A Study to Evaluate the Effectiveness of Google Solution on Middle School Teacher and Student Based on the Kirkpatrick 4 Level Model

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The Asian Conferecnce on Eduaction 2022
Official Conference Proceedings

Abstract
The purpose of this study is to evaluate the effectiveness of Google Solution (GS) on the application of classes. Participants were 17 teachers and 115 students of 'O' middle school in Busan, and the period was from April to September for five months. As a treatment, each teacher was given a Chromebook equipped with Google OS, and six individual GS coaching programs were provided during this period. To evaluate the effectiveness of GS, modified Kirkpatrick model was applied and constructed into four evaluation stages of reaction, learning, behavior, and outcome. For research, mixed research was designed, and online survey, online interview, and field observation were used as research methods. For data analysis, paired t-test was used for quantitative analysis, and for qualitative analysis, three PhDs in instructional technology and two graduate students cross-reviewed interview and field observation data. The results are as follows. According to the modified Kirkpatrick model, the effect of GS was significant in the areas of reaction (class satisfaction), learning (skill utilization ability), and behavior (collaborative learning), but no statistically significant results were found in the results (entrepreneurship). However, at least significant improvements in reaction, learning, and behavior have been proven to be effective in improving teaching effectiveness in the classroom. The limitation of research is that GS coaching programs focused only on using smart devices and software as a treatment, suggesting that support such as education as well as devices and software should be provided when applying the edge technology to the classroom.

Keywords: Google Solution, Kirkpatrick Evaluation Model, Middle School

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1. Introduction

The advent of the Fourth Industrial Revolution (4IR) and the epidemic of COVID-19 brought many changes to the school field. Due to the preventive measures implemented, many attempts were made using technology to carry out non-face-to-face classes, leading to the discourse on the digital learning environment (An Un-ho, 2021). Teachers want to incorporate various technologies for practical classes, and students also want dynamic and participation-oriented classes, rather than boring classes focused on unilateral knowledge transfer.

Advocated by the Organization for Economic Cooperation and Development (OECD), the DeSeCo project was a project that aimed to identify the core competencies required for an individual's successful life and social development in 21st-century society. The intellectual use of tools, social interaction, and autonomous behavior were presented as three core competency categories that individuals must possess in future society. It can be said to be a proper education if it develops the skills necessary for the future in which the learners will live. Particularly in the school environment, where digital transformation is accelerating, teachers and students have to play the leading role in acquiring and developing these competencies. The ability to use technological tools has become imperative for teachers- as educators and students- as change-makers in the 4IR era.

In a future society where talented individuals (entrepreneurs) who view their lives and local problems from a new perspective and practice change are needed, it is crucial to have an education that develops core competencies for the future. This kind of education is possible through the active participation of students, not the current teacher-centered learning environment. The transition from teacher-centered, one-sided classes to student-centered, active participatory classes is crucial, and technology development is expected to play a vital role. Today, students are called digital natives because they use technology daily, which suggests that the learning environment can also induce students to participate more actively while using standard technologies familiar to them.

In particular, Google Solution is a tool that is currently being used a lot in classroom. It is also free of charge for educational purposes in many countries worldwide; this is meaningful because it provides an environment where students from various countries, including developing countries, can receive a quality education. Google Solution is expected to be a handy tool for both teachers and students because teachers can present, collect, and evaluate student assignments at once, and students can do assignments and create creative results using various applications. Many teachers are currently attempting student-participation classes using various technologies in the school field. Although technology research is actively being conducted by many, research on the effect of technology use by teachers and students in classroom instruction is insufficient. Therefore, the researchers analyzed the effect of using Google Solution for teachers and students at O Middle School in P Metropolitan City, applying the Kirkpatrick evaluation model, and implications were derived and presented.

The purpose of this study is to evaluate the effectiveness of teachers and students on Google Solution based on Kirkpatrick's evaluation model. In order to achieve the research objectives effectively in the theoretical background, first, we looked at the Creator Society, which is the shape of the future society, Entrepreneur, a concept similar to Creator, which creates new things, and the future capabilities of the OECD DeSeCo project. second, the specific contents

of the Google Solution, which is the intervention element of this study, were investigated. third, the four-level evaluation factors of Kirkpatrick applied to investigate the effectiveness of this study were considered.

