Implementing Digital-Based Differentiated Learning to Improve Digital Literacy and Learning Motivation in Informatics: A Classroom Action Research Study

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ARTICLE INFO	ABSTRACT
	Background/Context: The integration of digital learning in secondary education requires instructional models that accommodate students' diverse learning needs while enhancing essential competencies such as digital literacy and learning motivation. In Informatics subjects, conventional teaching approaches often limit students' active engagement and effective use of digital resources. **Objective/Purpose:** This study aims to examine the implementation of a digital-based differentiated learning model and to analyze its effectiveness in improving digital literacy and learning motivation among Grade X TJKT students in Informatics at SMKN 3 Enrekang. **Method:** The study employed Classroom Action Research conducted in two cycles, each consisting of planning, action, observation, and reflection stages. The research subjects were Grade X TJKT students at SMKN 3 Enrekang. Data were collected through observations, questionnaires, tests, and documentation.
	Results: The findings indicate that the implementation of the digital-based differentiated learning model improved across cycles. Although several limitations were identified in Cycle I, targeted improvements in Cycle II resulted in optimal learning implementation. Students' digital literacy and learning motivation showed significant improvement from the first to the second cycle, progressing from the adequate category to the excellent category. In addition, students' learning outcomes demonstrated an increase in classical completeness from Cycle I to Cycle II. **Conclusion:** The study concludes that the digital-based differentiated learning model is effective in improving digital literacy, learning motivation, and learning outcomes of Grade X TJKT students in Informatics. This model contributes to more inclusive and engaging digital learning practices in vocational secondary education.

INTRODUCTION

Education is the most important thing that cannot be separated from a person's life, whether in the context of family, community, or nation (Aprima & Sari, 2022). To achieve success in education, efforts are needed to improve the quality of education consistently and continuously. The Indonesian government has made various efforts to improve the quality of education, including developing a more flexible and creative curriculum, namely the independent curriculum (Khoirurrijal & others, 2022).

The independent curriculum is a curriculum that implements a new paradigm, namely independent learning, which gives teachers the freedom to choose and adapt learning tools according to the needs of educational institutions and students (Elviya, 2023). As is well known, students in schools or classrooms have different characteristics, including learning readiness, learning motivation,

interests, talents, and learning styles (Wahyuningsari et al., 2022). Therefore, students need different teaching services so that they can understand the competencies and learning materials based on their respective characteristics and uniqueness.

The differentiated learning model is one of the efforts designed by the National Education System to develop the concept of independent learning. Differentiated learning is a form of effort in a series of learning activities that pays attention to the specific needs of students in terms of their readiness to learn, learning profiles, interests, and talents. In differentiated learning, educators seek to understand their students and respond to their learning based on the differences that exist among them (Ju & Joe, 2021).

Teachers must be able to deal with the diversity among students and create various learning innovations based on student diversity, such as the use of various media as learning resources. The use of digital technology in line with current developments is one effective strategy for implementing differentiated learning models in the classroom. Through the use of digital technology, teachers can provide learning materials tailored to the needs of each student. The collaboration between education and technology not only benefits teachers, but also helps students develop 21st-century skills, such as digital literacy.

Digital literacy is a person's ability to use digital media and communication to find, understand, select, use, and create works based on the information obtained (Masropah et al., 2022). Students' digital literacy skills need to be improved as part of efforts to provide education related to the use of technology. Therefore, technology-based differentiated learning is one solution that educators can apply to improve students' digital literacy.

Student motivation is also a crucial factor in achieving educational success (Rahman, 2021). Motivation is a driving force that comes from within or outside a person, which encourages them to engage in learning activities and fosters enthusiasm for learning (Andriani & Rasto, 2019). One of the most important things a teacher can do to achieve learning objectives and success is to increase student motivation. However, teachers often face challenges in increasing student motivation to learn, especially in heterogeneous school environments. Students have different characteristics, so they require different learning strategies in order to motivate them to learn (Mubarok, 2023).

A digital-based differentiated approach is considered a learning model that can provide solutions to the challenges of increasing student motivation (Hanah et al., 2023; Wulandari, 2022). The application of digital-based differentiated learning allows teachers to tailor learning materials, teaching methods, and assessments based on the individual learning needs and interests of students. By using digital technology, teachers can present information in a more interesting and interactive way, creating a learning experience that is relevant to students' daily lives.

