*Data and Metadata*. 2024; 3:.398
doi: 10.56294/dm2024.398

ORIGINAL

# The effectiveness of the use of Google Sites-Based mobile learning to improve 21st-Century Skills of vocational high school students

## La eficacia del uso del aprendizaje móvil basado en Google Sites para mejorar las habilidades del siglo XXI de los estudiantes de educación secundaria vocacional

Agusti Tamrin[1], Cucuk Wawan Budiyanto[1], Ahya' Alimuddin[1], Asnul Dahar Minghat[2]

[1]Vocational Teacher Education, Faculty of Teacher Training and Education, Universitas Sebelas Maret. Surakarta 57146, Indonesia.
[2]Razak Faculty of Technology and Informatics, Universiti Teknologi Malaysia. Johor 81310, Malaysia.

**Cite as:** Tamrin A, Budiyanto CW, Alimuddin A, Minghat AD. The effectiveness of the use of Google Sites-Based mobile learning to improve 21st-Century Skills of vocational high school students. Data and Metadata. 2024; 3:.398. https://doi.org/10.56294/dm2024.398

**Submitted:** 06-02-2024 **Revised:** 29-05-2024 **Accepted:** 17-09-2024 **Published:** 18-09-2024

**Editor:** Adrian Alejandro Vitón Castillo

**Corresponding Author:** Agusti Tamrin

## ABSTRACT

**Introduction:** Google Sites was chosen because it can provide real-time services when there are updates to learning materials.
**Objective:** this research aims to develop mobile learning based on Google Sites and determine its effect in improving the skills of 21st-century vocational students.
**Method:** the development model is based on the Research and Development models by Gall, Gall, and Borg. Product validation by experts is getting a very proper predicate. The application of the media was conducted for students in the 11th class of the Machining Engineering Competency. The product was tested in three Vocational High Schools (VHS) with 78 respondents in three practical and three control classes. The data collection techniques utilized in this study encompassed a multiple-choice test of 4C abilities; an observation sheet completed by teachers, and structured interview instruments for both students and teachers. Data analysis techniques include: qualitative data analysis employing an interactive approach involving data reduction, data display, and conclusion drawing; and quantitative data analysis comprising tests for normality, homogeneity, and hypothesis testing using the independent sample t-test.
**Results:** findings of the research indicated that: observations conducted by teachers revealed a significant enhancement in skills within both experimental and control groups; within the experimental group, critical thinking skills increased by 11,85 % communication skills by 5,6 %, collaboration skills by 11,72 %, and creative skills by 8 %; and the results of the t-test can be inferred that there exist notable disparities between the practical and control classes across the three schools.
**Conclusions:** the conclusion drawn from this research is that Google Sites-based mobile learning effectively enhances the 21st-century skills of students in Vocational High Schools.

**Keywords:** Mobile Learning; Google Sites; 21st-Century Skills; Vocational High School.

## RESUMEN

**Introducción:** se eligió Google Sites porque puede proporcionar servicios en tiempo real cuando hay actualizaciones de los materiales de aprendizaje.
**Objetivo:** esta investigación tiene como objetivo desarrollar el aprendizaje móvil basado en Google Sites y determinar su efecto en la mejora de las habilidades de los estudiantes vocacionales del siglo XXI.
**Método:** el modelo de desarrollo se basa en los modelos de Investigación y Desarrollo de Gall, Gall y Borg. La validación del producto por parte de expertos está obteniendo un predicado muy adecuado. La aplicación de los medios se llevó a cabo para estudiantes de la 11.ª clase de la Competencia de Ingeniería de Maquinado.

El producto se probó en tres escuelas secundarias vocacionales (VHS) con 78 encuestados en tres clases prácticas y tres de control. Las técnicas de recopilación de datos utilizadas en este estudio abarcaron una prueba de opción múltiple de habilidades 4C; una hoja de observación completada por los maestros e instrumentos de entrevista estructurada para estudiantes y maestros. Las técnicas de análisis de datos incluyen: análisis de datos cualitativos que emplean un enfoque interactivo que involucra reducción de datos, visualización de datos y extracción de conclusiones; y análisis de datos cuantitativos que comprende pruebas de normalidad, homogeneidad y prueba de hipótesis utilizando la prueba t de muestra independiente.
**Resultados:** los hallazgos de la investigación indicaron que: las observaciones realizadas por los maestros revelaron una mejora significativa en las habilidades tanto dentro de los grupos experimentales como de control; dentro del grupo experimental, las habilidades de pensamiento crítico aumentaron en un 11,85 %, las habilidades de comunicación en un 5,6 %, las habilidades de colaboración en un 11,72 % y las habilidades creativas en un 8 %; y los resultados de la prueba t permiten inferir que existen disparidades notables entre las clases prácticas y de control en las tres escuelas.
**Conclusiones:** la conclusión extraída de esta investigación es que el aprendizaje móvil basado en Google Sites mejora de manera efectiva las habilidades del siglo XXI de los estudiantes en las escuelas secundarias vocacionales.