2. Research Problem

The purpose of this study is to verify and evaluate the effectiveness of applying Google Solution in the school field. Accordingly, the following research questions were established to achieve the research purpose.

● What is the level 1 (Reaction) evaluation of teachers and students?
● What is the level 2 (Learning) evaluation for teacher and students?
● What is the level 3 (Behavior) evaluation for teachers and students?
● What is the level 4 (Entrepreneurship) evaluation for teachers and students?

To this end, data were collected through questionnaires, interviews, and field observations, and the data were analyzed.

3. Theoretical Background

3.1 New Talent Image and Creator Society as Emerging New Era

3.1.1 Emerging Creator Society

Generally, a creator refers to a person who shares their content online or on a platform to generate profit and effectively express or convey information or opinion. This platform can be expanded to the creator economy from the perspective of profit generation since it supports creators who produce original content and builds a creator economy ecosystem. However, from the perspective of education, it is necessary to introduce the concept of the creator society, where diverse, original, creative, and high-quality content is produced through sharing and collaboration among individual creators.

3.1.2 Entrepreneur as New Talent Image

The term 'entrepreneur' has been defined by many scholars. Schumpeter (2016) defines an entrepreneur as someone who creates new combinations through creative destruction, such as inventing new products, introducing new production methods, and opening new markets. Peter Drucker defines an entrepreneur as a person always exploring and responding to change and putting it into practice as a new opportunity. Park Su-hong (2009) defined an entrepreneur as a person who conceives and practices a new system that does not exist in all areas of society and emphasizes creativity and practicality. From the preceding definitions, an entrepreneur can be defined as a person with practical power who does not fear change and uses change as an opportunity to create valuable new products through creative destruction. In other words, an entrepreneur is a practitioner who recognizes new values and creates them through practice.
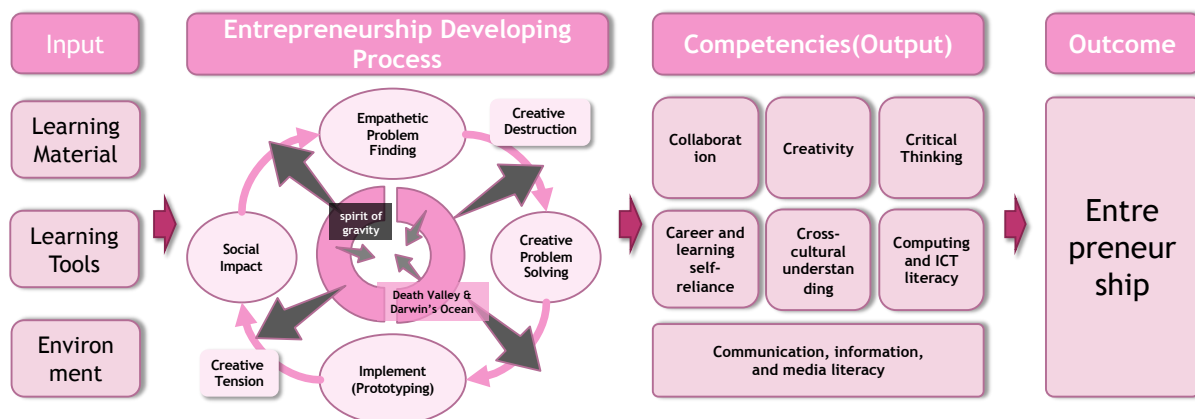
Figure 1. Entrepreneurship developing process

3.1.3 DeSeCo, a Core Competencies

The OECD's DeSeCo core competency emerged from the background of finding out the core competencies required for the present and future society by learners and actualizing them through school education, as educational competitiveness is a source of national competitiveness. The core competency of life refers to the ability to contribute to a successful life and a well-functioning society.