Based on observations and discussions conducted with an information technology teacher, initials K, and students in class X TJKT at SMKN 3 Enrekang, it was found that SMKN 3 Enrekang students have different characteristics. Each student has different interests, talents, and abilities. Teachers still use conventional teaching methods and do not make full use of technology, while students are not familiar with various digital tools and platforms, resulting in low digital literacy skills among students. Most students are not yet able to understand and manage the information they obtain, including the ability to sort valid sources of information and the ability to use technological tools in learning, and they do not yet understand the importance of digital literacy in today's information age.

The motivation of students at SMKN 3 Enrekang to learn is still low. Based on interviews conducted with computer science teachers, most students do not respond well to the lessons because they are busy with other activities such as talking to their friends and not doing their assignments. Through interviews conducted with students in class X TJKT, it was found that the learning process in class was not very interesting for students, there was a lack of interaction between teachers and students, the learning media used was not very interesting, and the teaching style was not very interactive, so students were not motivated to learn.

Low learning motivation among students results in poor learning outcomes (Moslem et al., 2019). Based on data obtained during observation, it was found that of the 27 students in class X TJKT SMKN 3 Enrekang in the 2023/2024 academic year, based on the results of the final semester I test in informatics, using the Minimum Passing Criteria (KKM) of 75 as the standard for assessment, 14 students (51.85%) passed and 13 students (48.14%) failed. Therefore, teachers need to find solutions to overcome this problem by implementing more interesting learning models and learning media in accordance with the applicable curriculum, one of which is by using a digital-based differentiated learning model.

The digital-based differentiated learning model is a learning model that utilizes digital technology to provide learning experiences based on the diversity of student characteristics. Teachers can use various digital tools, platforms, and online resources to provide diverse learning materials, allowing students to learn according to their learning styles. The use of a digital-based differentiated learning model will increase student motivation and familiarize them with the use of technology in learning, which will improve their digital literacy.

METHOD

This study is a Classroom Action Research (CAR). It was conducted at SMKN 3 Enrekang, located at Jl. Dr. Ratulangi No. 7 Maroangin, Bangkala Village, Maiwa District, Enrekang Regency, South Sulawesi. The subjects in this study were 27 students in class X TJKT SMKN 3 Enrekang, consisting of 11 boys and 16 girls in the 2023/2024 academic year. The implementation of CAR in this study used the Kemmis & Mc. Taggart model design, which consisted of two cycles. Each cycle consisted of the planning, action, observation, and reflection stages. The data collection techniques used were observation, interviews, tests, and documentation (Palinkas et al., 2015). The research instruments used were observation sheets, questionnaires, and test questions (Syifa et al., 2024). Observation sheets were used to observe and record everything that happened during the learning process. Questionnaires were used to determine the improvement in students' digital literacy skills and learning motivation. Test questions were used to determine students' understanding before and after the implementation of the digital-based differentiated learning model.

The data analysis techniques used in this study were descriptive statistical analysis and qualitative analysis (Sugiyono, 2017). Descriptive statistical analysis was used to analyze the results of student questionnaires and learning outcomes (pre-test and post-test). Qualitative analysis was used to draw conclusions from the observations recorded in the observation sheets and field notes. The collected data was then analyzed qualitatively using an inductive approach . The results of this analysis are presented in the form of a description of the research findings.

RESULTS AND DISCUSSION

Result

This study used classroom action research (CAR) aimed at improving the digital literacy skills and learning motivation of 10th grade students majoring in Computer Network and Telecommunications Engineering (TJKT) at SMKN 3 Enrekang in the subject of informatics. This research was conducted over two cycles, with each cycle consisting of two meetings. Thus, a total of four meetings were held in this classroom action research.

A. Initial Activities (Pre-Cycle)

On Monday, April 29, 2024, researchers visited SMKN 3 Enrekang to request research permission and meet with the principal. After obtaining permission, the researchers coordinated with the 10th grade TJKT computer science teacher and agreed to conduct the research every Monday and Wednesday. The researchers also explained the stages of digital differentiation-based learning to the teachers to ensure a common understanding. In the pre-cycle stage, the researchers and computer science teachers conducted a non-cognitive diagnostic assessment of the 10th grade TJKT students at SMKN 3 Enrekang to obtain information about the students' learning styles. This assessment was

conducted using the akupintar website. The results of the assessment were used as a benchmark in the formation of study groups.

