

Changes in Teacher's Awareness When First Supporting the Utilization of 1:1 Information Devices by Elementary School Students

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Abstract

In this study, we conducted a structured interview with a teacher who supported elementary school students utilizing 1:1 information devices for the first time and evaluated the responses to analyzed changes in the teacher's awareness. Before the 1:1 information devices were used, the teacher was concerned about how to utilize them and the students' unfamiliarity. In particular, the teacher did not expect to teach the students until after completely mastering their use herself. However, the teacher and students increased their familiarity with the 1:1 information devices in class, and as the students taught each other, they were eventually able to utilize them. The teacher's mindset had changed, and she tried to have the students teach her. Even with the 1:1 information devices, however, there were some aspects of the teacher's awareness of classroom management and learning guidance that did not change.

Keywords: 1:1 information devices, Global and Innovation Gateway for All School Program, Information and communications technology, Operating skills

1 Introduction

The utilization of information and communications technology (ICT) in everyday life has become a matter of course in today's society, and its use is expected to further intensify with the rapid development of artificial intelligence (AI) in applications such as generative AI, the Internet of Things (IoT), and robotics. In Japan, the National Curriculum Standards were announced in 2017 and 2018 [1][2][3] to ensure that students will develop the qualities and abilities that will let them pioneer the coming era of rapid change and unpredictability. In particular, information literacy is being positioned along with language and problem-solving skills as basic and fundamental knowledge and skills that will help students think, make judgments, and express themselves with an attitude of proactive learning [4]. The Global and Innovation Gateway for All (GIGA) School Program was established to provide 1:1 information devices to elementary, lower secondary, and upper secondary schools to cultivate students' ability to utilize ICT [5].

In Japan, 6th grade students in elementary schools and 3rd grade students in lower secondary schools across the nation are surveyed each year on their academic achievement and learning status. The 2023 survey asked the 6th grade students how much they utilized ICT devices

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such as computers and tablets. Among the students who used such devices almost every day, 29.3% used them for research, 17.0% used them for summarizing, presenting, and expressing ideas, 29.5% used them for teacher–student communication, and 16.6% used them for student–student communication. In addition, 1.1% of the students communicated with people in facilities outside the school at least once a week, and 4.0% did so at least once a month. It is difficult to conclude that 6th grade students are provided opportunities to collect, organize, and present information and to interact with others using the 1:1 information devices provided by the GIGA School Program, even 2 years after its establishment [6].

This has raised the question of how teachers feel about ICT utilization. Various studies have been conducted on analyzing teacher’s awareness. Yagisawa and Horita [7] compared the attitudes of young and experienced teachers toward ICT utilization. Both the young and experienced teachers emphasized the importance of teaching learning discipline, and that they believed that obtaining the skills to utilize ICT was necessary. Sato et al. [8] surveyed teachers and students in two 6th grade classrooms where 1:1 information devices are routinely used, and their results showed that the teachers could guide the use of information devices in school with regard to regulations and morality but not at home. Murakami et al. [9] surveyed the attitudes of teachers and students in three lower secondary schools where 1:1 information devices were used on a daily basis. Both teachers and students felt that the students could collaborate with friends in class. However, the above studies mostly considered cases in which ICT utilization was a schoolwide effort or in which teachers were already familiar with ICT. At some schools, ICT utilization is not sufficient. Thus, it is necessary to analyze teacher’s awareness in cases where ICT utilization efforts are not schoolwide and the teachers are not previously familiar with ICT.

In a previous study [10], we introduced 1:1 information devices to two classes at different elementary schools before the full-scale installation of the GIGA School Program and investigated the acquisition of ICT operation skills. In these two classes, we investigated the acquisition of ICT operating skills such as information devices and applications (hereafter referred to as “ICT operating skills”). One of the teachers in charge was previously familiar with ICT while the other teacher (i.e., Teacher X) was not good at utilizing ICT and did not provide much support to her students. We observed Teacher X’s classroom after the 1:1 information devices were introduced, and we analyzed the changes that occurred as Teacher X and her students became accustomed to the devices.

In the present study, we conducted a structured interview with Teacher X and analyzed the responses to evaluate changes in her awareness before, during, and after the utilization of the 1:1 information devices. This analysis should help clarify how teachers unfamiliar with ICT can overcome their resistance and support their students in acquiring ICT operation skills.