3.2 Google for Education

3.2.1 Composition and Characteristics

The Google solution consists of a software-concept Google workspace and a hardware-concept Chromebook. Google workspace is used differently depending on whether it is for business or education, with Google Workplace for Education used as a tool for teaching and learning. Chromebook is a Chrome OS-based laptop developed by Google, and Using Chrome Education, the educational use can be enhanced. Both Google Workplace for Education and Chromebook are cloud-based; that is, they are driven by cloud computing technology. Cloud computing refers to an environment in which resources can be shared, and various computing tasks can be executed through a server connected to a network medium such as the Internet (Park, 2015). In other words, Google Workspace for Education and Chromebooks provide an environment where data can be stored in a server connected through resources, and the data can be retrieved or processed through various terminals.

3.2.2 Characteristics of Google Workplace for Education

Google Workspace for Education is Google's online space and tool to easily collaborate, streamline classes, and keep the learning environment safe to improve the quality of educational activities. It consists of Google Classroom, a space for education and learning, and tools such as Google Docs, Google Sheets, and Google Slides used for various purposes. Although Google tools have high individual use value, incorporating them using Google Classroom presents tremendous advantages. Using Google Classroom, teachers can distribute class materials and assignments and also share videos necessary for their class. Students can download or view teacher-provided materials, perform tasks directly within Google Classroom, or upload projects created with applications other than Google tools. Students can perform tasks individually and as a team within Google Classroom, which is systematized, promoting communication and collaboration (Kim, 2022).

According to Google for Education(2022), the following values can be realized using Google Workplace for Education in the educational scene. First, strengthen the class effect by increasing the efficiency of collaboration and connectivity with easy-to-use learning tools. Second, improve productivity through saving time by creating, organizing, sharing, and grading assignments in one place. Third, enhance the level of student assignments. It's about helping students submit their best work with simple tools that support learning. And fourth, protect school data. It keeps all users' assignments, identities, and personal information safe with proactive security features and controls.

When using Google Workspace for Education, other tools are integrated based on Google Classroom, so it is a kind of Learning Management System (LMS). Of course, individual devices can be used without linking with Google Classroom, providing real-time data sharing and collaboration between members.

3.3 Kirkpatrick 4 Level Evaluation Model

Kirkpatrick's evaluation model is usually mentioned when stating the most widely used education and training evaluation models. The model consists of four steps: reaction, learning, behavior, and result. The details of each step are as follows:

The first-stage evaluation is an evaluation of the reaction stage and is intended to measure the satisfaction of people participating in the program. The evaluator can obtain information on the most basic needs of the participants through the evaluation of the reaction stage. Subjects to evaluate in the reaction stage are learning topics, instructors, educational facilities, educational schedules, learning materials, and other suggestions or suggestions.

The second step is evaluating the learning stage, which aims to measure the degree of change in learners' attitudes and knowledge or technology development due to education and training. The evaluation of the learning stage is usually carried out immediately after the completion of learning. Still, pre-and-post-evaluation can be conducted to compare the before and after situations. When constrained by circumstances or budget, this evaluation can be performed more accurately by possibly using a control group.

The third step evaluation is the evaluation of the behavior. This evaluation aims to assess the changed behaviors observed when the training participant returns to the space where work or daily life takes place after the training is over. The period for evaluating the behavioral stage is usually divided into before and after the training.