**Palabras clave:** Aprendizaje Móvil; Sitios de Google; Habilidades del Siglo XXI; Escuela Secundaria Vocacional.

## INTRODUCTION

Science's accelerating synergy is one of the 21st century's defining characteristics. The Indonesia's The National Education Standards Agency states that the "space and time" factor, the determining aspect of humanity's speed and success in mastering science, is narrowing and melting away due to the use of information and communication technology in education. On the other hand, in high school, diploma, and undergraduate students lack the following skills: (1) oral and written communication, (2) critical thinking and problem solving, (3) work and professional ethics, (4) teamwork and collaboration, (5) working in diverse groups, (6) operating technology, and (7) project management and leadership.[1,2]

Enhancing students' 21st-century skills will require considerable effort. The 21st-century skills are the demands of the education world that require teachers to present collaborative learning content and prepare students for the real world.[3] This content of 21st-century education is known as 4C (Critical Thinking and Problem Solving, Communication, Collaboration, and Creativity and Innovation).[4,5] Integrating this skill into classroom instruction is non-negotiable because it is believed to equip students to compete in the harsh world of work. Students in vocational schools who are prepared for the workforce after graduation must also possess communication skills from a young age. Since the beginning of the 20th century, communication skills have been the essential criterion of job suitability in job interviews.[6,7] Therefore, it is hoped that graduates of the Vocational School can effectively communicate their skills to others.[8]

Recognizing the significance of 21st-century skills in 21st-century education, UNESCO has initiated the Global Network of Learning Cities (GNLC) to support cities worldwide in developing policies and programs that promote lifelong learning for all citizens. Cities participating in this network exchange best practices in cultivating 21st-century skills through both formal and informal education.[9,10] Furthermore, the OECD has developed the Future of Education and Skills 2030 program aimed at assisting education systems worldwide in responding to the changing needs of the 21st century. Its primary focus lies in the development of competency frameworks encompassing cognitive, social, and emotional skills essential for the future. The program also underscores the importance of lifelong learning and student-centered education.[11,12]

However, the reality on the ground contradicts this notion, as evidenced by The Programme International Student Assessment (PISA) study, students lack 21st-century skills. Communication, mathematics, reasoning and arguments, problem-solving strategies, operations and mathematical tools are among the indicators of the PISA questions.[13] Their science literacy scores are below the PISA average. Despite the skills required in the 21st century, our learners cannot comprehend the concepts of science and their application to daily life.[14,15] Furthermore, twenty eleventh-grade students were interviewed to analyse student needs. According to an analysis, 65 % of teachers had yet to utilise various learning media, and 80 % still relied on lecture methods. Eighty-five per cent of students said they enjoyed being taught with interactive media, and 95 per cent agreed that the material was presented more interactively with the media used. In addition, 95 % of students stated that they would comprehend the material better if it were presented in multimedia format, including text, images, sounds, and animations, and 100 % of students owned Android smartphones. At the stage of needs analysis, a teacher needs analysis is also conducted using a written interview with a vocational subject educator. Due to a lack of time to prepare learning tools, learning media variations.

Mobile Learning will undoubtedly be inevitable with various appropriate complementary technologies

combined with conventional learning.[16] The results showed that the average score of students learning using mobile learning is higher than learning using PowerPoint.[17,18,19] In this learning concept, mobile learning benefits from the availability of teaching materials that can be accessed at anytime and anywhere.[20,21,22]

One of the online platforms is a website on the internet that is very suitable to be used as an alternative learning option.[23] Website media can also be used as a learning tool to increase the positive impact of internet use. Google Sites is one of the website media that can be used in learning. Google Sites is the easiest way to create information that can be accessed by people in need quickly and in real-time.[24,25,26] With teachers' creativity, Google Sites can be more integrated. This integration can likely affect the effectiveness of online learning, student learning motivation, and student interest in education. Innovation needs to be continuously formed and developed. Teachers must be able to facilitate their students to learn quickly.[27,28]

Therefore, development research is needed on Google Sites-based mobile learning that can improve the skills of 21st-century vocational school students. I hope this research can add references to the mobile learning variable and 21st-century skills used and can be a reference in other studies.[29,30]

## METHOD

### Type of Research

This research uses Research and Development (R&D). R&D is a research method used to produce a particular product and test its effectiveness of the product.[31] The development method used is the development model of Borg and Gall.[32] The research stages are divided into introduction, development, and testing. The Research and Development (RnD) method was chosen due to its capacity for iterative development and evaluation of Google Sites as a mobile learning tool, ensuring the produced product is both relevant and effective in enhancing 21st-century skills. This method also involves stakeholders in the development process, ensuring alignment with user needs. Furthermore, RnD facilitates testing in real-world contexts, thereby providing high validity and reliability of research outcomes.

*Research Sample*

The population are students in State VHS 2 Jiwan, VHS PGRI 1 Mejayan and State VHS 1 Madiun. There are all in Madiun, East Java. Consists of 389 students, and we brought a 20 % of them to be participants. Students as the research sample consisted of male and female with the average of students being 15-16 years old, students come from medium socio-economic conditions so that all of students have android as their source and learning media. Testing the effectiveness of Google Site mobile learning is by using a pretest and posttest with a distance of giving questions for two meetings.

*Research Instrument and Procedure*

The data collection techniques employed in this research encompass both test and non-test methods. The test method involves the use of multiple-choice tests designed to measure 4C abilities (critical thinking, communication, collaboration, and creativity) within the context of lathe matching materials. In addition, the non-test methods include observation and interviews. Observations are conducted by teachers who complete observation sheets to assess students' performance and engagement during the learning process.[33] Structured interviews are also conducted with both students and teachers to gain deeper insights into their experiences, perceptions, and feedback regarding the use of Google Sites-based mobile learning.

The instruments used in this research consist of a teaching instrument and data collecting instrument. The teaching instrument is in the form of lesson plans, and Google Site mobile learning. The data collecting instrument is a multiple-choice test of 4C abilities in lathe matching materials and observation sheet which fulfilled by the teacher dan structured interview instruments for students and teachers.