2 Research Methods

2.1 Subject of analysis

Table 1 summarizes details on the school, Teacher X, and her students. Teacher X had 6 years of teaching experience, and this was her first year to support ICT utilization by her students. At the school, each classroom was equipped with a large digital TV, document camera, and information device for the teacher. In addition, 1:1 information devices were provided for

one-third of the classrooms, which was the target value in 2020. However, Teacher X utilized ICT infrequently at only a few times a month. Furthermore, the students did not experience utilizing ICT until the 5th grade. Even the 6th grade students utilized ICT only once a month before the 1:1 information devices were introduced. For a 7-month period of September 2020–March 2021, 1:1 information devices adhering to the specifications of the GIGA School Program (Acer Chromebook 11 C732 LTE model) were provided to each student in Teacher X's classroom. During this period, the first author observed Teacher X's classroom for 1–2 h about once a week. Teacher X was told that we wanted to observe a class in which every student was utilizing the 1:1 information devices. We did not specify any other subjects or learning content.

Table 1: Details of the school under study

School	Details	A elementary school (17 classes), City of B, Prefecture C
	Availability of ICT in regular classrooms	Each classroom was equipped with a digital TV, document camera, and information device for the teacher. 1:1 portable information devices (Windows) were provided for one-third of the classrooms
Teacher X	Teaching experience	6 th year
	Teaching experience with own ICT utilization	1 st year
	Experience with supporting ICT utilization by students	1 st year
	Frequency of own ICT utilization before the introduction of 1:1 information devices	Few times a month
Students	Details	6 th grade (35 students)
	ICT utilization before the introduction of 1:1 information devices	Browser-based searching and printing using a shared information device about once a month

The school had two 6th grade classes. Teacher Y was in charge of the other class and was a veteran with over 20 years of teaching experience. Teacher Y was actively involved in ICT utilization and promoted ICT utilization in B city. He had been considering the utilization of Google Workspace for Education even before the introduction of 1:1 information devices in this study. Teacher X was able to ask Teacher Y when she did not understand the operation of the device or its applications.

In addition, Teacher X, Teacher Y, Teacher Z (i.e., other teacher where 1:1 information devices were introduced [10]), and four researchers specializing in the informatization of education (including the two authors) used the communication tool Slack to share information on a daily basis. We asked Teachers X and Z to report on their utilization of the 1:1 information devices and to survey the students on their acquisition of ICT operation skills. When

Teachers X and Z had a question about using Slack, the four researchers and Teacher Y were able to respond.

2.2 Method of analysis

A structured interview was conducted with Teacher X to identify changes in her awareness with the utilization of 1:1 information devices. The interview was conducted in mid-May 2021, which was 2 months after the 7-month period of utilizing the 1:1 information devices. The interview was conducted by using the web conferencing tool Google Meet and it lasted for approximately 1 hour. The structured interview was conducted to objectively determine changes in Teacher X's awareness and difficulties encountered in different phases of the utilization of 1:1 information devices. Table 2 lists the questions of the interview, which were designed by referring to the semistructured interview questions of the previous study on teacher attitudes toward ICT utilization [7]. The responses were analyzed according to the following procedure, which was also taken from the previous study [7]:

- 1) Transcribe the responses into textual data.
- 2) Divide the textual data into segments according to content.
- 3) Label each segment indicating its content.
- 4) Compare labels to create categories in which to classify the segments.
- 5) Review the created labels and categories, and finalize them after discussion among the authors.

Table 2: Questions of the structured interview regarding utilization of 1:1 information devices

Phase	Questions
Before utilization	What kind of ICT was utilized before the introduction of the 1:1 information devices?
	What kind of ICT did you have your students utilize before the introduction of the 1:1 information devices?
	What did you think when you heard that 1:1 information devices would be provided by the GIGA School Program?
	What did you think when you heard that 1:1 information devices would be introduced to all classrooms?
	What did you think about the decision to provide 1:1 information devices to your classroom before the others?
Early utilization	What problems did you encounter in the early phase of utilization?
	What kind of support did you want in the early phase of utilization?
	What explanation was given to students' parents?
During utilization	When did you feel capable of utilizing 1:1 information devices in the classroom?
	When did you feel that the students could utilize the 1:1 information devices for learning? Why was this the case?
	How did you feel?