The fourth step, result evaluation, aims to evaluate the final output from the participants due to education and training. The outcomes generated by education participants as a result of education and training include an increase in production, quality improvement, cost reduction, accident reduction, sales increase, turnover rate reduction, and profit increase. When evaluating these final outputs, data are collected before and after the implementation of education and training while operating the experimental and control groups as much as possible. Statistical analysis is often performed using internal data such as organizational reports, questionnaires, and interviews.
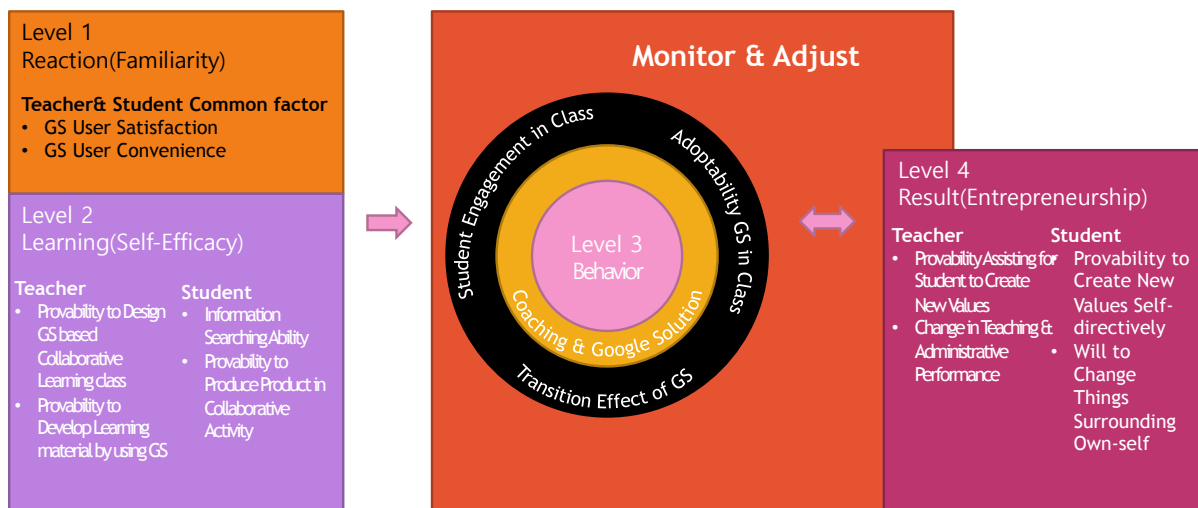
Figure 2. Modified Kirkpatrick evaluation model

In this study, we evaluated the effectiveness of teachers and students on Google Solution based on Kirkpatrick's evaluation model. In order to achieve the research objectives effectively in the theoretical background, first, we looked at the Creator Society, which is an image of the future society, Entrepreneur, a concept similar to Creator, which creates new things, and the future capabilities of the OECD DeSeCo project. second, the specific contents of the Google Solution, which is the intervention element of this study, were investigated. third, the four-level evaluation factors of Kirkpatrick applied to investigate the effectiveness of this study were considered.

4. Research Method

4.1 Research Design and Procedures

This study was conducted in the order of research preparation, pre-data collection, treatment, post-data collection, and data analysis. In the research preparation stage, questionnaires and interview questions were formed for data collection, and rubrics for field observation were developed. According to the characteristics of the field research, a meeting was held with the head of the research department of O Middle School, the research site, and the representative of Company E, who will run the teacher training program, to share the necessary information and request cooperation.

After preparing for the study, pre-treatment data were collected through questionnaires, interviews, and field observations. Due to the restrictions associated with the pandemic, data collection from a large number of people, through questionnaires and interviews, was conducted online. In contrast, researchers visited the school site and conducted face-to-face observation for field observation. As for the treatment, students were given Chromebooks while teachers were provided with a Google coaching program. After treatment, data were collected in the same way as pre-treatment data. Data analysis was performed by synthesizing pre-post data.
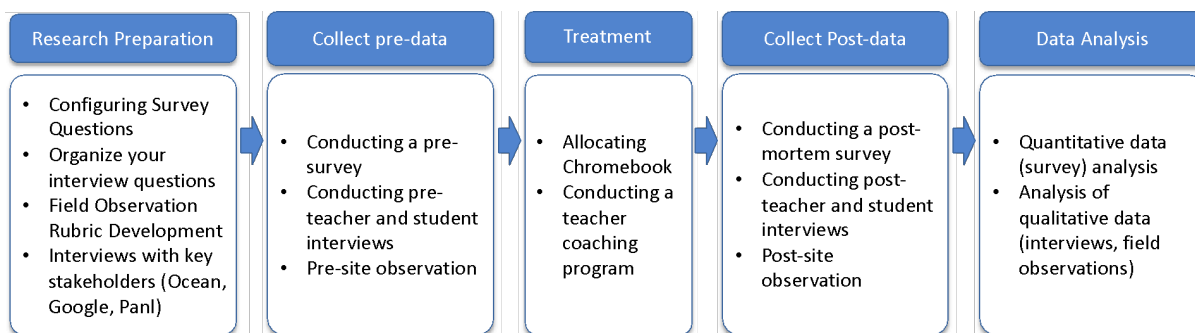
Figure 3. Research process

