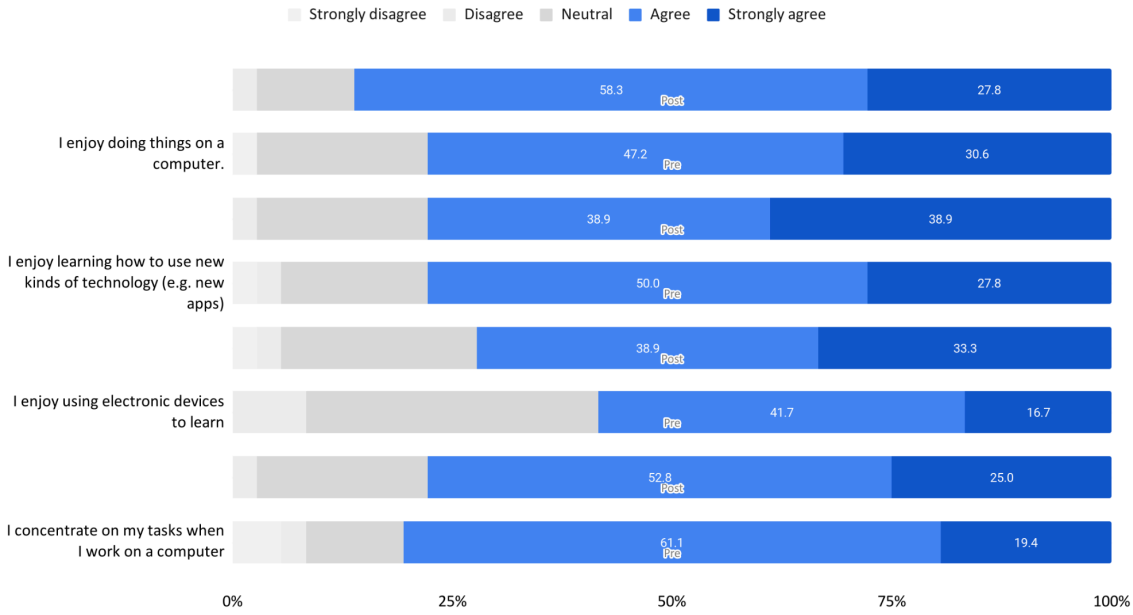

Figure 7. Students' opinions regarding the use of computers

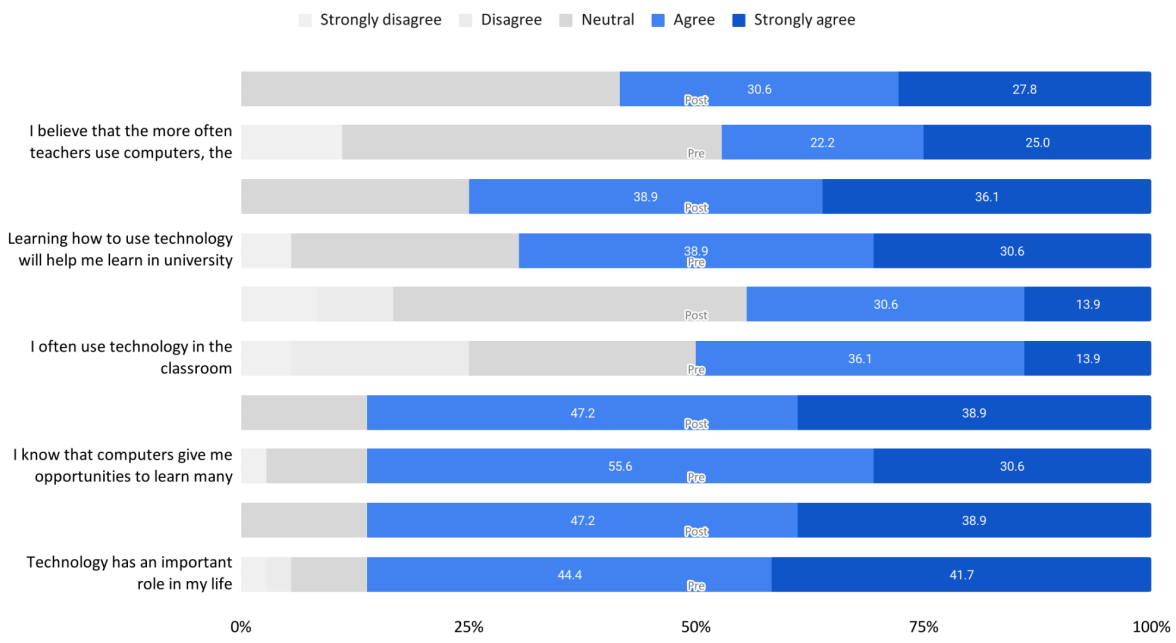

Figure 8. Students' opinion regarding the role of technology

How Google Solutions transform teaching and learning activities in classroom

As mentioned earlier, Google Solutions refers to Chromebooks and Google Workspace for Education. In order to explore how Google Solutions has transformed teaching and learning activities in the pilot school, this section provides the results on the impacts of Chromebooks and Google Workspace for Education from teachers' and students' perspectives.