A. Cycle 1

Planning Stage

The implementation of Cycle I in this study began with the planning stage, in which researchers and teachers collaborated to develop teaching materials in accordance with learning objectives. In addition, they created learning scenarios, mapped students' learning styles, and developed pretest and posttest questions, digital literacy questionnaires, and learning motivation questionnaires. Supporting facilities and resources were also prepared.

Action Phase

The implementation of Cycle I consisted of two meetings. The first meeting took place on May 6, 2024, with the topic of Computer Networks. The lesson began with introductory activities, where the teacher greeted the students, motivated them to learn, and administered a pretest. The main activity began with the screening of an educational video and the grouping of students based on their learning styles: visual, auditory, and kinesthetic. Each group received materials tailored to their learning style and held group discussions to produce presentations. The visual group created a PPT, the auditory group created posters, and the kinesthetic group created mind maps. The meeting ended with a reflection and briefing for the next meeting. The second meeting on May 8, 2024, discussed Internet Connectivity with a format similar to the first meeting. After watching a video and regrouping students, they were again given materials according to their learning styles and conducted discussions and presentations. At the end of the meeting, students were given a post-test to measure their understanding, followed by reflection and reinforcement of the material by the teacher.

Observation

Observations were conducted during the implementation of digital-based differentiated learning, with the researcher acting as an observer and the computer science teacher acting as the instructor. The observations showed that the learning process proceeded according to the planned scenario. The teacher divided the students based on their learning styles, and most students were seen actively discussing and completing group assignments. However, some students still lacked focus, seemed to have difficulty completing assignments, and lacked confidence in presenting the results of their discussions and summarizing their learning in front of the class.

Reflection

Reflection was conducted to analyze the learning that had taken place and plan improvements for the next cycle. Based on data analysis, the results of the digital literacy skills questionnaire, learning motivation, and student learning outcomes, cycle I did not achieve the expected success indicators. Learning went well, but not optimally, with the main obstacles being a lack of focus and active questioning on the part of students. For the next cycle, improvements are planned by increasing focus and supervision, providing intensive guidance, regrouping students, and giving rewards to encourage active participation.

Results of Cycle I Data Analysis

a. Cycle Questionnaire Results Data I

Data on students' digital literacy skills and learning motivation after the implementation of the digital-based differentiated learning model was obtained through a questionnaire given to students at the end of cycle I. The results of the analysis of the questionnaire data on students' digital literacy skills in cycle I can be seen in Table 1 below:

Table 1 Categories of Student Digital Literacy Skills Cycle I

No	Kategori	Skala (%)	Frekuensi	Presentase (%)
1	Sangat Baik	86-100	0	0
2	Baik	76-86	12	45
3	Cukup	60-75	9	33
4	Kurang	55-59	6	22
5	Sangat Kurang	<54	0	0
	Jumlah		27	100

Sumber: Hasil Olah Data, 2024 12 or 45% of students have good digital literacy skills, 9 or 33% of students have adequate digital literacy skills, and 6 or 22% of students still have poor digital literacy skills. The results of the student questionnaire in Cycle I did not meet the predetermined success indicator, which was an average student score in the good category.

The data on student learning motivation in Cycle I was obtained from a learning motivation questionnaire filled out by students at the end of Cycle I after the implementation of the digital-based differentiated learning model. The results of the analysis of the student learning motivation questionnaire data in Cycle I can be seen in Table 2 below:

Tabel 2 Student Learning Motivation Categories Cycle I

No	Kategori	Skala (%)	Frekuensi	Presentase (%)
1	Sangat Baik	86-100	4	15
2	Baik	76-86	11	41
3	Cukup	60-75	12	44
4	Kurang	55-59	0	0
5	Sangat Kurang	<54	0	0
	Jumlah		27	100

Based on Table 2, it can be seen that 4 or 15% of students have very good learning motivation, 11 or 41% of students have good learning motivation, and 12 or 44% of students have sufficient learning motivation. The results of the student questionnaire in cycle I did not meet the predetermined success indicators, namely that the average student score was in the good category.

b. Student Test Results Data

The pretest results for cycle I were obtained from tests given to students before implementing the digital-based differentiated learning model. The results of the pretest data analysis for cycle I, descriptive statistics obtained are as shown in Table 3 below:

Tabel 3 Descriptive Statistics of Student Pretests in the Cycle I

No	Statistik	Nilai Statistik
1	Skor Tertinggi	80
2	Skor Terendah	20
3	Rata-rata	49

