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Self-Directed Learning Model: Communication, Collaboration, Critical Thinking, Creativity (4C) Skills for Elementary School Students

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ABSTRACT

The challenges of modern education demand mastery of 21st-century skills (4Cs), but their implementation is often hampered by conventional learning patterns that have not been able to stimulate student independence. This study aims to analyze the application and influence of the Self-Directed Learning (SDL) model on Communication, Collaboration, Critical Thinking, and Creativity (4Cs) skills in fourth-grade students at Elementary School Inpres Paccerakkang, Makassar City. The method used is quantitative with a pre-experimental design, involving a sample of 29 students selected through a saturated sampling technique. The results of the study indicate that the application of the SDL model is effective in creating an active learning atmosphere and increasing student motivation. Furthermore, the hypothesis test shows a significant influence of the SDL model on 4Cs skills with a significance value of $0.00 < 0.05$. This proves that the independent learning approach is empirically able to improve students' integrative abilities. Practically, this research contributes to educators implementing innovative student-centered strategies, as well as being a strategic reference for schools to produce graduates who are adaptive to the demands of the times through developing independent learning from an early age.

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1. INTRODUCTION

Entering the second half of the 21st century, global dynamics demand a fundamental repositioning of the basic education system. The massive flow of digitalization and the uncertainty of the future landscape require students to master not only functional literacy but also higher-level skills (Huang et al., 2025; Lazou & Tsinakos, 2023). At the elementary school level, this foundation is formulated through the competencies of communication, collaboration, critical thinking, and creativity, collectively known as the 4Cs (communication, collaboration, critical thinking, and creativity) (Nurfadila, 2024; Thornhill-Miller et al., 2023). These skills are no longer merely curriculum

supplements but are crucial for enabling the younger generation to adapt, objectively filter information, and solve complex problems like never before (Tohani & Aulia, 2022).

However, the reality on the ground demonstrates a wide gap between curriculum ideals and instructional practices. Learning patterns in elementary schools have historically been dominated by a teacher-centred approach, where students are positioned as passive recipients of information (Rahayani, 2025; Zamjani, 2022). This conventional model tends to reduce the scope for students' emancipatory thinking. As a result, children's ability to articulate ideas (communication) is hampered, group work becomes merely a superficial division of labor (collaboration), analytical skills regarding surrounding phenomena are dulled (critical thinking), and originality in creating solutions is understimulated (creativity).

One of the root causes of this low mastery of the 4C skills is students' weak learning independence from an early age (Weng et al., 2022). Many educators still ignore elementary school children's capacity to direct their own learning, assuming that children at this developmental stage require rigid and constant instruction (Barus, 2024). However, excessive reliance on external direction stifles children's intrinsic motivation and natural curiosity. Without space for decision-making in the learning process, students will struggle to fully explore their cognitive and social potential, leading to stagnation in the development of 21st-century skills.

As a solution to these problems, the Self-Directed Learning (SDL) model offers a relevant new paradigm. SDL positions students as the primary agents in control of their learning process, from identifying learning needs, formulating goals, selecting strategies, and evaluating their own learning outcomes (Ibrahim et al., 2026; Woods & Copur-Gencturk, 2024). Through the implementation of SDL, students are encouraged to gradually let go of their dependence on teacher authority and begin actively constructing their own knowledge (Morris & Rohs, 2023; Voskamp et al., 2022). In the elementary school context, this phase is a valuable opportunity to instil metacognition, where children learn to understand how they learn (Shahmohammadi et al., 2020).

Although the importance of SDL and the 4C skills has been widely discussed separately, their integration within the primary school setting remains a matter of scholarly debate. Much of the literature on self-directed learning has focused on higher education or adult learning (andragogy), as the characteristics of independence are assumed to mature only at that age (Adigun et al., 2025; Curran et al., 2019; Loeng, 2020; Zhoc et al., 2018). Research on SDL at the primary school level remains very limited and is often viewed with scepticism. A research gap exists regarding how adaptive SDL structures and syntax can be applied to children at the concrete operational stage to simultaneously trigger the acceleration of 4C skills.