	What kind of support did you want during utilization (may be the same as in the early utilization phase)?
	What information was helpful for utilizing the 1:1 information devices?
	What did you think of the practices of Teacher Z, who also introduced 1:1 information devices?
After utilization	How did you feel after the utilization of 1:1 information devices?
	What skills do you think teachers need to utilize 1:1 information devices?
	What skills do you think students need to utilize 1:1 information devices?
	What did you think was important for ICT utilization before the introduction of 1:1 information devices?
	What do you think is equally important with the introduction of 1:1 information devices?
	What do you think is important only with the introduction of 1:1 information devices?

An example of the analysis procedure is presented below.

1) The following textual data are transcribed from an interview response:

There was an expectation that having 1:1 information devices would make it possible for students to learn without anyone being left behind. However, I felt that there would be a difference between urban and rural areas in terms of whether the Internet environment would work.

2) The textual data are divided into three segments according to content:

There was an expectation that having 1:1 information devices would make it possible for students to learn without anyone being left behind

I felt that there would be a difference between urban and rural areas

Whether the Internet environment would work

3) Each segment is labeled to indicate its content:

There was an expectation... → Individualized response

I felt that there would be a difference... → Regional disparities

Whether the Internet environment... → Network environment

4) The label “Individual response” was placed into the Expectations category before the introduction of 1:1 information devices, and the labels “Regional disparities” and “Network environment” were placed into the Concerns category before the introduction of 1:1 information devices.

5) We then reviewed the labels for their validity and revised them after discussion if necessary. The labels were assigned from the perspective of both Teacher X and the students. For example, the students’ teaching each other could be labeled as both an activity from the students’ point of view and a benefit from Teacher X’s point of view.

3 Result

In this section, examples of typical responses indicating changes in awareness are shown in italics. Categories are indicated by square brackets [], and individual labels are indicated by parentheses ().

3.1 Before and in the early phase of utilization

Table 3 lists the labels in the [Expectations] category before utilization, and Table 4 lists the labels in the [Concerns] category before and in the early phase of utilization. Before utilization, Teacher X had [Expectations] that *no one will be left behind* (individualized response) and *the range of learning will be expanded* (breadth of learning). However, Teacher X also had [Concerns] about her own capabilities, such as *I could not think of a way to utilize the 1:1 information devices in class* (how to utilize), *I did not know when to utilize the 1:1 information devices in class* (timing of utilization), *I am not familiar enough with the 1:1 information devices* (teacher's familiarity), and *I did not have the knowledge* (teacher's lack of knowledge). In addition, Teacher X had [Concerns] about the students, such as *the students are not familiar with the 1:1 information devices* (students' familiarity) and *the class will not go as planned* (time needed). Before and in the early phase of utilization, Teacher X expressed two [Expectations] and 20 [Concerns]. When asked about the type of support desired in the early phase of utilization, Teacher X responded that she wanted support on *how to operate the 1:1 information devices and their applications* as well as *possible methods of utilizing the 1:1 information devices*.

Table 3: [Expectations] Before the beginning of utilization

Labels.	Sum
Individualized response	1
Breadth of learning	1

Table 4: [Concerns] Before the beginning and in the early phase of utilization

Labels.	Sum
How to utilize	4
Timing of utilization	4
Teacher's familiarity	3
Teacher's lack of knowledge	2
Students' familiarity	2
Time needed	2
Network environment	1
Needs to be utilized in many ways	1
Regional disparities	1

3.2 During and after utilization

Tables 5–8 list the labels in the [Teacher's behavior], [Students' behavior], [Positive aspects for the teacher], and [Positive aspects for the students] categories during and after utilization. During utilization, Teacher X identified [Positive aspects for the teacher] such as *the ability to review the class and complete questionnaires in a short period of time* (time saving and efficiency) and *the ability to see each other's faces during remote learning* (mental effects). Teacher X also felt that *the students had more varied ideas than I did* (learn the richness of students' ideas). Teacher X identified several [Positive aspects for the students] such as *I was surprised by the richness of the students' ideas* (various ideas) and *the students became able to do various things by themselves* (learn to operate). She also noted that *we had a thorough class discussion about some small problems* (discuss rules) and that the students could follow the rules they set themselves. When asked what kinds of support she wanted during utilization, Teacher X responded that she wanted support on *possible methods of utilizing 1:1 information devices* as in the early phase of utilization.