The Use of Google Workspace for Education from Teachers' Perspectives

(i). Comfort level

In the pre-survey and post-survey teachers were asked about their comfort level when using Google Solutions (GS) in the classroom. Table 2 shows the results in these surveys

	Pre-survey	Post-survey
Not comfortable at all, I would not try.	9.1%	
Mostly not comfortable, I might experiment.	27.3 %	
Basic level of comfort, I could use them.	9.1 %	13.3%
Very confident, I know them well.	45.4 %	73.4 %
Extremely confident, I am well trained in them.	9.1 %	13.3%
Total	**100%**	**100%**

Table 2. Teachers' comfort levels when using Google Solutions (GS) in the classroom

The result shows that after the pilot, teachers were more comfortable to use Google Workspace for Education for their teaching activities. Over 86% of teachers stated that they were very confident to use Google Solutions in the classroom. Table 3 also indicates that teachers became more confident with all Google applications, especially Google Forms, Google Slides, Google Search, Google Calendar.

	Pre-survey	Post-survey
Google Classroom	2.64	3.73
Google Drive	2.55	3.64
Google Documents	2	3.55
Google Sheets	2.18	3.45
Google Forms	2.36	3.73
Google Slides	1.91	3.45
Google Search	2	3.73
Gmail	2.91	4
Calendar	2.27	3.64
YouTube	2.55	3.91
Google Maps	2.09	3.55

Table 3. Teachers' comfort levels in using Google Workspace for Education in the classroom (scale: 1-5)

From the classroom observations, teachers mostly apply Google Meet, Google Docs, Google Slides, Google Forms, Youtube, Google, Google Scholars in their classes, in which Google Meet is used by all teachers, especially in the period of using online teaching. For

this application, although in the first stage of use, there were some difficulties in breaking students into smaller rooms, but after some practices, teachers have proficiently used this function. Some teachers used Google Slides for presentations without any difficulty. With Google Docs, some teachers used it to assign interactive exercises for students. Google Form was quite familiar to teachers as it was a simple tool to apply. However, due to the short period of the pilot, through the observation process, it can be seen that teachers were not able to use a diverse range of Google applications in their teaching activities. Moreover, with the shift to face-to-face teaching, there were not many opportunities for teachers to use Google applications directly in the classroom.

(ii). Impact on teaching activities

Teachers in the pilot program were also asked about the impacts of Google Solutions on their teaching practices after the pilot. Figure 9 shows the results.

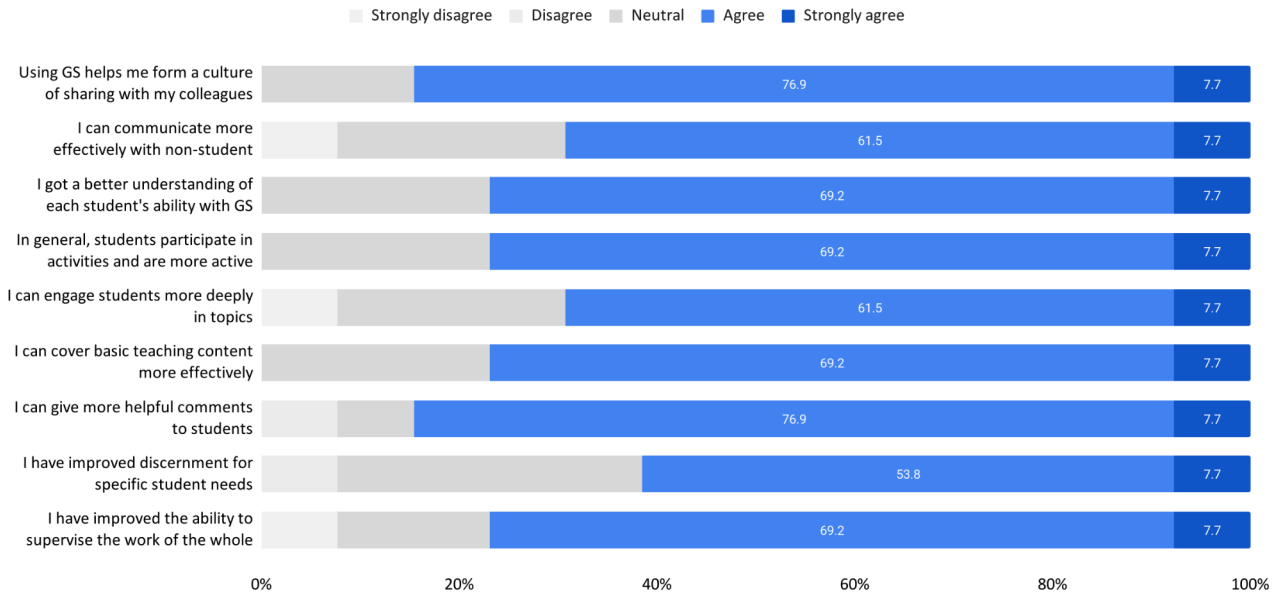

Figure 9. Impacts of Google Solutions on teaching practices

In general, Google Solutions have positively affected teaching practices (from 61% to 85% of teachers agreed with the statements demonstrating the positive impacts of Google Solutions on their practices). In which, the teacher agreed the most with the view "I have improved the ability to supervise the work of the whole class" (88% agreed

and strongly disagreed). When all the applications used for teaching are in one technology platform, it will be more convenient for teachers to integrate different solutions, enabling more effective class monitoring. In addition, the notable impacts include covering basic teaching content more effectively, providing more useful comments to students, and more active participation from students.

Many teachers also indicated that they saved time significantly thanks to the use of Google Solutions for their teaching (with 60% stating they saved 1-5 hours per week, and 6.7% of teachers also stated that they could save more than 5 hours per week) in Figure 10.