This is where this research's uniqueness lies. Unlike previous studies that view SDL as an independent concept exclusively for adult learners (Khiat, 2017; Kruszelnicki, 2020), this article reconstructs and deconstructs the self-directed learning model into a child-friendly framework (pedagogical SDL) specifically designed to intervene with 4C skills in primary school students. The novelty of this research lies in its mechanistic

mapping of how elements of independence (such as self-management and self-monitoring) directly intersect with the stimulation of social interaction (communication and collaboration) and in-depth reasoning (critical thinking and creativity) within the elementary school classroom ecosystem.

The importance of researching this topic is also based on the urgent need for practical guidance for elementary school educators. Teachers need a clear methodological bridge to transform their role from mere material deliverers (sages on the stage) to facilitators and dialogue partners (guides on the side) capable of fostering children's independence without losing the direction of the curriculum. By formulating a directed SDL model, this research provides an alternative, concrete, measurable, and applicable instructional model for transforming the classroom atmosphere into a space for experimentation that fosters 21st-century skills from an early age.

Building upon the existential and empirical background mentioned above, this study aims to analyze the application and influence of the Self-Directed Learning (SDL) model on Communication, Collaboration, Critical Thinking, and Creativity (4Cs) skills in fourth-grade students at elementary school. This study aims to analyze the application and influence of the Self-Directed Learning (SDL) model on Communication, Collaboration, Critical Thinking, and Creativity (4Cs) skills in fourth-grade students at elementary school, which is considered crucial. This study is expected to yield a conceptualization and strong empirical evidence regarding the effectiveness of the SDL model in enhancing the potential of elementary school students' 4Cs. The results are projected to significantly contribute to enriching agency-based learning theory and serve as a strategic reference for policymakers and education practitioners in reforming learning practices in elementary schools.

2. METHOD

This study employed a quantitative approach with a quasi-experimental approach. The design employed was a pre-experimental design in the form of a one-group pretest-posttest design. In this design, subjects were given a pretest before treatment, then administered an intervention model, a Self-Directed Learning (SDL), and concluded with a posttest to measure the effectiveness of the treatment on the 4C skills.

The population in this study was all fourth-grade students at the SPF Unit of SD Inpres Paccerakkang, Biringkanaya District, Makassar City. The sampling technique used was saturated sampling, with all 29 students being used as the sample. This selection was based on the limited number of subjects and the need to obtain a comprehensive picture of the class group.

This study systematically examines the effect of implementing the Self-Directed Learning (SDL) model as the independent variable—which emphasizes student independence and autonomy in planning, implementing, and evaluating their learning process—on the development of the 4C skills (Communication, Collaboration, Critical Thinking, and Creativity) as the dependent variable. Through the integration of this student-centered learning strategy, the study aims to analyze the effectiveness of

independent learning in optimizing the essential competencies required in 21st-century education.

Data collection in this study was conducted comprehensively through three main instruments covering aspects of the learning process and outcomes. First, observation sheets were used to monitor the consistency of the Self-Directed Learning (SDL) model implementation by educators and the dynamics of student activity during the learning process. Second, measurement of higher-order cognitive abilities, particularly critical thinking and creativity, was conducted using skills tests in the form of pretests and posttest. Finally, to evaluate students' interpersonal competencies, a systematically designed portfolio or performance assessment rubric was used to measure the effectiveness of communication and collaboration within group work.

This research procedure was systematically implemented through three main stages, starting with the preparation phase, which included the development of a Self-Directed Learning (SDL)-based Lesson Plan (RPP), the preparation of validated 4C skills assessment instruments, and technical coordination with relevant school officials. Next, during the implementation phase, initial data collection was conducted through a pretest, followed by the implementation of the SDL model, which encompasses the cycle of needs diagnosis, goal setting, resource identification, strategy selection, and learning outcome evaluation, concluding with a posttest. This series of activities concluded with a final stage focused on processing and analyzing the collected data to draw comprehensive research conclusions.