Table 3 shows that the scores obtained by students varied, with the highest score being 80, the lowest score being 20, and the average score being 49. Based on this data, students were grouped into categories of passing and failing, as shown in Table 3 below.:

Tabel 4 Completion of Student Learning Outcomes Pre-test Cycle I

Nilai	Frekuensi	Persentase (%)	Keterangan
75 – 100	6	22	Tuntas
<75	21	78	Tidak Tuntas

Based on the table, it can be seen that in the implementation of the Cycle I pretest of 27 students in class X TJKT SMKN 3 Enrekang, 6 students passed with a percentage of 22% and 21 students failed with a percentage of 78%. The Cycle I posttest learning outcomes were obtained from the test results given to students after implementing the digital-based differentiated learning model. The results of the Cycle I posttest data analysis and descriptive statistics are shown in Table 5 below:

Tabel 5 Descriptive Statistics of Posttest Learning Outcomes Cycle I

Statistik	Nilai
Nilai Tertinggi	93
Nilai Terendah	47
Rata-rata	71

Table 5 shows that the scores obtained by students varied, with the highest score being 93, the lowest score being 47, and the average score being 71. Based on this data, students were grouped into categories of passing and failing, as shown in Table 6 below:

Tabel 6 Completion of Student Learning Outcomes Post-test Cycle I

Nilai	Frekuensi	Persentase (%)	Keterangan

75 – 100	15	56	Tuntas
<75	12	44	Tidak Tuntas

Based on Table 4.8, it can be seen that in the implementation of the Cycle I posttest of 27 students in class X TJKT SMKN 3 Enrekang, 15 students passed with a percentage of 56% and 12 students failed with a percentage of 44%. Therefore, it can be concluded that the mastery of student learning outcomes in Cycle I has not yet reached the success indicator, which is 85% of students achieving the minimum competency standard (KKM).

B. Cycle II
Planning Stage

In Cycle II, action planning is carried out based on the results of reflection from Cycle I. Planning in Cycle II is carried out with improvements in the learning process that refer to the results of reflection from the previous cycle.

Action Phase

In Cycle II, learning was conducted in two sessions. The first session, on May 13, 2024, focused on Data Communication. Learning began with introductory activities, in which the teacher greeted the students, motivated them to learn, and administered a pretest. The main activity began with the screening of an instructional video and the grouping of students based on their comprehension abilities as determined by the Cycle I post-test. Each group received materials tailored to their comprehension abilities and held group discussions to produce presentations. Group 1 (high ability) created a PPT, group 2 (medium ability) created a poster, and group 3 (low ability) created a diagram. Next, each group presented their work in front of the class. The meeting ended with a reflection and briefing for the next meeting. The second meeting, held on May 15, 2024, discussed personal data protection in a format similar to the first meeting. After watching a video and regrouping the students, they were again given materials according to their comprehension abilities and conducted discussions and presentations. At the end of the meeting, students were given a post-test to measure their comprehension, followed by reflection and reinforcement of the material by the teacher.

Observation Stage

The observer noted several findings from observing the implementation of digital-based differentiated learning in computer science in cycle II, namely that the learning activities were in accordance with the teaching module plan, almost all students were active in learning, asking questions and participating in discussions, students showed greater enthusiasm and confidence in completing group assignments and presentations, and teachers provided more intensive guidance and feedback, circulating to monitor and assist students according to the difficulties they faced.

Reflection Stage

Based on the observations made, the learning process has been running optimally. This is because, in implementing the learning process, teachers have applied the planned improvements based on the reflections from cycle I to the fullest extent. Based on the analysis of the results of the questionnaire on students' digital literacy skills and learning motivation, as well as their learning outcomes, there has been an improvement and the predetermined success indicators have been achieved.

Hasis Analisis Data Siklus II
a. Data Hasil Angket Siklus II

The results of the analysis of student digital literacy questionnaire data in cycle II can be seen in Table 7 below:

Tabel 7. Student Digital Literacy Ability Categories Cycle II

No	Kategori	Skala (%)	Frekuensi	Presentase (%)
1	Sangat Baik	86-100	18	67
2	Baik	76-86	9	33
3	Cukup	60-75	0	0
4	Kurang	55-59	0	0
5	Sangat Kurang	<54	0	0
	Jumlah		27	100

Based on Table 7, it can be seen that the level of students' digital literacy in Cycle II has increased compared to Cycle I. In Cycle II, 18 students or 67% were in the very good category, while 9 students or 33% were in the good category. There were no students in the poor category.