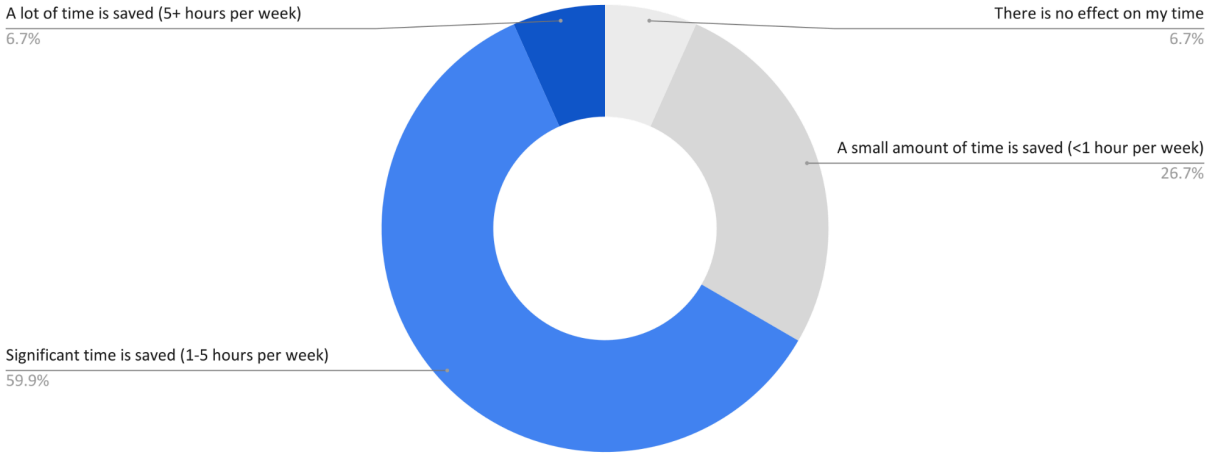

Figure 10. Teachers' opinion on saving time when using Google Solutions

(iii). Impacts on learning experience

Google Solutions not only entail considerable impacts on teaching but also on students' learning experience. The majority of teachers participating in the survey (over 76%) agree that Google Solutions have positively improved their learning experience, for example, encouraging students to collaborate more, supporting students to complete assignments faster, and helping students achieve better results. Figure 11 and Figure 12 show the detailed results.

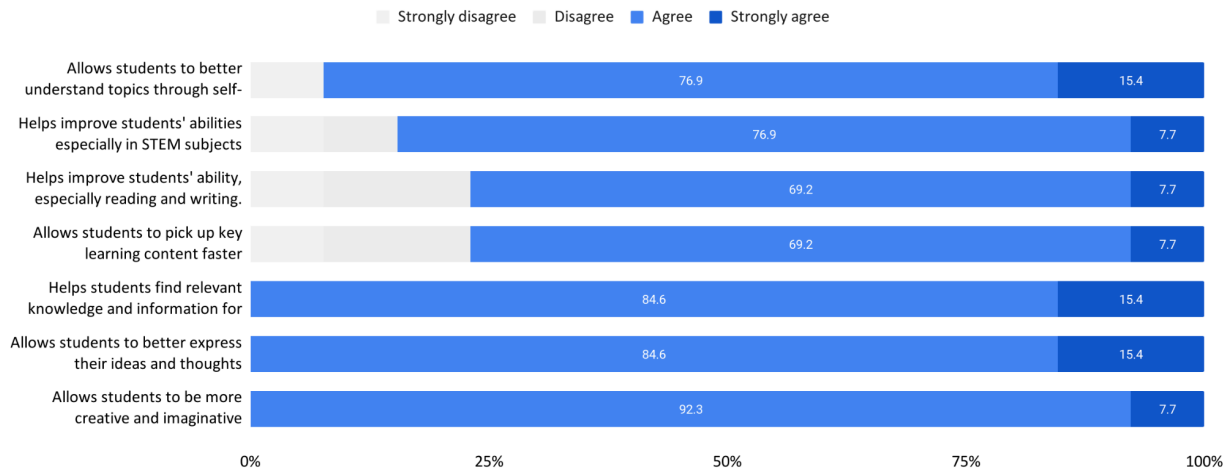

Figure 11. Impacts of Google Solutions on students' learning (1)