The collected data was statistically analyzed using SPSS software through several comprehensive testing stages. Descriptive analysis was conducted to provide an in-depth overview of the average score, maximum, minimum, and standard deviation of students' 4C skills before and after the treatment. Prior to the core testing, prerequisite tests, including normality and homogeneity tests, were conducted to ensure data validity. Furthermore, hypothesis testing was conducted using the Paired Sample T-Test—assuming the data was normally distributed—to evaluate the significance of differences in students' 4C skills between before and after the implementation of the SDL model, where the decision-making criteria were based on a significance value of $p \leq 0.05$.

3. RESULTS AND DISCUSSION

Results

The initial phase of the research focused on administrative preparation and field instruments through technical coordination with the supervising lecturer and school officials to align the action plan with classroom conditions. Researchers systematically developed learning materials based on the Independent Curriculum, including integrated teaching modules for literacy outcomes and the Pancasila Student Profile values (independent and critical thinking). To maintain data validity, various audiovisual learning media were developed along with evaluation and monitoring instruments,

including teacher and student activity observation sheets to objectively record classroom dynamics, as well as pre- and post-test questions.

In the implementation phase, the research focused on digitizing materials tailored to the characteristics of 29 fourth-grade students at Elementary School Inpres Paccerakkang, Makassar City, over six sessions. The intervention began with a pre-test to measure the initial competency base of the 4C skills (Communication, Collaboration, Critical Thinking, and Creativity), followed by exploration of Indonesian language materials using interactive media, folklore infographics, and independent Student Worksheets. The core of this research applies the Self-Directed Learning (SDL) model through four main phases—planning, implementation, monitoring, and self-evaluation—where the dynamics of student participation are closely monitored through structured observations for three days, then concluded with a post-test as a comprehensive evaluation of the model's effectiveness.

Teacher Activity

The evaluation phase was systematically designed to measure the success of the program through analysis of learning outcomes, level of material understanding, and the effectiveness of the SDL model in fostering students' independence and 4C skills. Based on the analysis of teacher activity observations, the implementation of the SDL model was progressing according to the established strategic plan. Teachers successfully performed their role as facilitators, from preparing materials and scheduling activities with students to providing intensive supervision during projects, to facilitating group presentations and formative evaluations. The implementation indicators for teacher activities in implementing the Self-Directed Learning (SDL) model demonstrate excellent consistency across all stages of the study. Following the pretest at the first meeting, the second meeting recorded an implementation percentage of 91.6%, categorized as very high, although there were minor issues related to optimizing apperception and final evaluation. At the third meeting, teachers successfully maintained their performance with a score of 11 (91.6%) through the systematic implementation of SDL procedures, from providing prompting questions for apperception to designing project schedules and conducting comprehensive assessments. Furthermore, at the fifth meeting, teacher activity performance remained in the high category, followed by a posttest at the sixth meeting to accurately measure the final results of the treatment.

Student Activities

Observations of student activities indicate that the learning process took place with a very high level of enthusiasm and passion. This increased learning activity is a crucial instrument in building dynamic educational interactions between students and educators, thus optimizing deeper understanding and mastery of the material. Through the implementation of the Self-Directed Learning (SDL) model, students' active involvement in independently exploring knowledge has created a participatory classroom ecosystem.

Student activity during the implementation of the Self-Directed Learning (SDL) model showed a significant upward trend from the first to the sixth meeting. Following the pretest, student activity in the second and third meetings recorded a percentage of 91.6%, falling into the very high category. Students demonstrated problem-solving skills and effective collaboration in designing group project schedules. Entering the fourth and fifth meetings, students increasingly optimized their integration of creative ideas and teamwork to complete projects, peaking in the very high category before the posttest concluded. These observations confirm that the use of the SDL model not only increased student active participation but also effectively honed the communication skills and 21st-century competencies of fourth-grade students at Elementary School Inpres Paccerakkang.