Student learning motivation data in Cycle II was obtained from a learning motivation questionnaire completed by students at the end of Cycle II. The results of the analysis of student learning motivation questionnaire data in Cycle II can be seen in Table 8 below:

Tabel 8 Student Learning Motivation Categories Cycle I

No	Kategori	Skala (%)	Frekuensi	Presentase (%)
1	Sangat Baik	86-100	14	52
2	Baik	76-86	13	48
3	Cukup	60-75	0	0
4	Kurang	55-59	0	0
5	Sangat Kurang	<54	0	0
	Jumlah		27	100

Based on Table 8, there was a significant increase in student learning motivation in Cycle II. A total of 14 or 52% of students had very good learning motivation, and 13 or 48% of students had good learning motivation.

b. Cycle Test Results Data II

The pretest results for cycle II were obtained from tests given to students before implementing the digital-based differentiated learning model. The results of the pretest data analysis for cycle II and the descriptive statistics obtained are shown in Table 9 below:

Tabel 9 Descriptive Statistics of Student Pretests in the Cycle II

No	Statistik	Nilai Statistik
1	Skor Tertinggi	87
2	Skor Terendah	43
3	Rata-rata	67

Table 9 shows that the scores obtained by students varied, with the highest score being 87, the lowest score being 43, and the average score being 67. Based on this data, students were grouped into categories of passing and failing, as shown in Table 10 below:

Tabel 10 Completion of Student Learning Outcomes Pre-test Cycle II

Nilai	Frekuensi	Persentase (%)	Keterangan
75 – 100	12	44	Tuntas
<75	15	56	Tidak Tuntas

The posttest results for cycle I were obtained from tests given to students after implementing the digital-based differentiated learning model. The results of the posttest data analysis for cycle II, the descriptive statistical values obtained are as shown in Table 11 below:

Tabel 11. Descriptive Statistics of Posttest Learning Outcomes Cycle I

Statistik	Nilai
Nilai Tertinggi	100
Nilai Terendah	73
Rata-rata	85

Table 11 shows that the scores obtained by students varied, with the highest score being 100, the lowest score being 73, and the average score being 85. Based on this data, students were grouped into categories of passing and failing, as shown in Table 12 below:

Tabel 12. Completion of Student Learning Outcomes Posttest Cycle I

Nilai	Frekuensi	Persentase (%)	Keterangan
75 – 100	23	85	Tuntas
<75	4	15	Tidak Tuntas

Based on Table 12, it can be seen that in the implementation of the Cycle II posttest of 27 students in class X TJKT SMKN 3 Enrekang, 23 students passed with a percentage of 85% and 4 students failed with a percentage of 15%. Therefore, it can be concluded that the mastery of student learning outcomes in Cycle II has achieved the success indicator, namely 85% of students achieving the minimum competency standard (KKM).

C. **Application of Digital-Based Differentiated Learning Models in Informatics Subjects**

The implementation of a digital-based differentiated learning model in class X TJKT SMKN 3 Enrekang was carried out in two cycles, each with two meetings. Each cycle included planning, action, observation, and reflection. In cycle I, there were obstacles such as students who were not yet accustomed to the new learning model, lack of focus, and lack of mastery of technology, which caused many students to not achieve the minimum competency standard. However, in cycle II, after improvements were made based on reflections from cycle I, learning went better and achieved the success indicators.

The learning activity began with the teacher guiding students towards conducive learning by motivating them to learn and conveying the learning objectives to be achieved and the material to be studied. The core activity began with a short educational video, followed by questions to spark discussion. Students are then divided into heterogeneous groups based on assessment results, and each group is given tasks according to their needs. These tasks involve digital literacy, where students search for information independently and create presentation products. After that, students present the results of their discussions. Teachers provide intensive guidance during the learning process and end the session by reinforcing the material that has been taught.