**Table 1.** Skill data instrument 4c

| Skills | Indicator | Realm | Kind |
|---|---|---|---|
| Critical thinking | 16 | Cognitive, Affective, Psychomotor | Tests and Observations |
| Work | 7 | Affective, Psychomotor | Observation |
| Collaborate | 8 | Affective, Psychomotor | Observation |
| Creativity | 9 | Affective, Psychomotor | Observation |

The validity of the multiple-choice test instrument for measuring 4C in lathe matching materials includes content validity through expert assessment, which examines the alignment between test items and the measured competencies, and construct validity through factor analysis to ensure that test items group according to the

theoretical constructs of 4C, with a test of the test instrument. As for the reliability of the multiple-choice test instrument, the product-moment formula is employed. Furthermore, the validity of the observation sheet and interviews is assessed using content validity, involving experts in the development and assessment of observation sheets and interviews, as well as criterion validity by comparing observation results with other verified performance indicators.

### Data Analysis

The data analysis used is through qualitative and quantitative approaches. The qualitative stage is done by Miles and Huberman which includes data reduction, presentation, and conclusion.[34] Analysis of expert validation and questionnaire data is carried out quantitatively. Furthermore, quantitative data processing was carried out using statistical tests of pre-test and post-test data results from experimental and control classes. However, before the prerequisite test is carried out, the analysis includes the normality and homogeneity tests. Normality tests were performed to determine whether the data of both classes came from normally distributed populations. Test Shapiro Wilk with α=0,05 and assisted by the SPSS program. Moreover, a homogeneity test is performed to determine whether the data obtained have a homogeneous variance. A homogeneity test is performed to determine whether the population variance of the data tested has a homogeneous variance.[35] The method used is through Levene's test with α = 0,05 and assisted by the SPSS program. As for hypothesis testing, this study employs the independent sample t-test. The independent sample t-test is a test used to compare two unrelated or free data samples. This study's independent sample t-test was to test the significant average difference between the experimental and control classes after being treated.

### Research Procedure

The research stages are divided into introduction, development, and testing.[32] At the upstream location, researchers collect preliminary information on the needs of learning models through observation, literature studies, and interviews. The development phase includes preparing product designs, validating material and media experts, pro-manufacturing, and trialling hypothetical models. The initial product format development stage provides for the preparation of learning materials and evaluation tools. Furthermore, the content expert analysis tests the feasibility of content consisting of an introduction, content, evaluation, and conclusion by senior teachers without revision/improvement. Meanwhile, media experts validate aspects of display and programming. The hypothetical test phase includes initial field trials, revised trial results, and field trials. The third stage, the testing stage, includes field implementation tests, final product improvements, and the dissemination and implementation stage. After revising the product, it is tested again by involving an even more prominent subject. The final product revision is a revision that is carried out based on a broader field test. This stage is carried out by publishing mobile learning, reporting results in the form of thesis reports, and creating articles for publication.

## RESULTS

### Introduction Stage

The introduction phase represents the most crucial and foundational stage in developmental research. Activities within this phase help ensure that the research is grounded in a solid understanding of the issues at hand and its theoretical context, as well as having clear objectives and a viable plan to achieve them. During this phase, the analysis of the potential use of Google Sites in learning demonstrates that the platform offers advantages in accessibility, user-friendliness, collaboration, integration with other Google tools, and interactivity. However, within the context of vocational high school students, there are still several challenges to address, such as varying levels of technological skills among students, limited internet access availability, and the challenge of integrating technology-based learning with existing vocational curricula. Preliminary data collected through initial surveys indicate a high interest among students in using technology for learning, but also highlight the need to enhance 21st-century skills such as critical thinking, communication, collaboration, and creativity.

It is widely acknowledged that the development of this product facilitates easy access to learning anytime, anywhere. The adaptability afforded by mobile learning Lathe Machining Techniques based on Google Sites is consistent with some research recommendations to expand online media as a learning platform.[36,37,38,39,40,41] Students can access course materials and educational resources from anywhere and anytime, which is one of the most significant advantages of mobile learning based on Google Sites. This flexibility permits students to learn at their own pace, which can aid them in better comprehending the material and retaining it.[1,42,43]

Using Google Sites for mobile learning, however, comes with obstacles. One of the most significant obstacles is providing all students with the technology required to participate in mobile learning activities. This can be especially difficult for low-income students or those residing in rural areas with limited Internet access.[44]

Furthermore, access to technology in some places remains very expensive, so students and parents need help to purchase a tablet or smartphone with sufficient capabilities to support learning.[37,39,45] In addition, it addresses the deficiencies of mobile learning development research that require downloading files, updates, and installs to obtain the most recent content.[1,38,46]

Another obstacle is the need for effective monitoring and management of mobile learning activities. The use of self-paced learning afforded by technology requires discipline on the part of the students. Evidence from this research suggests that the students involved were engaged in their learning and could remain on task while working independently.[47,48] Teachers must be able to track student progress and provide timely feedback, which can be challenging when students use their own devices to access course materials.[49,50]

**Development Stage**

After the development and validation process, a Google Site mobile learning-based was generated to run on Android smartphones. Products are assembled by utilizing several applications. Icons and images are created and downloaded from Canva for education, while interactive multimedia is built using Google Sites. The appearance of the learning application can be seen in the following picture.


**Figure 1.** Mobile learning introductory view


**Figure 2.** Display of comic materials and mobile learning videos

Because it is a self-learning medium for students, there are instructions for students and a search button. Teaching materials are equipped with videos, comics, and student worksheets as an evaluation tool. Overall, these features contribute to the effectiveness of Google Sites-based learning in developing 21st-century skills among vocational high school students.

Figure 3 shows the results of media and material validation results. Material experts validated this mobile learning with a score of 90 % and media experts with a value of 97,5 %, so they get the title Very Decent. A recapitulation of the importance of validation appears in the image below. With the excellent ratings from both experts, it can be ensured that Google Sites-based mobile learning meets quality standards and can be relied upon to enhance learning in vocational high schools.