Learning Outcomes

Based on the results of the research conducted at Elementary School Inpres Paccerakkang, Makassar City, data collected through instruments revealed Indonesian language learning outcomes in the form of grades for fourth-grade students at Table 1.

Table 1. Descriptive Statistics Results

	N	Range	Minimum	Maximum	Sum	Mean	Std. Deviation	Variance
Pretest	29	21.00	56.00	77.00	1967.00	67.8276	5.98849	31.877
Valid N (listise)	29							

From the calculation results above, the N value (number of students) is 29, the mean value is 67.8276, the standard deviation value is 5.98849, the range value is 21, the minimum value is 56, the maximum value is 77 and the total value is 1967.00. The results of the level of mastery of the pretest material are presented in Table 2.

Table 2. Level of Mastery of Pretest Material

No	Interval	Frequency	Percentage (%)	Learning Outcome Categories
1	0 – 34	0	0	Very Low
2	35 – 54	3	14,28	Low
3	55 – 64	7	33,33	Medium
4	65 – 84	11	52,38	High
5	85 – 100	0	0	Very High
	Total	21	100	

The Indonesian language learning outcomes of sixth grade students at the pre-test stage using the test instrument are categorized as very low (0%), low (14.28%), moderate (33.33%), high (52.38%), and very high (0%). Looking at the existing percentage results, it can be said that the level of students' understanding of communication and 21st-century skills/collaboration, communication, critical thinking, and creativity (4C) before the self-directed learning model treatment is classified as high.

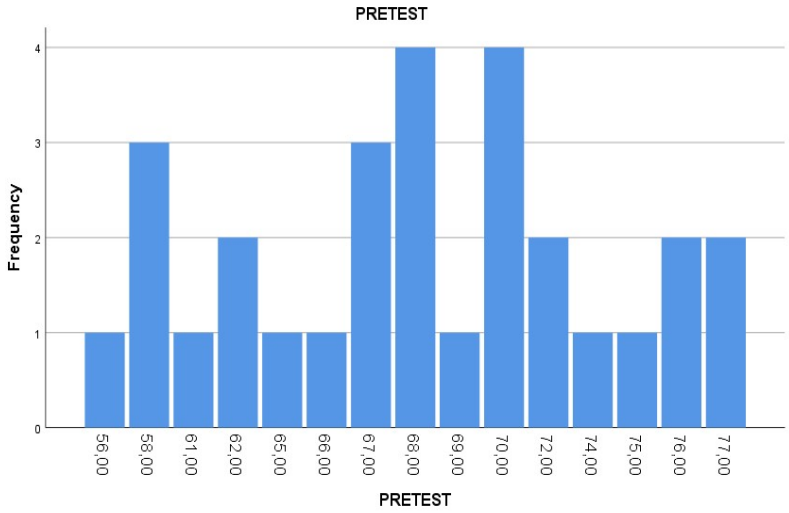

Figure 1. Pretest results

The diagram above shows the pretest results of students with low, medium, high, and very high scores. This indicates that students' initial understanding of the material is still lacking, as there are still 3 students who have learning success in the low category and 7 students with medium. Therefore, there is a need for treatment or a model that can increase their enthusiasm for learning. One suitable learning model to use is the Self-Directed Learning (SDL) model.