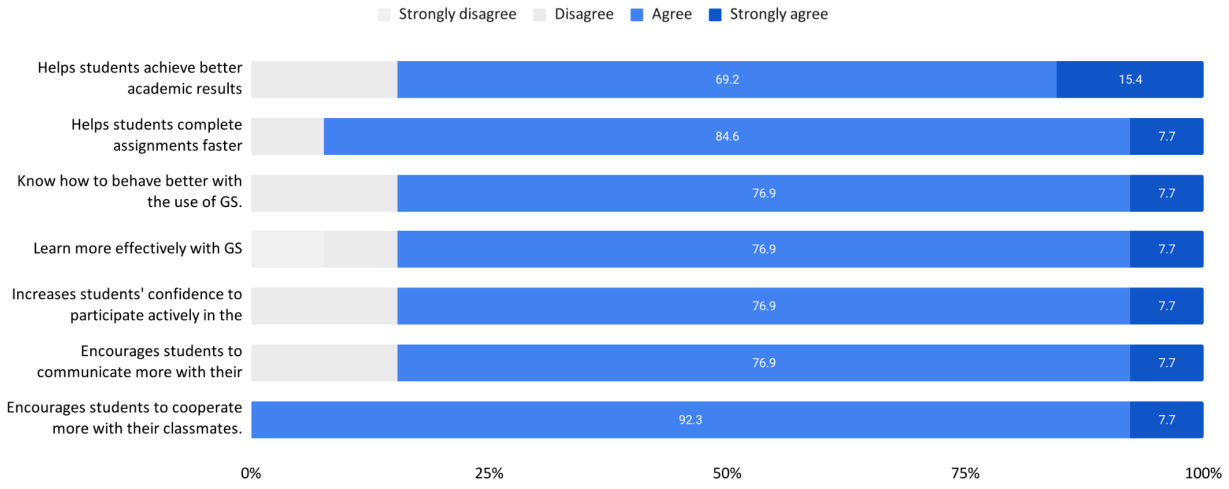

Figure 12. Impacts of Google Solutions on students' learning (2)

(iv). Usage patterns of teachers

Among Google solutions, the most frequently used applications by teachers are Drive and Gmail (about 80% of teachers participating in the survey have used it regularly and very often). Jamboard applications is the least common app. The remaining apps are also used by over 40% to 70% of teachers regularly and very often. There is also an increase in frequency of using Google Workspace for Education from the results of pre-survey to post-survey.

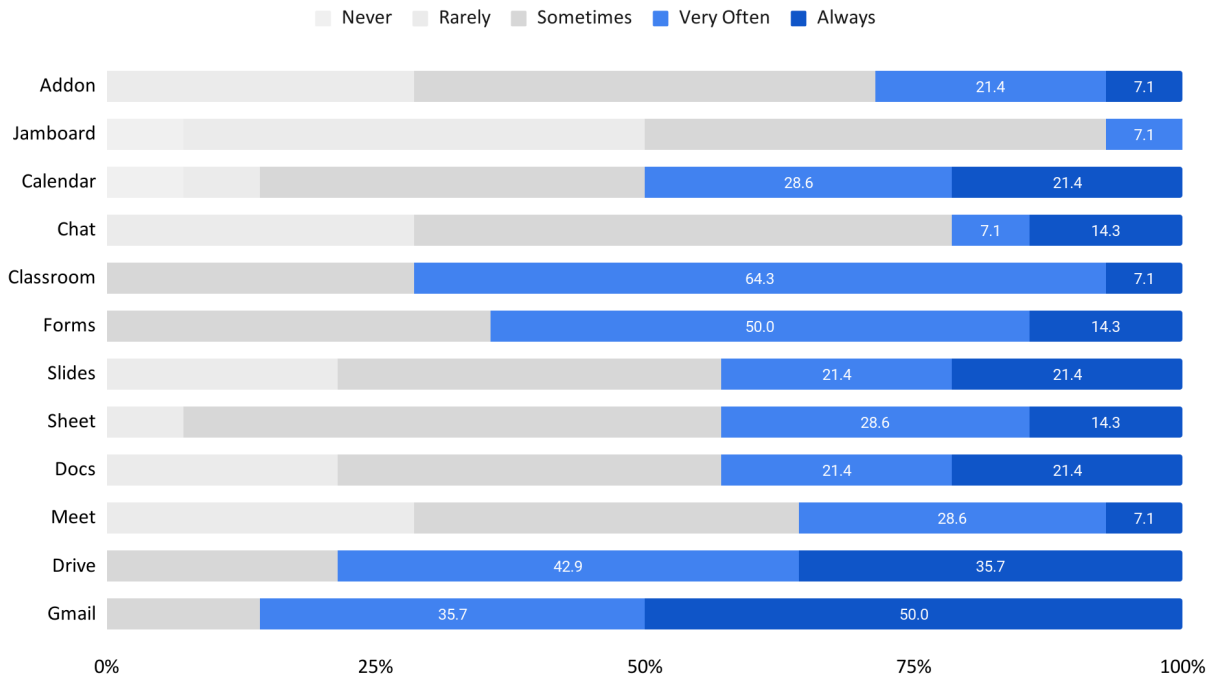

Figure 13. Frequencies of using Google applications from teachers

For example, for Math at the Experimental School, at first, teachers only used Google Meet application to deliver lessons, and Powerpoint to present slides. However, after observing the next lessons, teachers changed to Google applications for their classes, in particular, using Google Slides, Google Forms, specifically using Jamboards to make the class environment more dynamic and encourage students' participation.

Teachers also made efforts to link the content of the lessons with the use of Google applications in other subjects. The preparation of lectures (including on PowerPoint or Google Slides) was shared by teachers via Google Slides to convey the content to students. In addition, teachers also recommended students in class to use some applications such as Google Scholars and Google Docs for specific purposes. This helped teachers and students experience the full benefits of Google applications. However, through observing the classroom, the teaching was still heavily traditional, when the teacher transmitted the knowledge and asked the students to complete the exercises, making the lessons less exciting, and only a handful of Google applications were effectively utilized.

The Use of Chromebooks from Teachers' Perspectives

Each teacher received a Chromebook during the pilot. At the end of the pilot program, they were asked about the suitability of Chromebooks and other devices for different activities. Table 4 shows the results that teachers scored different devices for learning activities. It can be seen that Chromebook is the superior device for all learning purposes such as completing students' homework or focusing students' attention on the learning tasks.