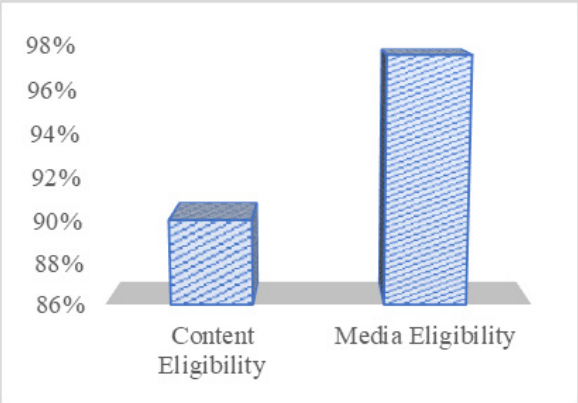


**Figure 3.** Results of material and media expert validation of mobile learning

In addition, it also received a positive response from students as users. They were asked to fill out a media usage response sheet. Based on figure 4, the first assessment was 90,7 % in the first, 77,5 % in the second, and 93,35 % in the third. The positive response reflects that students feel assisted and engaged with the learning materials presented through Google Sites-based mobile learning. The evaluation conducted by students validates the effectiveness and usefulness of Google Sites-based mobile learning in supporting the learning process.

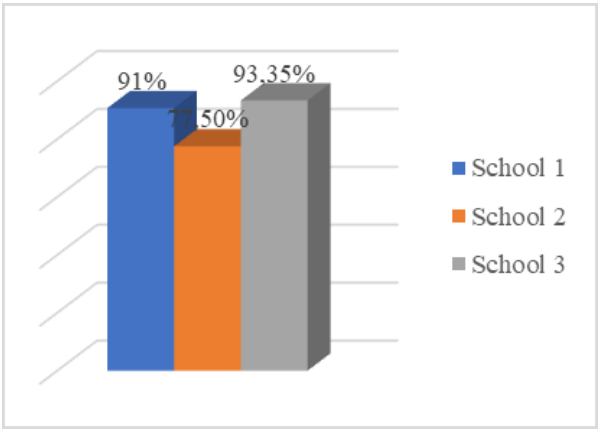


**Figure 4.** Recapitulation of student responses to mobile learning

The use of mobile learning based on Google Sites has the potential of strengthening vocational high school students' 21st-century skills. The results of this study show that mobile Learning Lathe Machining Techniques based on Google Sites effectively improve the students' 21st-century skills. These results also follow research by Nasution et al. which shows that learning materials are delivered more effectively with mobile learning.[52] Google Sites-based mobile learning offers several vital advantages in the context of 21st-century education. Firstly, its high accessibility allows students to engage in flexible learning anytime and anywhere, thus supporting self-directed and continuous learning.[2] Secondly, the platform provides flexibility in content delivery, enabling the use of various media such as videos, images, and interactive texts, which enhance student engagement and comprehension.[36] Thirdly, its collaborative features facilitate student cooperation in projects and online discussions, fostering crucial collaboration skills in an increasingly connected work environment.[39] Lastly, Google Sites provides an inclusive learning environment where students with different learning styles can find the most suitable methods to comprehend the material.[38]

**Testing stage**

The effectiveness of Google Sites-based mobile learning measured by posttest questions was given to experimental and control classes in each school. This problem is included in mobile learning based on Google Sites. The collected data were then analyzed for normality, homogeneity, and independent t-test. Figure 5, figure 6, and figure 7 show that sig (2-tailed) value < 0,05 is rejected, meaning that there is a significant difference between the $H_0$ experimental class posttest and the control class posttest. All of this suggests that there are significant differences between the three schools' practical and control classes in the three schools. So, it can be concluded that mobile learning based on Google Sites is effective and significantly increases students' critical thinking competence.

**Independent Samples Test**

| | | t-test for Equality of Means | | | |
|---|---|---|---|---|---|
| | | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence ... Lower |
| post | Equal variances assumed | .000 | 5.67647 | .68471 | 4.30940 |
| | Equal variances not assumed | .000 | 5.67647 | .68471 | 4.30892 |

**Figure 5.** Independent test t-test posttest grades of experimental and control classes in school 1 (State VHS 2 Jiwan)

**Independent Samples Test**

| | | t-test for Equality of Means | | | |
|---|---|---|---|---|---|
| | | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence ... Lower |
| post | Equal variances assumed | .000 | 4.34483 | .81674 | 2.70870 |
| | Equal variances not assumed | .000 | 4.34483 | .81674 | 2.70406 |

**Figure 6.** Independent test t-test post-test grades of experimental and control classes in school 2 (VHS PGRI 1 Mejayan)

**Independent Samples Test**

| | | t-test for Equality of Means | | | |
|---|---|---|---|---|---|
| | | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence ... Lower |
| post | Equal variances assumed | .002 | 2.88235 | .87600 | 1.13336 |
| | Equal variances not assumed | .002 | 2.88235 | .87600 | 1.13323 |

**Figure 7.** Independent test t-test post-test grades of experimental and control classes in school 3 (State VHS 1 Madiun)

Supported teacher observations on the achievement indicators of students' 21st-century skills show that these skills are improving. The visualization of the percentage increase is as follows. Based on observations during the study, it was seen that the experimental class students were more enthusiastic about participating in learning compared to the control class, in line with research that states that a fun learning process can foster new skills and a spirit of learning.[2,37,38,39]

Figure 8 shows that in school 1, the critical thinking skills of experimental class students increased by 13,79 % and control class by 9,63 %. School 2 increased by 9,35 % in the testing and 8 % in the control classes. In school 3, the increase in the experimental class was 12,4 %, and the control class was 9,79 %.