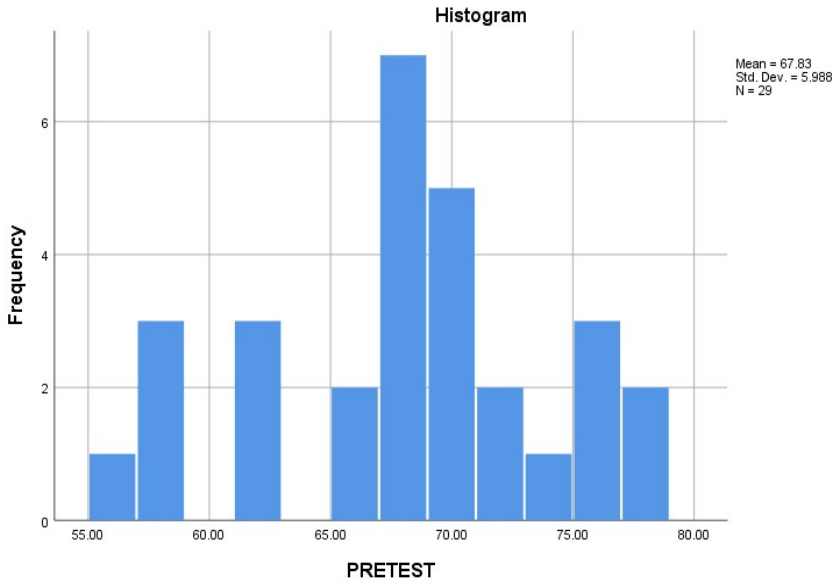

Figure 2. Pretest Histogram

The histogram shows the categories of each score. Three students scored 55, which is considered low; seven students scored 60, which is considered medium; five students scored 70, which is considered high; and six students scored 80, which is considered high. In the posttest, changes in Indonesian language learning outcomes occurred during the study after the treatment. These changes were in the form of learning outcomes, data obtained after the posttest. These changes can be seen in the following data in Table 3.

Table 3. Posttest Results

	N	Range	Minimum	Maximum	Sum	Mean	Std. Deviation	Variance
Posttest	29	20.00	80.00	100.00	2542.00	87.6552	5.64596	31.877
Valid N (listise)	29							

From the calculation results above, the results of Indonesian language learning for fourth grade students of Elementary School Inpres Paccerakkang, after implementing the Self-Directed Learning learning model, the mean value is 87.6552, the standard deviation value is 5.64596, the Variance value is 31.877, the range value is 20, the minimum value is 80, the maximum value is 100 and the sum value is 2542.00. The results of the posttest for mastery level material are presented in Table 4.

Table 4. Posttest material mastery level

No	Interval	Frequency	Percentage (%)	Learning Outcome Categories
1	0 – 34	0	0	Very Low
2	35 – 54	0	0	Low
3	55 – 64	0	0	Currently
4	65 – 84	8	38,09	Tall
5	85 – 100	13	61,90	Very high
	Total	21	100	

From the table data above, it can be concluded that the Indonesian language learning outcomes of fourth-grade students at the Posttest stage using the test instrument are categorized as very low (0%), low (0%), medium (0%), high (38.09%) and very high (61.90%). Looking at the existing percentage results, it can be said that the level of student understanding of communication and 21st-century skills (communication, collaboration, critical thinking, and creativity) towards Indonesian language learning outcomes after the implementation of the self-directed learning model is classified as high.