After utilization, Teacher X identified several [Positive aspects for the teacher], such as *I utilized the 1:1 information devices with the awareness of growing together with the students* (learn with students), *I was able to prepare for various classes using just one information device to save a lot of time* (time saving and efficiency), and *no one was left behind because the class support app could track the progress of students* (individualized response). Teacher X also identified various [Positive aspects for students], such as *students utilized the 1:1 information devices in ways that I did not teach* (learn to operate), *students utilized the 1:1 information devices in school life* (think about how to utilize the 1:1 information devices), and *students realized that they could create by themselves and took on various challenges independently* (challenge).

When asked what information was helpful for utilizing the 1:1 information devices, Teacher X responded that the information from Teacher Y was the most helpful. In addition, Teacher X was able to learn about the practices of Teacher Z through Slack. This information helped Teacher X identify several more aspects of [Teacher's behavior], such as *teachers with their own knowledge can utilize the 1:1 information devices more* (get information) and *I learned the importance of trying new things even if they are difficult* (know the importance of taking on challenges).

Table 5: [Teacher's behavior] During utilization

Labels.	Sum
Get information	5
Enforce rules	4
Provide more opportunities for students to be exposed to 1:1 information devices	3
Have students discuss rules	3
Learn with students	2

Utilize 1:1 information devices as if they are taught by students	2
Provide more opportunities for teacher to be exposed to 1:1 information devices	2
Help students understand the 1:1 information devices	1
Know the importance of taking on challenges	1
Become proactively involved with individual students	1
Need to know how to use a word processor	1
Teach what is needed in each case	1
Incorporate students' opinions	1
Praise students for teaching each other	1
Utilize what you can	1

Table 6: [Students' behavior] During utilization

Labels.	Sum
Utilize proactively	3
Learn to operate	2
Think about how to utilize the 1:1 information devices	2
Teach each other	1
Challenge themselves	1
Everyone plays an active role	1

Table 7: [Positive aspects for the teacher] During and after utilization

Labels.	Sum
Time saving and efficiency	4
Students can teach each other	2
Individualized response	2
Learn effectiveness	2
Mental effects	2
Students learn	1
Know the richness of students' ideas	1
Effects of takeaways	1
Give back to students	1
Ease of operation	1
How to utilize the 1:1 information devices	1
Students can solve problems	1

Table 8: [Positive aspects for students] During and after utilization

Labels.	Sum
Learn to operate	2
Be able to teach each other	1
Various ideas	1
Confidence	1
Challenge	1
Increased motivation to learn	1
Discuss rules	1
Opportunities for each individual to play an active role	1
Think about how to utilize of the 1:1 information devices	1

4 Discussion

In a case study on elementary schools, Nakao et al. [11] identified two inhibiting factors for the utilization of ICT such as document cameras and computers: dissatisfaction with the ICT environment and concerns about ICT utilization. In addition, they identified several facilitating factors: improving the ICT environment, realization of the benefits of ICT, and sharing of information within the school. In our study, the results identified two factors that facilitated ICT utilization. Although the target of this study was a single teacher, the introduction of 1:1 information devices and Internet access via LTE lines were considered to improve the ICT environment. Teacher X also responded that the information from Teacher Y was most helpful for learning how to utilize ICT, which corresponds to sharing of information within the school. The information from Teacher Z obtained via Slack was also useful. The facilitating factors identified by [11] focused on teachers communicating within an elementary school, but considering that teachers can also access and learn from outside information, the facilitating factor can be extended to sharing of information inside and outside the school. Furthermore, Teacher X realized the benefits of ICT such as time saving and efficiency, proactive involvement with individual students, the students learning to operate the 1:1 information devices independently, and gaining confidence. These factors helped Teacher X utilize ICT despite this being the first time for her to support the utilization of 1:1 information devices.

Teacher X had many concerns before and in the early phase of utilization. Before utilization, Teacher X thought that she would not teach or allow the students to use ICT until she had mastered the use of ICT herself. However, after the utilization of the 1:1 information devices, her mindset had changed to using what she thought would be useful and to have the students teach her. In fact, the students mastered utilizing the 1:1 information devices, which helped shorten the class time [12]. Thus, Teacher X's positive and flexible approach and the students' mastery of IT utilization eliminated their anxiety. Although this corresponds to the realization of the benefits of ICT as identified by [11], the elimination of anxiety as the students acquired ICT operation skills appears characteristic of 1:1 information devices.