https://doi.org/10.56294/dm2024.398

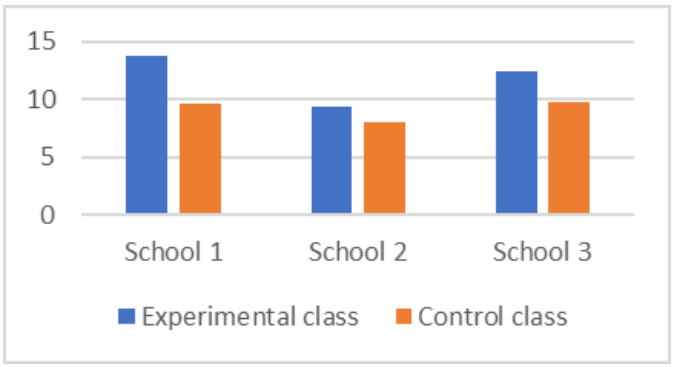


**Figure 8.** Test results and observation of critical thinking skills

The results of this study support research by Nainggolan which also applies mobile learning to enhance students' critical thinking skills.[52] Through Google Sites-based mobile learning, students can access a variety of challenging learning materials, encouraging them to question, analyze, and evaluate information more deeply.[43] Google Sites provides students with the opportunity to develop their critical thinking skills through interactive and flexible tasks that stimulate problem-solving, analysis, and synthesis.[41,42]

Figure 9 found that in school 1, the communication skills of experimental class students increased by 5,5 % and the control class by 2,8 %. School 2 rose 1,3 % in the testing and 1,4 % in the control classes. In school 3, the increase in the experimental class was 1,0 %, and the control class was 5,8 %.

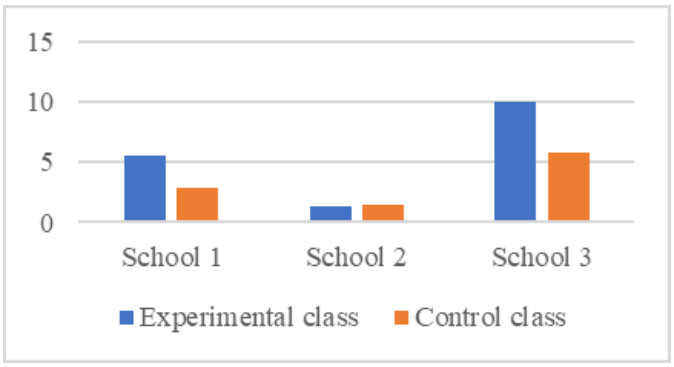


**Figure 9.** Results of observation of communication skills

Google Sites-based mobile learning has the potential to enhance students' communication skills through active participation in online discussions, collaboration with peers, and effective sharing of ideas through features such as comments and feedback.[46,47] From figure 10 the results were obtained that in school 1, the collaboration skills of experimental class students increased by 23,7 % while the control class did not improve. School 2 increased by 2,74 % in the practical course and 6,25 % in the control class. In school 3, the increase in the experimental class was 8,7 %, and the control class was 7,7 %.

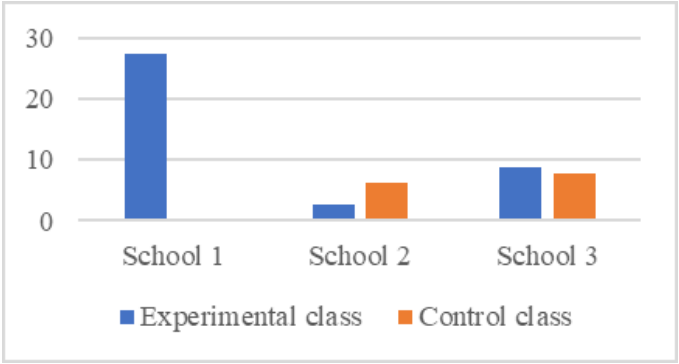


**Figure 10.** Results of observation of collaboration skills

Using mobile devices can boost student engagement by allowing them to learn in a friendly and comfortable manner that encourages student collaboration and communication.[43,45,47] Students can collaborate and

share their ideas more efficiently through online tools such as discussion forums, group projects, and virtual presentations. This collaboration can aid in developing essential teamwork and communication skills for the workplace.[36,38,41] Figure 10 shows that in school 1, the creativity of experimental class students increased by 11,3 %, while the control class did not. School 2 rose 5,9 % in the practical and 2,9 % in the control classes. In school 3, the increase in the experimental class was 6,8 %, and the control class was 8,5 %.

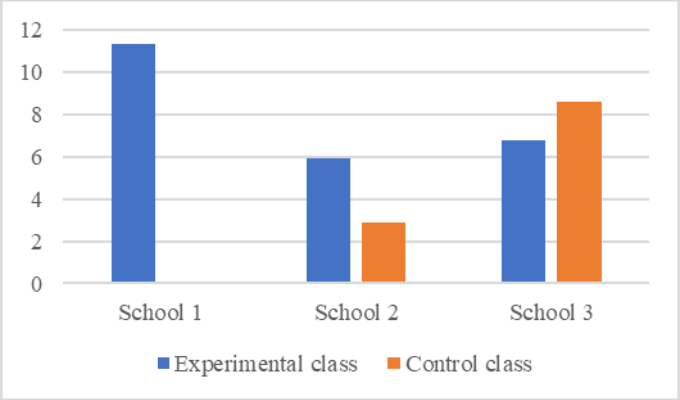


**Figure 11.** Results of observation of creativity skills

The results of this study are also in line with Ramasundrum which states that mobile learning can trigger an increase in students' creative skills.[43] With a variety of multimedia features available, such as images, videos, and interactive texts, Google Sites-based mobile learning enables students to express their creative ideas visual and audio-visual.[49] Furthermore, the ability to collaborate online facilitates the exchange of ideas among students, triggering processes of brainstorming and innovation.[39,45]