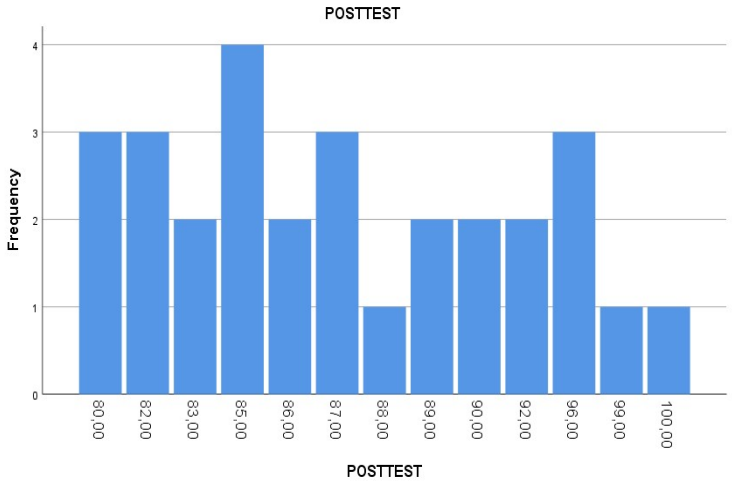

Figure 3. Posttest Results

The diagram above shows the students' posttest results, which are in the high and very high categories. This indicates an improvement in the fourth-grade students' Indonesian language learning outcomes using the self-directed learning model, resulting in students' understanding of the material more quickly grasping and completing the projects or problems given. The histogram reveals the categories of each score. Two students scored 75, which is in the high category, eight students scored 90, which is in the very high category, and four students scored 100, which is in the very high category.

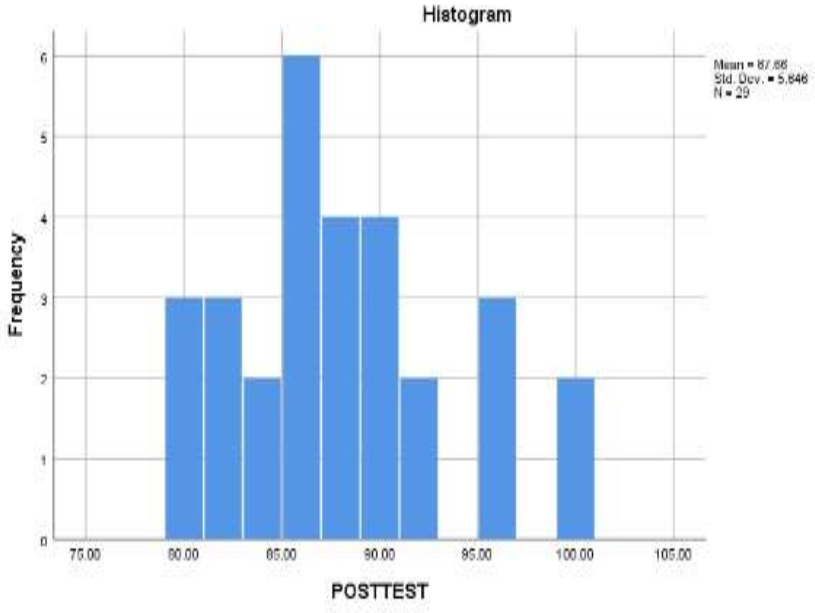

Figure 4. Posttest histogram

The Self-Directed Learning Model on Communication, Collaboration, Critical Thinking, and Creativity (4C) Skills

Hypothesis testing regarding the impact of the Self-Directed Learning model on the 4C skills and Indonesian language learning outcomes of fourth-grade students of SD Inpres Paccerakkang was conducted using paired sample t-test inferential statistics via SPSS Version 26, after the data were declared to meet the requirements of the classical assumption test (normality and homogeneity). The results of the assumption test showed that the pretest ($p = 0.174 > 0.05$) and posttest ($p = 0.72 > 0.05$) data were normally distributed, and had homogeneous variance with a significance value of $0.238 > 0.05$. Furthermore, paired sample t-test analysis was applied to identify significant differences between student learning outcomes before and after the intervention, with validity criteria based on significance values (2-tailed) < 0.05 as presented in Table 5.

Table 5. Hypothesis Test Results

Connection	Paired Differences	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference (Lower)	95% Confidence Interval of the Difference (Upper)	t	df	Sig. (2-tailed)
Pair 1	pretest – posttest	-20.24138	9.06585	1.68349	-23.68984	-16.79291	-12.023	28	0

The results of the hypothesis test using the Paired Samples Test obtained a t-value of -12.023 with a significance value (Sig. 2-tailed) of 0.000. This significance value is much smaller than the specified significance level, which is $0.000 < 0.05$. This condition statistically indicates that H_0 is rejected and H_1 is accepted, meaning there is a very significant average difference between student learning outcomes before (pre-test) and after (post-test) the intervention was given. This significant difference empirically proves that the intervention through the implementation of the Self-Directed Learning (SDL) model has a significant impact on improving student learning outcomes in the classroom.