Teacher X also noted that the most important aspect of ICT utilization is to make sure that

students fully understand the importance of classroom management and rules before utilizing the 1:1 information devices so that the learning process goes smoothly. Teacher X had been conducting cooperative learning in which students supported each other in her classes before the 1:1 information devices were introduced. Teacher X did not consider the environment containing the 1:1 information devices to be special. She considered providing support for ICT utilization as an extension of her previous support. Her awareness of classroom management and learning guidance had not changed.

The J-curve law is originally a financial term that can be used to visualize the growth of organizations and individuals [13]. As shown in Fig. 1, the J-curve law can be applied to a classroom where students learn while utilizing 1:1 information devices for the first time. Teacher X was concerned about the introduction of 1:1 information devices but also had high expectations. The trough of the J-curve corresponds to when Teacher X did not know how and when to use the devices and felt that the classes did not go as planned in the early phase of utilization. However, Teacher X did not give up, and the utilization of the 1:1 information devices was subsequently facilitated by the improvement in the ICT environment, sharing of information inside and outside the school, and the realization of the benefits of ICT. The turning point was when Teacher X noticed that the students were gradually acquiring ICT operation skills by learning on their own and by teaching each other, and she let the students utilize the 1:1 information devices with the intention of having them teach her by believing in their growth.