## CONCLUSIONS

Based on the results and discussion of the research, it can be concluded: (1) expert validation, this mobile learning is deemed valid and feasible as a learning medium for Lathe Machining Techniques in Vocational Schools; (2) mobile learning is validated and deemed practicable after being subjected to student trials, both limited and extensive; (3) using an independent t-test on pre-test and post-test data, the effectiveness of mobile learning for Google Sites was evaluated. There is a statistically significant difference between the average post-test scores of experimental and control classes, so mobile learning based on Google Sites improves students' 4C skills. The development of mobile learning based on Google Sites effectively improves students' 4C skills when coupled with teacher observations on indicators of student 4C skill achievement during education. The development of mobile learning on Google Sites has a favourable impact on education. Because they can use smartphones, this media can facilitate access to knowledge for students. So that students can learn independently while enhancing learning materials whenever and wherever they choose. This media creation can be an alternative to technology-based learning media and a self-development portfolio for teachers.

## BIBLIOGRAPHIC REFERENCES

1. Gunawan MH, Hanifa ESD, Gunawan AP, Suherdi D. The Use of Google Sites in Extensive Listening Classroom: Students' Voices. English Review: Journal of English Education. 2023 Jun 30; 11(2):365–78. Available in: https://doi.org/10.25134/erjee.v11i2.8225

2. Abdjul T. Effectiveness of Google Sites-Assisted Learning Media on Vibration, Waves, and Sound Materials. Jurnal Penelitian Pendidikan IPA. 2023 Aug 25; 9(8):5859–63. Available in: https://doi.org/10.29303/jppipa.v9i8.3879

3. Kim S, Raza M, Seidman E. Improving 21st-Century Teaching Skills: The Key to Effective 21st-Century Learners. Res Comp Int Educ. 2019; 14(1):99–117. Available in: https://doi.org/10.1177/1745499919829214

4. Fletcher EC, Tan TX. Examining the 21st-Century Skillset Perceptions of Academy and Comprehensive School Students [Internet]. Vol. 40, Thinking Skills and Creativity. Elsevier BV. 2021. p. 100817. Available in: http://dx.doi.org/10.1016/j.tsc.2021.100817

5. Belchior-Rocha H, Mauritti R, Monteiro JP, Carneiro L. 21st Century Skills and Digital Skills, are One and The Same Thing? [Internet]. Edulearn Proceedings. IATED; 2020. Available in: http://dx.doi.org/10.21125/edulearn.2020.0831

6. Fitria D, Lufri L, Elizar E, Amran A. 21st Century Skill-Based Learning (Teacher Problems in Applying 21st Century Skills) [Internet]. Vol. 2, International Journal of Humanities Education and Social Sciences (IJHESS). CV. Afdifal Maju Berkah; 2023. Available in: http://dx.doi.org/10.55227/ijhess.v2i4.409

7. Osamu U. Building Next-generation Schools with 21st Century Skills(learning) and ESD (Reconstructing Japanese Teacher Education System) [Internet]. Vol. 1, Journal of Sustainable Development Education and Research. Universitas Pendidikan Indonesia (UPI); 2017. p. 11. Available in: http://dx.doi.org/10.17509/jsder.v1i1.6239

8. Karatepe R, Karakuş İ. An Investigation on the Relationship Between Learner's Skills and Perceptions to Use Information and Communication Technologies (ICT) and 21st Century Skills (C21 Skills) in Education [Internet]. Vol. 17, International Journal of Progressive Education. Pen Academic Publishing; 2021. p. 259–69. Available in: http://dx.doi.org/10.29329/ijpe.2021.382.18

9. Wheeler L. TVET and the UNESCO Global Network of Learning Cities: relevance for countries in the Middle East. International Journal of Training Research. 2017; 15(3).

10. Pryima S, Yuan D, Anishenko O, Petrushenko Y. The Unesco Global Network Of Learning Cities: Tools For The Progress Monitoring. Sci Educ (Dordr) [Internet]. 2017 Apr; 30(4):74–81. Available in: http://scienceandeducation.pdpu.edu.ua/en/articles/2017-4-doc/2017-4-st13-en

11. OECD. The Future of Education and Skills: Education 2030. OECD Education Working Papers. 2018.

12. Nando D. The Future of Education and Skills. Education Journal of Learning. 2023; 4(1).

13. PISA 2012 Data [Internet]. PISA 2012 Results: Students and Money (Volume VI). OECD; 2014. p. 147–94. Available in: http://dx.doi.org/10.1787/9789264208094-11-en

14. Wardono MS, Mariani S. The Realistic Learning Model with Character Education and PISA Assessment to Improve Mathematics Literacy [Internet]. International Journal of Education. 2014. Available in: https://www.ijern.com/journal/July-2014/30.pdf

15. Demir SB. The Effect of Teaching quality and teaching practices on PISA 2012 Mathematics Achievement of Turkish Students [Internet]. Vol. 5, International Journal of Assessment Tools in Education. International Journal of Assessment Tools in Education; 2018. p. 645–58. Available in: http://dx.doi.org/10.21449/ijate.463409

16. Chamdani M, Salimi M, Fajari LEW. Perceptions of First-Year Students in Online Lectures in the Covid-19 Pandemic Era Viewed from Learning Motivation. Pegem Egitim ve Ogretim Dergisi. 2022; 12(2). Available in: http://dx.doi.org/10.1177/1745499919829214

17. Astuti IAD, Dasmo D, Nurullaeli N, Rangka IB. The impact of pocket mobile learning to improve critical thinking skills in physics learning. In: Journal of Physics: Conference Series. 2018; 1114(1): 012030. Available in: http://dx.doi.org/10.1088/1742-6596/1114/1/012030