By rejecting H_0 (which states there is no influence of the model) and accepting H_1, it can be concluded that the Self-Directed Learning model has a significant effect on the 4C skills, namely communication, collaboration, critical thinking, and creativity, as well as the Indonesian language learning outcomes of fourth-grade students at Elementary School Inpres Paccerakkang, Makassar City. The independence built through the SDL model has been proven to be able to optimize students' active participation, so that it not only boosts their understanding of academic material related to transitive and intransitive sentences, but also hones their essential 21st-century competencies in an integrated manner.

Discussion

Effectiveness of Teacher Implementation of the Self-Directed Learning (SDL) Model

Based on observation data, the teacher's implementation of the Self-Directed Learning (SDL) model demonstrated excellent consistency across each learning session. This success was evident in Meetings II and III, which achieved a 91.6% implementation rate (Very High Category). Although minor challenges arose related to optimizing apperception and final evaluation at the beginning of the session, the teacher successfully mitigated these challenges in subsequent meetings by reinforcing prompting questions and designing a more structured project schedule.

The teacher successfully fulfilled her role as a facilitator and mediator, no longer a teacher-centered learning center. This role shift is crucial in the SDL model, where the teacher is responsible for providing learning modules based on the Independent

Curriculum (Kurikulum Merdeka) that integrate the values of the Pancasila Student Profile, preparing interactive audiovisual media (such as the video of the "Maling Kundang" folktale), and providing intensive supervision during group work. This quantitative data demonstrates that thorough administrative and instrument preparation during the pre-research phase can ensure a smooth learning process in the classroom.

Transformation of Student Activities and Independence

The implementation of the Self-Directed Learning (SDL) model has had a significant positive linear impact on transforming the learning ecosystem of fourth-grade students at Elementary School Inpres Paccerakkang into a more participatory one. Through four main phases—planning, implementation, monitoring, and self-evaluation—this model has been empirically proven to increase students' active engagement in autonomously exploring language materials. Observation data shows a consistent trend of increasing participation, reaching a "Very High" qualification (91.60%) in meetings II and III. This activity was driven by the integration of digital media and independent student worksheets, which stimulated students' curiosity, which then led to optimized teamwork and creative ideas to complete projects in meetings IV and V.

This increase in students' intrinsic activity and motivation aligns with the main principles of Piaget's cognitive constructivism theory and Vygotsky's social constructivism, which assert that knowledge is built meaningfully when students are given agency to construct their own understanding through interactions with a material-rich environment (Belolutskaya et al., 2022; Mishra, 2023). This finding also strengthens previous studies conducted by Knowles regarding the effectiveness of independent learning in increasing cognitive resilience (Kamışlı & Özonur, 2017), and confirms modern empirical research (such as the SDL research cosmology in elementary education) that conditioning SDL phases from an early age not only accelerates mastery of academic material but also simultaneously fosters students' collaborative and creative thinking skills along with increasing their self-regulated learning in the classroom.

Improvement of Indonesian Language Learning Outcomes and 21st Century Skills (4C)

The results of the study showed a significant improvement in student academic performance before and after the implementation of the Self-Directed Learning (SDL) model. In the pretest, students' understanding of the Indonesian language learning material was in the low category, with an average score of 67.82. Specifically, 14.28% of students fell into the low category and 33.33% into the medium category. Data visualization using an initial histogram confirmed that the previously implemented conventional learning model was not optimal in stimulating cognitive achievement. This situation underscores the urgency of a new intervention model capable of breaking through learning stagnation and boosting enthusiasm and effectiveness in class.