	Chromebook	Tablet	Laptop
Focusing student's attention on the learning task	3.54	3.43	3.64
Student's problem-solving activities in class	3.69	3.43	3.64
Student collaboration activities in class	3.69	3.50	3.64
Student creative activities in class	3.62	3.21	3.57
Student homework completion	3.69	3.43	3.71

Table 4. Teachers' rates for their students' learning in different devices

In addition, teachers also rated the suitability of Chromebooks and other devices for their teaching activities. The results shown in Table 5 indicate that Chromebooks performed better than Tablets but less competitive than Laptops. However, teachers believed that Chromebooks help them save time in the planning, implementing, and managing each phase of their teaching process.

	Chromebook	Tablet	Laptop
Teacher lesson planning	3.54	3.21	3.79
Teacher classroom instruction	3.54	3.21	3.71
Teacher feedback to students	3.54	3.50	3.71

Table 5. Teachers' rates for their teaching activities in different devices

Overall, many teachers (67.7%) agreed that Chromebooks were suitable for their needs. Some teachers said that they used Chromebooks all time within the pilot and they would

continue that usage in the future. Some teachers also said that Chromebooks were small, compact, lightweight, and especially with strong batteries, making them very suitable for teachers to carry during classroom teaching; Chromebooks offered specialized tools to help teachers focus on work without distractions. In addition, Chromebooks were reported to be convenient for teachers to store data anywhere anytime; enhance connections between teachers and other stakeholders; save time in preparing lessons, assigning, grading, commenting, and correcting students' works; monitor the progress of students' projects effectively, especially during online learning. Overall, teachers believed that Chromebook was a great support for education in general and it was suitable for teachers' needs. Figure 14 shows the levels of agreement with the statement "Chromebooks are suitable for teachers' needs".

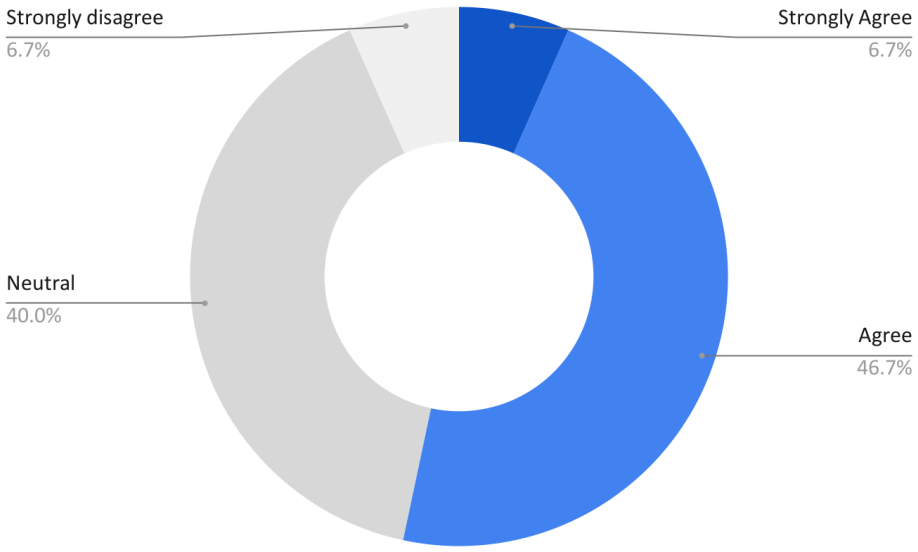

Figure 14. Teachers' agreement on the statement: "Chromebooks are suitable for teachers' needs."

Teachers also rated high (73.3% agreed 60% or above with the statement "I will recommend Chromebooks for my colleagues") for the likelihood of introducing Chromebooks to their colleagues. The main reasons were that Chromebooks saved time significantly in teaching and learning; Chromebooks provided a wide range of material; Chromebooks had many benefits to students and teachers; Chromebooks helped colleagues understand and take advantage of online resources. A teacher also stated

that “I clearly see the benefits of Google Workspace for Education after testing it, so I will definitely recommend it to colleagues''. This result is also consistent with the teachers’ interview through biweekly meetings.

Teachers also believed that Chromebooks were suitable for their students’ learning activities. 100% of teachers in the pilot agreed with this statement. From teachers’ perspectives, some of the reasons for this agreement were that students are supported to carry out academic activities under necessary supervision. From teachers’ interview insights, Chromebooks were small, compact, and lightweight, suitable for students to carry and use during their studies. The use of Chromebooks helped students save a lot of time in finding information, supported students to self-study and interact with the teachers and with other classmates. In particular, Chromebooks helped students have a safer experience with technology as it limited the pages/websites/applications students can access, thus, restricting inappropriate content. A teacher stated that:

> *Chromebooks help students develop a number of necessary skills such as: being proactive in searching and processing information, promoting students' proactiveness, independence, creativity, and improving the capability of self-study. The use of Chromebooks facilitates the learning process, enhances the effective use of Google applications, and helps to reduce the number of books students bring to school every day. The learning process and monitor of homework completion becomes more organised and encapsulated in a Chromebook.*

However, some teachers also reported issues when using Chromebooks during the pilot. For example, Chromebooks were not very convenient to install tools and applications to compose content with mathematical formulas and drawings; Chromebooks had small keyboards, as a result, it was difficult to edit texts; There were no flexible ports to connect devices such as projectors or televisions.