4.2 Research Subject

The subjects used for this study included 17 teachers and 131 students. The teachers from O Middle School voluntarily participated in the study. Out of the 17 teachers, eight have been teaching for less than a year, and four teachers with more than five years and less than ten years of experience. Three teachers with more than ten years and less than 20 years of experience, and two teachers had more than 20 years of experience. Each teacher participated in a pre-post survey and interviews. Details are shown in the table below.

Participant	Subject taught	Teaching Career	Gender
Teacher A	Korean Language	Less than 1 year	female
Teacher B	English.	Between 10 and 20 years	female
Teacher C	Mathematics	More than 20 years	female
Teacher D	Humanities Society	Between 5 and 10 years	female
Teacher E	Humanities Society	Less than a year	female
Teacher F	Humanities Society	Less than a year	male
Teacher G	Humanities Society	Between 10 and 20 years	female
Teacher H	Information	less than a year	female
Teacher I	Mathematics	less than a year	male
Teacher J	Mathematics	less than a year	male
Teacher K	Mathematics	between 5 and 10 years	female
Teacher L	Art	less than a year	female
Teacher M	Mathematics	less than a year	female
Teacher N	English	between 5 and 10 years	female
Teacher O	Science	between 5 and 10 years	female
Teacher P	Career and Occupation	for more than 20 years	female
Teacher Q	Science	Between 10 and 20 years	female

Table 1. List of teacher participant

The learning participants were 131 students in the second year of O middle school, and the number of survey and interview participants are shown in the table below.

Section	Method	Number Of Participants
Pre	Questionnaire	76
	Interview	15
Post	Questionnaire	115
	Interview	15

Table 2. Number of student participant

4.3 Research Tool

4.3.1 Survey

A survey was conducted to collect quantitative data. According to the Kirkpatrick 4-level model, the questionnaire domains were divided into response, learning, behavior, and result, and detailed questions were composed for each part. Survey questions were based on the existing Albus project, the item composition was revised, and additional items necessary for the research were developed. The questionnaire was implemented as an online questionnaire using a Google survey, and survey links were shared with the participants.

4.3.2 Interview

Pre and post-interviews were conducted to collect qualitative data. A structured interview composed of questions for each participant according to the Kirkpatrick 4-step model was designed, and the interview was conducted online by two doctoral researchers in education pedagogy.

4.3.3 Field Observation Rubric

For systematic field observation, rubric was developed, and field observation was conducted.

5. Research Results

For teachers and students, surveys were conducted before and after introduction of the Google solution, which is the treatment effect. Based on the Kirkpatrick model, the survey questions consisted of reaction, learning, behavior, and result, according to each level. The pre-and post-survey responses were compared and analyzed using paired t-test.

As a result of the analysis, teachers statistically showed significant results in the reaction, learning, and behavior levels, respectively, but not at the result level. In the case of students, it was statistically significant at all levels. The result of the overall analysis is shown in the table below:

section	level	Treatment	M	SD	t
teacher (n=17)	Reaction (Level 1)	Pre	2.64	0.63	2.524*
		Post	3.36	1.01	
	Learning (Level 2)	Pre	2.79	0.90	3.086**
		Post	3.79	0.99	
	Behavior (Level 3)	Pre	3.67	0.53	2.665*
		Post	4.22	0.67	
	Entrepreneurship (Level 4)	Pre	3.53	1.07	1.833
		Post	4.12	0.78	
	Result (Level 4)	Pre	3.69	1.23	-0.242
		Post	3.59	1.27	
student (N=115)	Reaction (Level 1)	Pre	3.19	1.07	5.687**
		Post	4.02	0.82	
	Learning (Level 2)	Pre	3.76	1.03	4.680**
		Post	4.42	0.78	
	Behavior (Level 3)	Pre	3.75	0.81	3.585**
		Post	4.17	0.76	
	Entrepreneurship (Level 4)	Pre	3.78	0.97	3.987**
		Post	4.31	0.85	

*p<.05, **p<.01

Table 3. Result of survey

5.1 Result of Level 1

In the level 1 reaction stage, users' satisfaction regarding the usage of Google Solution was determined. As a result of analyzing the pre and post results of the survey for teachers and students, it can be seen that the satisfaction of using Google Solution increased significantly for both teachers and students post-treatment.