D. **Improving Digital Literacy and Student Motivation to Learn**

1. **Improving Students' Digital Literacy**

Based on the research results, a comparison of the frequency distribution of the results of the student digital literacy questionnaire in Cycle I and Cycle II can be seen in Table 13 below:

Tabel 13 Comparison of Frequency Distribution of Digital Literacy Ability Questionnaire Results for Students in Cycle I and Cycle II

No	Kategori	Siklus I		Siklus II	
		F	(%)	F	(%)
1	Sangat Baik	0	0	18	67
2	Baik	12	45	9	33
3	Cukup	9	33	0	0
4	Kurang	6	22	0	0
5	Sangat Kurang	0	0	0	0
	Jumlah	27	100	27	100
	Skor Rata-Rata (%)	71,38		88,98	

Based on the data in Table 13, it can be said that there has been an increase in students' digital literacy skills. In Cycle I, no students achieved the excellent category, but in Cycle II, 67% of students achieved this category. The number of students in the good category decreased from 45% in Cycle I to 33% in Cycle II, indicating that many students improved to the excellent category. In addition, in the fair and poor categories, there were 33% and 22% of students in Cycle I, respectively, but in Cycle II, there were no students in those categories. A comparison of the results of the student digital literacy questionnaire in Cycle I and Cycle II shows that the average score for student digital literacy in Cycle I was 71.38% in the adequate category, while in Cycle II it was 88.98% in the excellent category. Thus, it can be concluded that student digital literacy improved by 17.6% from Cycle I to Cycle II.

2. **Increased Student Motivation to Learn**

Based on the research results, a comparison of the frequency distribution of student learning motivation questionnaire results in Cycle I and Cycle II can be seen in Table 14 below:

Tabel 14 Comparison of Frequency Distribution of Learning Motivation Questionnaire Results for Students in Cycle I and Cycle II

No	Kategori	Siklus I		Siklus II	
		F	(%)	F	(%)
1	Sangat Baik	4	15	14	52
2	Baik	11	41	13	48
3	Cukup	12	44	0	0
4	Kurang	0	0	0	0
5	Sangat Kurang	0	0	0	0
	Jumlah	27	100	27	100
	Skor Rata-Rata (%)	73,70		86,79	

Based on the data in Table 14, it was found that there was an increase in student learning motivation from Cycle I to Cycle II. In Cycle I, only 15% of students were in the excellent category, but in Cycle II this number increased to 52%. In addition, the number of students in the good category also changed from 41% in Cycle I to 48% in Cycle II. There were no students in the fair category in Cycle II, compared to Cycle I where there were 44% of students. A comparison of the results of the student learning motivation questionnaire in Cycle I and Cycle II shows that the average learning motivation score of students in Cycle I was 73.70% in the fair category and in Cycle II it was 86.79% in the very good category. Thus, it can be concluded that student learning motivation from Cycle I to Cycle II increased by 13.09%.

3. Improvement in Student Learning Outcomes

Based on the research results, data was obtained on the learning outcomes of grade X TJKT SMKN 3 Enrekang students using a digital-based differentiated learning model in Cycle I and Cycle II, which can be seen in Table 15 below:

Tabel 15 Comparison of Student Learning Outcomes in Cycle I and Cycle II

No	Komponen	Siklus I		Siklus II	
		Pretest	*Posttest*	*Pretest*	*Posttest*
1.	Siswa Tuntas	6	15	12	23
2.	Siswa Tidak Tuntas	21	12	15	4
3.	Persentase Tuntas (%)	22	56	44	85
4.	Persentase Tidak Tuntas (%)	78	44	56	15

Based on Table 15, student learning outcomes showed a significant increase from Cycle I to Cycle II. In Cycle I, the number of students who passed increased from 6 students in the pretest to 15 students in the posttest, or in other words, the percentage of students who passed increased from 22% in the pretest to 56% in the posttest, representing an increase of 34% from the pretest to the posttest. In Cycle II, there was a further increase with the number of students who passed increasing from 12 students in the pretest to 23 students in the posttest. The percentage of students who completed the test increased from 44% in the pretest to 85% in the posttest, representing an increase of 41% from the pretest to the posttest. Thus, it is known that there was an increase in the classical completeness of the students' posttest results from Cycle I to Cycle II, namely from 56% to 85%. This shows an increase in the classical completeness of student learning outcomes of 29%.

Discussion

Application of Digital-Based Differentiated Learning Models in Informatics Subjects

This study is a Classroom Action Research (CAR) that aims to improve the digital literacy and learning motivation of 10th grade TJKT students at SMKN 3 Enrekang in Informatics through a digital-based differentiated learning model. The research was conducted in two cycles, each cycle consisting of planning, action, observation, and reflection. The CAR design aligns with the reflective and iterative nature of instructional improvement in differentiated classrooms, where continuous adjustment based on learners' responses is essential (Tomlinson, 2017). The instruments used included questionnaires to measure digital literacy and learning motivation, as well as pre-tests and post-tests to measure improvements in student learning outcomes.