The Use of Google Workspace for Education from Students’ Perspectives

No	App Name	Mean (m)	SD
1	Google Classroom	3.61	0.96

2	Google Drive	3.28	1.00
3	Google Docs	3.25	1.08
4	Google Sheets	3.19	1.09
5	Google Forms	3.69	1.01
6	Google Slides	3.56	1.05
7	Google Search	3.86	0.99
8	Gmail	3.86	0.93
9	Calendar	3.14	1.05
10	YouTube	4.28	0.88
11	Google Maps	3.67	1.07

Table 6. Mean and SD of Level of comfort to use Google Workspace for Education, from 1 - Not comfortable at all, I would not try to 5 - Extremely confident, I am well trained in them.

Table 6 shows the Mean and SD of comfort levels regarding the use of Google Workspace for Education tools from students' experience. In this case, the mean shows the tendency of choices that students make to express their comfort levels, and standard deviation (SD) shows the variation of the data. It can be seen from Table 6 that students felt most comfortable with Youtube (m = 4.28, SD = 0.88) and felt least comfortable with Google Calendar (m = 3.14, SD = 1.05). Regarding the ease of use for students, they mainly experienced Google applications on Chromebooks, with the most frequently used apps include Google Meet, Google Slides, Google Docs and Google Forms. For Google Meet, students were quite proficient in operations such as turning on/off microphones, webcams, answering, interacting on chatbox, and raising hands to express opinions. Students also experienced working on Google Docs to take notes and collaborate and Google Forms for taking tests from teachers or peer-to-peer cross-evaluation. In addition, through some subjects such as Technology, Geography, and Mathematics, students worked in groups projects assigned by teachers and presented the outcomes to the whole class through Google applications. Through the observation process, students had almost no difficulty with operation on the Google applications.

Regarding student engagement, from the results of classroom observations, they were quite active in participating in the teachers' lessons. The best evidence was that most of the students turned on the microphone and camera on Google Meet, to answer the

questions when their names were called out. In addition, students were also active in class activities or following up with teachers after their assignments on Google Forms were corrected. Besides, students also interacted with each other through working together on Google Docs. Google solutions helped to enhance collaboration between students, with 55% of students also reported to help their peers in class more often thanks to the use of Google tools (Figure 15).

Figure 16 shows students' opinion on benefits of Google solutions. The three most outstanding benefits were: raising awareness about safe and effective use of the Internet; enhancing creativity in studying and doing homework; and learning more about the favourite subject.