In the interview results, the frequency of usage of negative words such as disappointing, difficulty, and uncomfortable was high for teachers and students in the pre-interview. However, satisfaction, efficiency, actively, easier, convenience, and confidence were words from teachers and students after the treatment. It can be seen that the frequency of appearance of more positive comments also increased.

In the observation of class, Edu-Tech, a different solution, was used periodically during the pre-testing; however, it was unfamiliar to users. GS was used subsequently, making it possible to observe the classes through Google Classroom. Results from this level showed a meaningful increase in the satisfaction level of users post-treatment.

5.2 Result of Level 2

In the level 2 learning stage, the self-efficacy of users in using Google Solution was examined. As a result of analyzing the pre- and post-results of the survey for all participants,

it can be seen that the sense of self-efficacy has significantly improved. Teachers confirmed their confidence in creating collaborative learning activity plans or class activity materials using Google Solution has increased. The result shows that the student's sense of efficacy in information search, cooperative learning activities, and joint production has also significantly improved.

From the interview results, negative vocabulary, such as difficult, ambiguous, and complicated, was used somewhat frequently in the Pre-Interview. However, participants expressed words reflecting more improvement in efficacy, such as professional, skillful, and better, after the class. Thus, the frequency in the appearance of terminology reflecting the gain has increased.

Regarding class participation observation, the use of Google Solution was relatively low initially. As neither teachers nor students could use it effectively, the goal of efficiency and effectiveness in class could not be achieved. On the other hand, after the course, teachers skillfully used Google Classroom as a platform for learning management. Through the various functions of Google Classroom, teachers led the class by proficiently utilizing tools from different Google Solution. In addition, students used the Google Solution tools presented by teachers readily, and the use of Chromebook, which has several advantages over tablets, seems to have increased the efficiency.

5.3 Result of Level 3

In the level 3 behavioral stage, the extent to which the use of technology such as Google Solution makes a difference in class or work life was investigated. As a result of a survey of teachers, it was found that there was a significant improvement in terms of students' participation in classes and teachers' behavior in applying technology to the learning environment. However, no substantial progress in classes conducted by the teachers was noticed. The survey results did show notable changes in the level of improvement in class concentration or changes in students' life.

From the interview results, the frequent use of negative vocabulary such as lecture-style, difficulties, annoying, problem, and harmful was noticeable in the beginning. Afterward, the appearance of more positive words- confidence, positivity, actively- for teachers and easier and better for students can be seen to have increased. In light of the interview content, rather than unilaterally stating that there was a significant change as a whole, the good and bad points were considered and recognized.

During field observation of class, there was a limit to the efficiency of class due to the use of the unfamiliar Edu-tech solution at the onset. Nonetheless, upon managing the class using Google Classroom and various Google tools, the effectiveness was enhanced by the increase in the concentration and interest of the participants.

5.4 Result of Level 4

In the level 4 result stage, the effect of using Google Solution on creating new value was confirmed. The result of the survey of teachers showed no significant change in whether students could help make new values through self-directed learning activities or not. In addition, it was confirmed that there was no substantial change in the effect of the Google Solution on work reduction.

Although it was found that there was no significant change in the survey results, the results confirmed by the interview showed that, due to the nature of school work processing, Google Solution was used more than in other schools, and as the Google Solution utilization capacity increased, it became possible to process the work more efficiently. From the interview results, it can be seen that the frequency of words such as problem and inconvenience in the preliminary test and efficiently and conveniently in the concluding test was high for teachers. In the case of students, the occurrence of vocabularies such as annoying, hard in the Pretest and confidence, solve, new, and better afterward was high. Students seemed interested in creating new values or making several attempts to change norms as their proficiency and freedom in executing tasks through Google Solution increased.