In cycle I, the implementation of the model went well, but there were obstacles such as students not yet fully adapting to the learning model, lack of active participation, and some students not yet achieving the minimum passing grade (KKM) and the questionnaires on students' digital literacy and learning motivation abilities were not yet in the good category. This condition is common in the early stages of differentiated learning implementation, as students require time to adjust to autonomous and technology-supported learning environments (Hattie, 2012). The results of cycle I became the basis for improvements in cycle II. Cycle II showed significant improvement, with learning running optimally and achieving the predetermined success indicators.

Differentiated learning is carried out by dividing students into heterogeneous groups based on their needs, providing appropriate digital learning media, and assigning digital literacy activities to complete group tasks. Each group produced a digital-based product aligned with their assignment. Teachers acted as facilitators by guiding students according to their learning difficulties, encouraging

collaboration, and providing opportunities for group presentations and reflection. This approach reflects the principles of digital competence development, which emphasize active participation, collaboration, and meaningful use of digital tools (Redecker, 2017).

Improving Digital Literacy and Learning Motivation among Grade X TJKT Students at SMKN 3 Enrekang

Based on the results of the study, the average score for students' digital literacy skills and learning motivation increased from cycle I to cycle II. The average percentage of students' digital literacy skills in cycle I was 71.38%, and the average percentage in cycle II was 88.98%, with an increase of 17.6%. The average score for students' digital literacy skills in cycle I was in the adequate category, and in cycle II it was in the excellent category. The improvement in students' digital literacy occurred because the application of a digital-based differentiated learning model allowed them to utilize various digital resources, such as online articles, videos, and interactive presentations. These findings are consistent with the digital literacy framework proposed by UNESCO, (2018), which emphasizes information evaluation, digital content creation, and responsible technology use. This study is in line with research conducted by Vinther & Lauridsen, (2020) entitled Improving Digital Literacy in Differentiated Learning Assisted by Quick Response Codes for LHO Text Material for Grade X High School. The results showed that quick response codes were able to improve students' digital literacy skills.

Furthermore, the average percentage of student learning motivation increased from 73.70% in cycle I to 86.79% in cycle II, resulting in a 13.09% improvement. The increase in motivation can be attributed to the flexibility of the differentiated learning model, which allowed students to learn according to their individual needs and preferences while engaging with varied and meaningful digital learning materials. This condition supports Self-Determination Theory, which states that learning motivation increases when students' needs for autonomy, competence, and relatedness are fulfilled (Deci & Ryan, 2000). This study is in line with the research conducted by (Shamdas, 2023), entitled Implementation of Differentiated Learning in Increasing the Learning Motivation of Grade 8 Students at SMP 2 Kalisat. This study shows the impact of implementing differentiated learning in the form of increased student learning motivation.

Based on research results after implementing a digital-based differentiated learning model experienced an increase, student learning outcomes experienced an increase in classical completeness from cycle I to cycle II. The percentage of students who completed cycle I was 56% and cycle II was 85%, an increase of 29%. Thus, it can be concluded that a digital-based differentiated learning model can improve student learning outcomes. Based on the results of the analysis, it can be concluded that the application of a digital-based differentiated learning model can improve the digital literacy and learning motivation of 10th grade students in the TJKT competency at SMKN 3 Enrekang.

CONCLUSIONS

Based on the results of the research that has been conducted, it can be concluded that the application of a digital-based differentiated learning model in computer science lessons is effective in improving digital literacy skills, learning motivation, and learning outcomes of 10th grade TJKT students at SMKN 3 Enrekang. Through the Classroom Action Research conducted, which consisted of two cycles involving the stages of planning, action, observation, and reflection, it was found that students' digital literacy skills increased from the adequate category in Cycle I to very good in Cycle II, with an average score increase of 17.6%. Students' learning motivation also increased from adequate in Cycle I to excellent in Cycle II, with an average score increase of 13.09%. In addition, student learning outcomes showed an increase in classical mastery from 56% in Cycle I to 85% in Cycle II, reflecting an increase of 29%. These results indicate that the digital-based differentiated learning model not only helps improve digital literacy and learning motivation but also has a positive impact on students' overall learning outcomes. Thus, this learning model can be considered an effective and innovative approach to improving the quality of learning in the digital age.

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