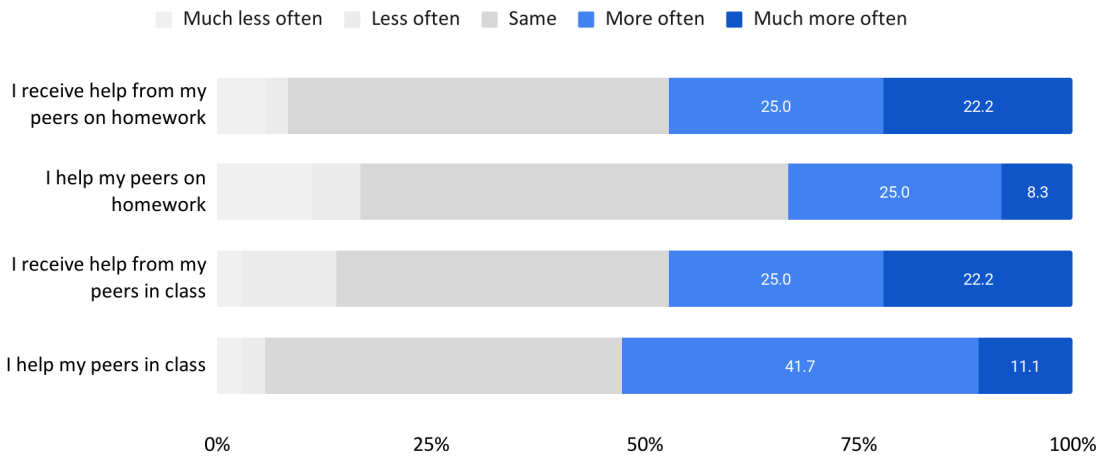

Figure 15. Students' comparison on classroom experience with Chromebooks

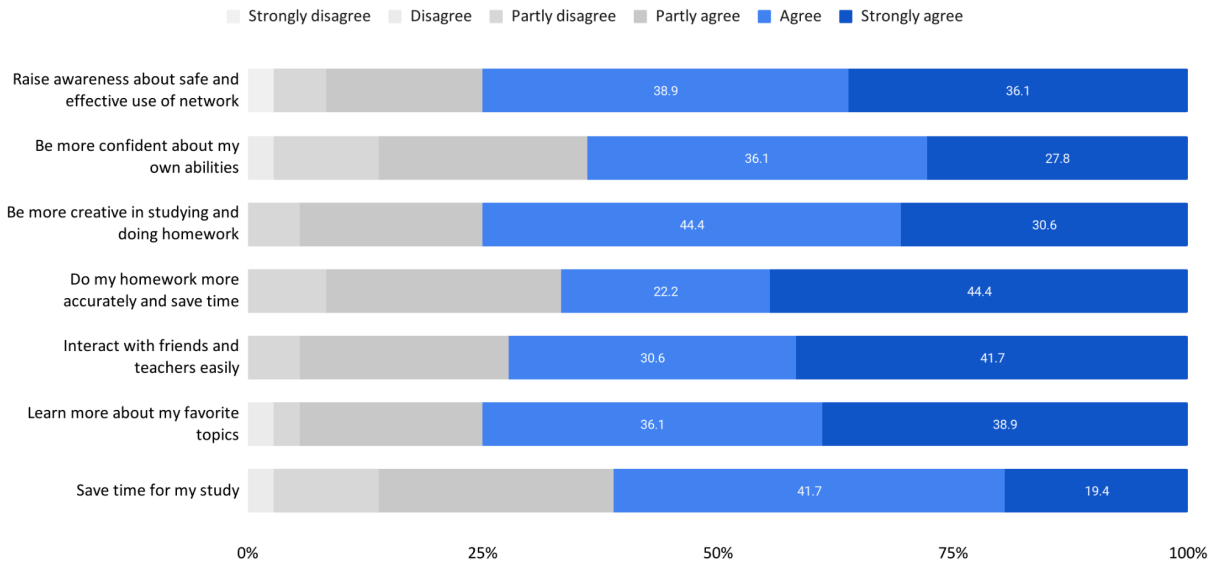

Figure 16. Students' opinion on benefits of Google Workspace for Education

The Use of Chromebooks from Students' Perspectives

Each student also received a Chromebook during the pilot. At the end of the pilot, they were asked to rate the suitability of Chromebooks and other devices for their activities. Table 7 shows the results that students rated for their educational activities in each device. It can be seen that laptops were still students' favourite devices for different learning activities (the average score is 4.4 - 4.5). However, Chromebooks had high appreciation from students for learning purposes, especially in finding information in class (4.47) and completing students' homework (4.28).

	Chromebook	Smartphone	Tablet	Laptop
Completing homework	4.25	3.64	4.19	4.47
Problem solving for study	4.28	4.08	4.25	4.56
Finding information in class	4.47	4.17	4.06	4.42
Reading eBooks	3.81	3.86	4.22	4.25

Creative work for study	4.28	3.75	4.31	4.56
Collaborating for study	4.28	3.72	4.03	4.44

Table 7. A comparison of level of suitable use for learning activities between devices (scale 1-5)

In addition, students also rated how suitable different devices were for their entertaining activities. The results shown in Table 8 indicate that Chromebook was not favored by students in recreational activities, which was an advantage of this device as it concentrated students' attention only on educational activities.

	Chromebook	Smartphone	Tablet	Laptop
Exploring the internet for fun	3.81	4.19	4.31	4.44
Keeping in contact with friends	3.69	4.47	4.06	4.19
Watching movies	3.81	3.86	4.11	4.53
Gaming	3.00	3.97	3.83	3.92

Table 8. A comparison of level of suitable use for entertaining activities between devices (scale 1-5)

Overall, a majority of students (over 72%) considered Chromebooks as a suitable device for their learning and they had a good experience in general. Some students said that they used Chromebooks all time during the pilot and they would continue to use it in the future.

Some students also said that Chromebooks were well-optimized and very simple to work with; Chromebooks helped them to focus on their learning because they could not load other applications such as games. A student also stated that "I find Chromebooks to be compact computers and very good for learning. It is also cheap with stable batteries for normal use".

Figure 17 shows the level of comfort of using Chromebooks from students. More than half of the students could use the device at basic level and around 40 % were very confident or extremely confident. This can be interpreted that overall, a majority of students were comfortable to use this digital device.

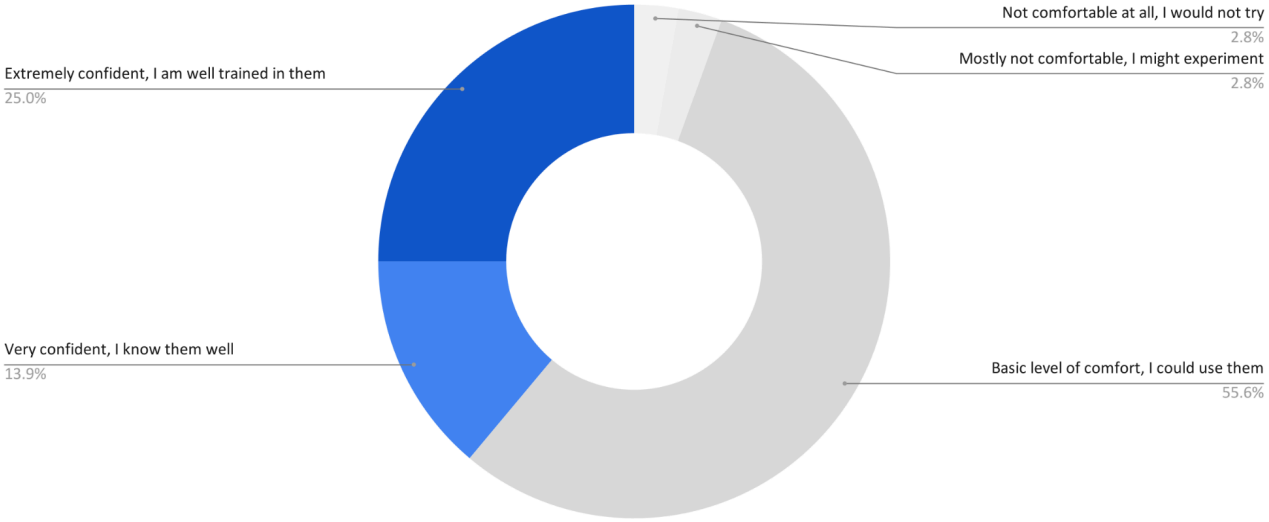

Figure 17. Level of comfort of using Chromebooks from students

On the scale from 1 to 10, the students have an average of 7.0 score to introduce Chromebooks to their peers. This reflected that in general, students were satisfied with Chromebooks and likely to introduce it to others.