After six sessions of the SDL model intervention, there was a drastic jump in academic quality in the posttest, with the average student score increasing sharply to 87.65, even reaching a perfect score of 100. This positive shift was clearly visible in the

distribution of material mastery levels, with no students falling into the low or medium categories. In contrast, the pass rate shifted significantly, with 38.09% of students in the high category and 61.90% achieving the very high category. Statistically, the Paired Samples T-Test yielded a t-value of -12.023 with a significance level (2-tailed) of 0.000 < 0.05, indicating that the null hypothesis (H_0) was rejected and the alternative hypothesis (H_1) was accepted. These figures empirically prove that the SDL model has a significant impact on improving elementary school student learning outcomes.

Theoretically, the effectiveness of this cognitive leap reinforces Deci and Ryan's Self-Determination Theory (SDT), which states that fulfilling the need for autonomy in learning (autonomy) directly escalates intrinsic motivation and academic performance (Adams et al., 2017; Ryan & Deci, 2020; Vallerand, 2021). This improvement in learning outcomes, coupled with the stimulation of 21st-century skills (4Cs), also aligns with previous studies on Self-Regulated Learning (SRL), which confirm that independence fosters critical thinking and creativity when students analyze problems and express ideas in worksheets. Furthermore, these findings reinforce recent empirical research at the elementary education level, which shows that communication and collaboration dimensions develop naturally through directed, self-directed spaces (Al-Hitani & Embarak, 2025). When teachers position themselves as facilitators in the SDL ecosystem, peer interactions during group discussions become more meaningful, thus boosting not only (cognitive) test scores but also holistically developing students' social-cognitive competencies.

The Self-Directed Learning (SDL) model intervention based on the Independent Curriculum for fourth-grade students at Elementary School Inpres Paccerakkang demonstrated a strong causal relationship with improved learning quality. The teacher's strategic approach to systematizing digital materials has proven successful in consistently igniting students' enthusiasm and independence in learning. In the final exploration, the independent activities developed through the SDL model contributed directly and integratively to increasing in-depth understanding of the material, achieving superior academic grades, and strengthening 21st Century Skills competencies that include aspects of communication, collaboration, critical thinking, and creativity (4C) of students.

4. CONCLUSION

The implementation of the Self-Directed Learning (SDL) model in the Indonesian Language subject of grade IV of Elementary School Inpres Paccerakkang has been proven to run consistently and provide a comprehensive positive impact. The effectiveness of the teacher's role as a facilitator was carried out very well, where the achievement of teacher activities was able to maintain the Very High category (91.6%) in meetings II and III, and the High category in meeting V. The success of this implementation simultaneously created a participatory class ecosystem, marked by a trend of student independent activity that increased significantly until it reached its peak before the post-test and was able to hone communication and group collaboration skills. This instructional impact culminated in a sharp spike in academic performance, where

the average (mean) score of students increased from 67.82 in the pre-test to 87.65 in the post-test, with the level of mastery of the post-intervention material based on the Ministry of Education and Culture standards dominated by the Very High (61.90%) and High (38.09%) categories with no more students in the low category. Empirically, the significant impact of the SDL model is supported by the results of the inferential test using the Paired Samples T-Test, which yielded a significance value (Sig. 2-tailed) of $0.000 < 0.05$, thus rejecting H_0 and accepting H_1. This confirms that the SDL model has a highly significant positive impact on improving learning outcomes while simultaneously strengthening students' 21st Century Skills (4Cs) in an integrated manner.

As a recommendation, educators, particularly elementary school teachers, are advised to consistently integrate this independent learning model into the classroom by utilizing interactive audiovisual media and relevant Merdeka Curriculum-based teaching modules. Furthermore, schools and education policymakers are expected to facilitate regular training for teachers to optimize their role as facilitators, as well as provide adequate digital resources such as projectors and laptops to support the creation of a participatory, active, and 21st-century competency-oriented classroom ecosystem.

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