18. Parmar P, Patond S, Rathod G, Ninave S. Google site as a tool for teaching undergraduate students in forensic medicine. Indian Journal of Forensic Medicine and Toxicology. 2020; 14(4):427-431. Available in: https://pdfs.semanticscholar.org/c507/d2e6d9b659ec12de5286aba115ef2397b4c7.pdf

19. Muyaroah S. Efektifitas Mobile Learning Sebagai Alternatif Model Pembelajaran. Lembaran Ilmu Kependidikan. 2017; 46(1):23-27. Available in: https://doi.org/10.15294/lik.v46i1.10183

20. Usman, Jumiati, Julianti F. Efektivitas Penggunaan Mobile Learning Terhadap Hasil Belajar Bahasa Indonesia Siswa. Jurnal Prakarsa Paedagogia. 2021; 3(2):190-197. Available in: https://doi.org/10.24176/jpp.v3i2.5859

21. Setuju, Triyono B, Muhtadi A, Widowati A. Mobile Application Smartphone: Does It Improve the 21st Century's Competence of Vocational School Students? International Journal of Information and Education Technology. 2022 Dec 1; 12(12):1286–1290. Available in: https://www.ijiet.org/vol12/1752-IJIET-5423.pdf

22. Nurmalisa Y, Sunyono S, Yulianti D, Sinaga RM. An Integrative Review: Application of Digital Learning Media to Developing Learning Styles Preference. International Journal of Information and Education Technology. 2023 Jan 1; 13(1):187–94. Available in: http://repository.lppm.unila.ac.id/47632/1/IJIET-5128_Yunisca%26Sunyono_2023.pdf

23. Susiani TS, Salimi M, Hidayah R, Fauziah M, Astuti D. Utilization of Free Platforms in Online Learning. In: Proceedings of the 5th International Conference on Learning Innovation and Quality Education [Internet]. New York, NY, USA: Association for Computing Machinery; 2022. (ICLIQE '21). Available in: https://doi.org/10.1145/3516875.3516997

24. Sudiana N. Mengoptimalkan Pemanfaatan Google Sites dalam Pembelajaran Jarak Jauh. Webinar dan Workshop Economic Teacher Exploration Skill. 2020. Available in: https://bpmplampung.kemdikbud.go.id/detailpost/mengoptimalkan-pemanfaatan-google-sites-dalam-pembelajaran-jarak-jauh

25. Harris RS, Hodges CB. Using Google Tools for Online Coursework: Student Perceptions. IEEE Trans Emerg Top Comput. 2016; 4(3):385-391. Available in: https://doi.org/10.1109/TETC.2015.2493340

26. Adzkiya DS, Suryaman M. Penggunaan Media Pembelajaran Google Site dalam Pembelajaran Bahasa Inggris Kelas V SD. Educate Jurnal Teknologi Pendidikan. 2021; 6(2):20-31. Available in: https://doi.org/10.32832/educate.v6i2.4891

27. Tzavara A, Lavidas K, Komis V, Misirli A, Karalis T, Papadakis S. Using Personal Learning Environments before, during and after the Pandemic: The Case of "e-Me." Educ Sci (Basel). 2023; 13(1):87. Available in: https://doi.org/10.3390/educsci13010087

28. Peceño-Capilla B, Lluch-Molins L, Bonilla-Pérez E, Bakit J, Cortés-Pizarro N. Students' Perception of Digital Tools Used with Online Teaching Methodologies in a Pandemic Context: A Case Study in Northern Chile. J Technol Sci Educ. 2022; 12(3): 596-610. Available in: http://dx.doi.org/10.3926/jotse.1692

29. Prahani BK, Rizki IA, Nisa K, Citra NF, Alhusni HZ, Wibowo FC. Implementation Of Online Problem-Based Learning Assisted by Digital Book With 3D Animations to Improve Student's Physics Problem-Solving Skills in Magnetic Field Subject. J Technol Sci Educ. 2022; 12(2):379-396. Available in: https://dialnet.unirioja.es/servlet/articulo?codigo=8554782

30. Ijirana, Aminah S, Supriadi, Magfirah. Critical Thinking Skills of Chemistry Education Students In Team Project-Based STEM-Metacognitive Skills Learning During The Covid-19 Pandemic. J Technol Sci Educ. 2022; 12(2):397-409. Available in: https://dialnet.unirioja.es/servlet/articulo?codigo=8554783

31. Sugiyono. Metode Penelitian Pendidikan Pendekatan Kuantitatif Kualitatif dan R&D. Alfabeta. 2015. Available in: https://digilib.unigres.ac.id/index.php?p=show_detail&id=43

32. Gall MD, Gall JP, Borg WR. Educational Research: An Introduction, 8th Edition. Educational An Introduction. 2006. Available in: https://books.google.co.id/books/about/Educational_Research.html?id=l9JfQgAACAAJ&redir_esc=y

33. Jamshed S. Qualitative Research Method-Interviewing and Observation. J Basic Clin Pharm. 2014; 5(4):64–77. Available in: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4194943/

34. Miles MB, Huberman AM. Qualitative Data Analysis. In: SAGE Publications. California: SAGE Publications; 2014. p. 1–338.

35. Creswell JW. Research design: Qualitative, quantitative, and mixed methods. In: Approaches: Fourth edition. Thousand Oaks, CA: Sage Publication; 2014.