Students' Motivation in Learning Math

As mentioned earlier, Students' learning Math motivation measures were adapted from the Middle School Student version of the Questionnaire. The purpose of the questionnaire is to measure the extent to which middle or high school students perceive the presence of each of the MUSIC model components in a class or other learning environment. It can be used by teachers to help them identify areas of strengths and weaknesses related to factors that affect students' motivation and engagement. The questionnaire consisted of 18 items measuring eMpowerment, Usefulness, Success, Interest, and Caring. Table 9 shows the reliability coefficient for each construct. It can be seen that all constructs have high coefficients of reliability. It means that items in each construct are reliable to measure that construct.

Construct	Pre-survey	Post-survey
eMpowerment	0.849	0.913
Usefulness	0.858	0.911
Success	0.929	0.954
Interest	0.91	0.943
Care	0.932	0.925

Table 9. Reliability coefficient for each construct

The construct of Care has the highest score for both pre- and post- pilot. It means students have a high level of beliefs that their math teachers care about their learning and themselves. In both pre-survey and post-survey, the construct of Interest has the lowest scores. It means that students have a low level of beliefs that Math is interesting and it is worth learning.

In order to explore the changes of students' motivation in learning Math for each construct, Table 10 shows the results of paired sample t – test between pre- and post- pilot. Although there are differences between pre- and post- pilot in Usefulness, Success, Interest and Care, however, all these differences are not statistically significant.

Variable	*Mean*	*Differences*	*t*	*p*
Pre_EMP	4.0857	- 0.47	-1.85	0.07
Post_EMP	4.5571			
Pre_USE	4.8056	- 0.18	-0.82	0.42
Post_USE	4.9815			
Pre_SUC	4.4643	-	-	1.00
Post_SUC	4.4643			
Pre_INT	4.2952	-0.24	-0.93	0.36
Post_INT	4.5333			
Pre_CAR	5.1319	-0.35	-1.71	0.10
Post_CAR	5.4861			

Table 10. Paired sample t – test results between pre- and post- pilot

This result is consistent with the classroom observations for Math. During the pilot program, Math teachers tried to apply many applications from Google Workspace for

Education. They recognised their limitations of using these applications, and they tried to improve their skills using Google products during the pilot. From observation, math teachers gave students more opportunities to discuss with each other the lessons and they encouraged students to participate in different activities using different applications such as Google Docs, Google Slides through Google Meet. The differences in eMpowerment among pre-survey and post-survey is statistically significant. It means that students positively change their feeling about having power in their learning. One of the explanations from observation data is that teachers give students more opportunities to explore and use Google Solutions during their learning journey.

CONCLUSION

The present research focuses on how teachers' and students use Google Solutions in the classroom within the context of the Vietnamese education system. In terms of teachers' attitudes toward using technology, it can be seen that most teachers had a positive approach and supported using technology in the classroom. They appreciated the role of Google Solutions in teaching and learning. Specifically, many teachers recognised Chromebooks as a valuable tool for their teaching practices because of the ease to use. They applied different Google applications in their teaching practices as they believed that Google Solutions would be suitable tools for teaching, learning and management Therefore, they were willing to recommend Chromebooks and Google Workspace for Education to their colleagues. From students' perspective, they acknowledged that Chromebook were a powerful device and Chromebooks had numerous benefits for their learning journey. They also agreed that Google applications were helpful for their learning activities such as collaboration, communication and problem-solving. However, the evidence from the research also shows that there are no differences in changing students' motivation in Math learning during the pilot. Overall, the research found a positive effect of Google applications on the teaching and learning in the context of Vietnamese schools.

This paper also presents some key lessons learned for the application of digital tools in Vietnamese classrooms. Firstly, there should be more consideration for cloud-based technologies to facilitate real-time communication, collaboration and monitoring using

the Internet. In this pilot, teachers and students actively participated in the program by exploring and using cloud-based technologies. During the pilot program, they also created a good environment to communicate and collaborate with each other, among students and teachers. Secondly, it is important to set up individual use of laptops for every teacher and student to allow equal access to digital resources and enable digital upskilling of future workforce. This is one of the important lessons. Teachers and students should have equal opportunities to use digital resources when they need it in their learning process. Lastly, digital tools should be well-integrated and serve a wide range of teaching and learning purposes. For example, emails can integrate calendar synchronization. Integrated solutions increase convenience, facilitate seamless communication and collaboration for both teachers and students. These lessons reflect the fact that although Vietnamese teachers and students have had great opportunities to access different forms of technologies for their teaching and learning, the results of the pilot program show that Google Solutions can become good alternatives for other forms of technology.

However, this research also has some limitations. Firstly, since the sample of the pilot program was quite small and the convenient sampling method was used, all results reflect only for the small group of teachers and students, some statistical analysis could not be applied to generalise the results. Secondly, teachers and students had freedom to choose the Google applications to apply and they also had their familiar platforms before the pilot. This restrained the application of more Google tools in the classroom. It is therefore necessary to expand the pilot to wider participants of teachers, students as well as school managers in order to have more information on the effectiveness of implementing Google Solution in the Vietnamese education context.

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APPENDIX