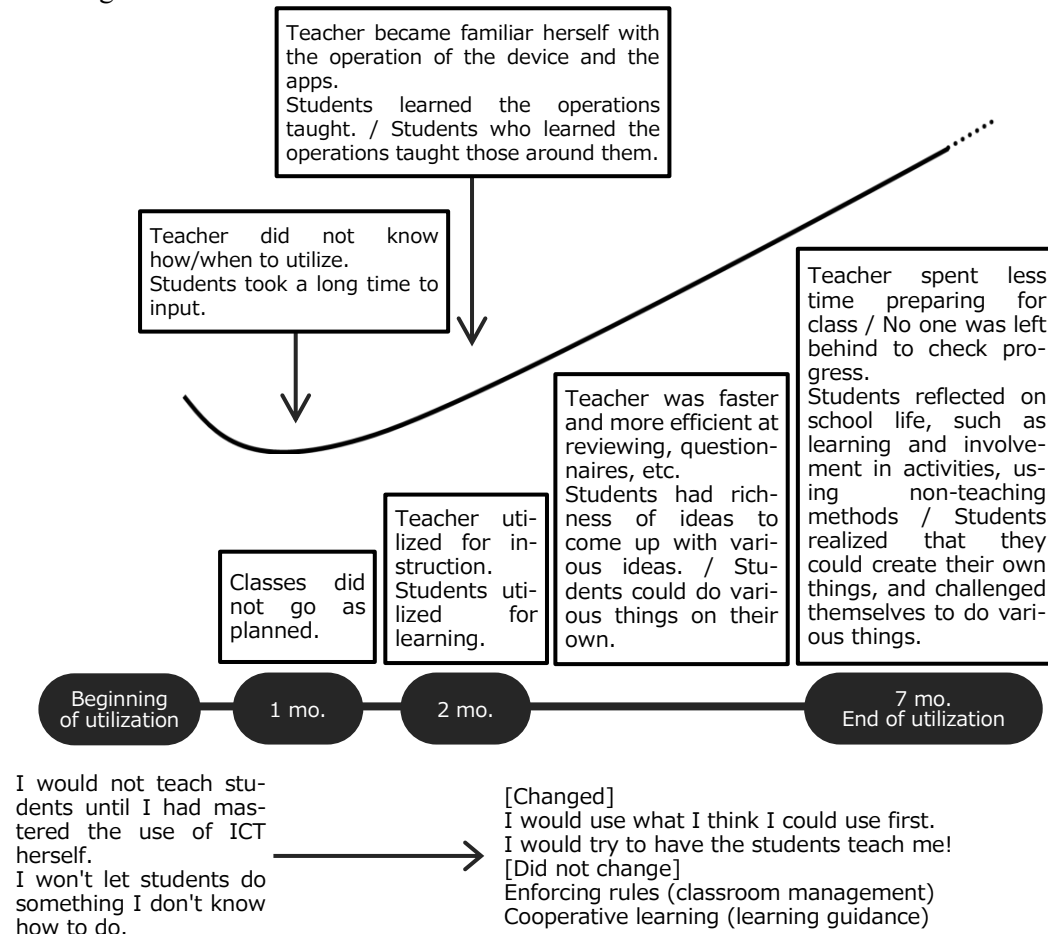


Figure 1: Changes in teacher's awareness

5 Conclusions

In this study, we analyzed the content of a structured interview with Teacher X, who supported elementary school students utilizing 1:1 information devices for the first time. After utilization, Teacher X felt that she and her students were able to effectively utilize the devices in class as they gained familiarity and taught each other. Before utilization, Teacher X thought that she would not teach students until she had mastered the use of ICT herself. After utilization, her mindset had changed to have the students teach her. However, there were some aspects in which Teacher X's awareness of classroom management and learning guidance did not change. This study was limited to the changes in awareness of a single teacher after a 7-month period of ICT utilization, so the obtained conclusions cannot be generalized excessively.

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References

- [1] Ministry of Education, Culture, Sports, Science and Technology, "National Curriculum Standards for elementary school (2017 revision)," 2017.
- [2] Ministry of Education, Culture, Sports, Science and Technology, "National Curriculum Standards for lower secondary schools (2017 revision)," 2017.
- [3] Ministry of Education, Culture, Sports, Science and Technology, "National Curriculum Standards for upper secondary schools (2018 revision)," 2018.
- [4] Ministry of Education, Culture, Sports, Science and Technology, "National Curriculum Standards for Elementary School (2017 revision) explanation, General Provisions," 2017.
- [5] Ministry of Education, Culture, Sports, Science and Technology, "GIGA School Program Enabling Package," https://www.mext.go.jp/content/20200219-mxt_jogai02-000003278_401.pdf, 2019.
- [6] National Institute for Educational Policy Research, "Report on the FY2023 National Survey of Academic Performance and Learning," 2023, <https://www.nier.go.jp/23chousa-kekkahoukoku/factsheet/primary.html>.
- [7] F. Yagisawa and T. Horita, "Comparison of Teachers' Awareness for ICT Use between Novices and Experts in 1:1 Elementary Education," *Japanese Journal of Educational Media Research*, Vol. 23 No. 2, 2017, pp. 83-94.

- [8] K. Sato et al., “Characteristics of Children’s use of ICT and Teachers’ Lesson at the Introduction of the 1-to -1 PC,” *Japan Journal of Educational Technology*, Vol. 45, No. 3, 2021, pp. 353-364.
- [9] Y. Murakami et al., “Teachers’ and Students’ Awareness in Junior High Schools Using One-to-One Computers and Cloud computing on a Daily Basis,” *Research Report of JSET Conferences*, Vol. 2021 No. 3, 2021, pp. 98-105.
- [10] M. Watanabe et al., “The Acquisition Level of ICT operating skills in the Class Where Every Elementary School Student Learns for the First Time in the Environment of 1-to-1 Devices,” *Computer & Education* Vol. 50, pp. 84-89.
- [11] N. Nakao et al. “A Case Study of Factors Affecting Teachers’ Use of Document Cameras and Computers on a Daily Basis in Class Teachings,” *Journal of JSEI (Research of educational information)*, Vol.30 No.3, 2014, pp.49-60
- [12] M. Watanabe et al., “An Attempt to Analyze Changes in Classes by Teachers Teaching for the First Time the Utilization of 1:1 Information Devices,” *Research Report of JSET Conferences*, Vol. 2023 No. 1, 2023, pp. 236-241.
- [13] Leverage LABO, “Understand the “Law of the J-Curve,” a compass for growth, and acquire the “ ability to work through it!”, <https://leverage-share.com/study/post-2904/>, 2018.
- [14] M. Watanabe et al., “An Attempt to Analyze Changes in the Awareness of a Teacher Teaching for the First Time to Elementary School Students the Utilization of 1:1 Devices,” *Research Report of JSET Conferences*, Vol. 2023 No. 2, 2023, pp. 46-51.