36. Kabilan SJ. Effective Creation and Usage of Simplified Virtual Curation Lab Using Google Sites: Implementation For Principles of Biochemistry Laboratory Course. Journal of Educators Online [Internet]. 2020; 3(3):1–7. Available in: https://pages.uoregon.edu/tgreenbo/pHbuffer20.html

37. Aisyah St, Syarifuddin S, Triana Y. Development of Learning Media Using Google Sites to Improve Students' Abilities. Jurnal Socius. 2023 Apr 15; 12(1):431–49. Available in: http://dx.doi.org/10.20527/js.v12i1.16115

38. Saifulloh F, Sudiyanto, Muchtatom M. Innovation of E-Learning Based Google Site on Islamic Lesson for High School Students an Effort to Facilitate Self-Control. Edukasi Islami: Jurnal Pendidikan Islam. 2023; 12(4):3029–42. Available in: https://doi.org/10.30868/ei.v12i04.5265

39. Yusuf DSA, Rahman MH, Saprudin, Hamid F. Development of Teaching Materials related Magnetic Field Based on the Google Sites Assisted Learning Cycle Model. Islamic Journal of Integrated Science Education (IJISE). 2023 Jul 30; 2(2):111–23. Available in: https://doi.org/10.30762/ijise.v2i2.1525

40. Hasna AF, Sabar N, Allesius M. The Development of Interactive Learning Media on Android Platform Assisted by Google Sites. Journal of Science Education Research Journal [Internet]. 2021; 5(2):10–6. Available in: www.journal.uny.ac.id/jser

41. Putra TM, Kusumaningrum SR, Sukma R, Dewi I. Use of Google Sites Fractional Materials to Improve Learning Effectiveness of Elementary School Students. SENTRI: Jurnal Riset Ilmiah. 2022; 1(4):1049–55. Available in: https://doi.org/10.55681/sentri.v1i4.321

42. West J, Malatji MJ. Technology Integration in Higher Education: The use of Website Design Pedagogy to Promote Quality Teaching and Learning. The Electronic Journal of e-Learning [Internet]. 2021; 19(6):629–41. Available in: www.ejel.org

43. Ramasundrum S. Effect of Google Sites on Science Achievement Among Year Five Students. Malaysian Online Journal of Educational Sciences [Internet]. 2022; 10(2):24–34. Available in: http://mojes.um.edu.my/ EISSN:2289-3024

44. Susiani TS, Salimi M, Ngatman, Hidayah R, Suhartono. STEAM in Art Education Course: Students Perception. In: Proceedings of the 4th International Conference on Learning Innovation and Quality Education [Internet]. New York, NY, USA: Association for Computing Machinery; 2021. (ICLIQE 2020). Available in: https://doi.org/10.1145/3452144.3452266

45. Puspitasari EDT, Surjono HD, Minghat AD. Utilizing Web-Based Learning as 21st Century Learning Media for Vocational Education. International Journal of Engineering and Technology (UAE). 2018; 7(4):157–60. Available in: https://www.academia.edu/download/75926617/11771.pdf

46. Morrison R. 'Google Speak'': The discursive practices of search in home-education.' Dialogic Pedagogy. 2022; 10(4):82–106. Available in: https://doi.org/10.5195/dpj.2022.387

47. Fadhilahn Hasna A, Nurohman S, Maryanto A. The Development of Interactive Learning Media on Android Platform Assisted by Google Sites. Journal of Science Education Research Journal homepage [Internet]. 2021(2):10. Available in: www.journal.uny.ac.id/jser

48. Thomas O, Simpun, Yulinda. The Effect of Using Google Sites as Learning Sources on Learning Outcomes of Students at SMK Negeri 4 Palangka Raya Academic Year 2021/2022. Budapest International Research and Critics in Linguistics and Education [Internet]. 2022; 5(1):91–102. Available from: https://doi.org/10.33258/birle.v5i1.4231

49. Oktalia D, Drajati NA. English Teachers' Perceptions of Text to Speech Software and Google Site in an EFL Classroom: What English Teachers Really Think and Know. International Journal of Education and Development using Information and Communication Technology (IJEDICT). 2018; 14(5):183–92. Available in: https://www.learntechlib.org/p/188288/

50. Duisenbayeva S, Urazgaliyeva S, Kassymova GK, Duisenbayeva SS, Adilbayeva UB, Bekalaeva A, et al. Cognitive Pedagogy and Teaching Approaches Via e-Learning System. Linguistica Antverpiensia [Internet]. 2021; 12(1):1609–24. Available in: https://www.researchgate.net/publication/351576227

51. Nasution A, Siddik Mohd, Manurung N. Efektivitas Mobile Learning Dalam Pembelajaran Bahasa Inggris Pada Sekolah Menengah Kejuruan. Journal of Science and Social Research. 2021; 4(1):1-5. Available in: https://doi.org/10.54314/jssr.v4i1.470

52. Nainggolan DY. Penerapan Model Problem Based Learning (Pbl) Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Berbantuan Aplikasi Math Mobile Learning. Cartesius: Jurnal Pendidikan Matematika. 2020; 3(1):87. Available in: https://core.ac.uk/download/pdf/327176712.pdf

## FINANCING

This study was not supported by any sponsor or funder.

## CONFLICT OF INTEREST

All authors declare that they have no conflicts of interest.

## AUTHORSHIP CONTRIBUTION

*Conceptualization:* A. G. Tamrin.
*Data curation:* A. G. Tamrin.
*Formal analysis:* Cucuk Wawan Budiyanto.
*Acquisition of funds:* A. G. Tamrin, Cucuk Wawan Budiyanto, Ahya' Alimuddin.
*Research:* A. G. Tamrin.
*Methodology:* Cucuk Wawan Budiyanto.
*Project management:* A. G. Tamrin.
*Resources:* Ahya' Alimuddin.
*Software:* Cucuk Wawan Budiyanto.
*Supervision:* Asnul Dahar Minghat.
*Validation:* Ahya' Alimuddin.
*Display:* Ahya' Alimuddin.
*Drafting - original draft:* A. G. Tamrin.
*Writing - proofreading and editing:* A. G. Tamrin.

https://doi.org/10.56294/dm2024.398