Results from class observation did not show an apparent change in the creation of new values. However, seeing that the student's proficiency in class improved, it can be inferred that there was a change in the student's attitudes toward creating new values.

6. Conclusion and, Implications

This study was conducted by applying Kirkpatrick model on the effectiveness of using Google Solution for O middle school in P metropolitan city. Kirkpatrick's education and training evaluation model consists of four stages: reaction, learning, behavior, and result. Though the results of evaluating the effectiveness of Google Solution were limited, the efficacy of the program, such as improving class satisfaction, increasing technology utilization, and promoting cooperative learning, was found to be high.

According to Kirkpatrick's education and training evaluation model, it is assumed that lower-level stages of hierarchical prerequisites for satisfying higher-level steps. In other words, the next stage's performance depends on the previous step's performance. For example, the performance of the second stage can be obtained only when the performance of the first stage is satisfactory. Since the results of this study were consistently obtained for all levels, it can be proven that using Google Solution for teachers and students was efficacious in the teaching and learning environment.

In the first-stage reaction level evaluation, the satisfaction of teachers and students with the Google solution improved significantly. The second-stage learning level evaluation recorded a noticeable increase in the self-efficacy level. Although there was no improvement in the third step behavioral level evaluation in the structural dimension of class change, the teacher's behavior in solution application in class and the student's learning behavior showed significant improvement. According to the Kirkpatrick evaluation model's level dependency assumption, increased user satisfaction led to the advancement of self-efficacy. A series of step-by-step processes resulted in a positive behavioral change in the evaluation subjects; hence, study results showed that applying the Google solution was effective.

However, in the fourth-stage result level, it was challenging to confirm satisfactory results. The evaluation was intended to determine the impact of training on creating new values by training participants. Changes in the quality of the class and work performance through improvement in the way teachers perform their duties and creative changes and modifications in students' learning behavior were evaluated.

Through the application of a technology called Google Solution, the degree of impact of technology application seen through the enhancement of class interest, increased ability to

use technology, teacher's work performance, and student cooperative learning ability- was found to be high. Among the future core competencies proposed by the OECD DeSeCO project, the ability to 'use technology interactively' and 'Interactive in a heterogeneous group' belonged to the first and second categories, respectively (OECD, 2019). Therefore, this study showed that GS's powerful data sharing and collaboration feature could improve digital literacy and educational interaction.

While the Google solution functions as an effective medium for education and contributes to improving the effectiveness of education in the course of the class, the following are suggestions to enhance its capacity for future society beyond technological knowledge. Undoubtedly, utilizing technology is necessary to develop talent for change-making. However, during the transition period of this new paradigm, called the 4IR, it is required to deviate from the existing framework and bring about new changes; that is to say, it is necessary to foster transformative competencies presented in OECD Education 2030 (OECD, 2019).

At the core of transformative competence is the creation of new values. The growth of transformative competence should lead to the development of an entrepreneur who discovers and seeks solutions to life and regional problems and leads to new changes for a better future. An entrepreneur is not a person who establishes a company for economic business and operates it for profit only, but a person who discovers and solves the problems of an individual's life and the problems of a region closely connected to that life from a broader perspective. An entrepreneur finds, solves, and brings about change (Park et al., 2022).

To prepare for the future society, fostering entrepreneurial competencies is necessary. Entrepreneurs can discover real problems, creatively analyze the causes of problems, and develop innovative solutions to bring about changes in the lives of individual members and the local ecosystem. Therefore, education should take place in the big picture to foster entrepreneurship as a transformative competency for the future society.

From the preceding, it is recommended that GS go beyond improving the effectiveness of classes and become an integrated tool for fostering entrepreneurship through creative problem-solving education methods based on practical problems such as problem-based learning, active learning, design thinking, and entrepreneurship competency-enhancing class models. Therefore, Google Solution for Education needs to present a methodology for fostering entrepreneurship as a functional transformative competency, along with the use of software tools like Google Classroom and Chromebook as mediums to promote competency development.

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