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Schneeball-Wırbelgruppe learning model: improving students' concept mastery and critical thinking

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ABSTRACT

Good concept mastery through critical thinking using various approaches, models, strategies, and methods of learning German is essential for the Education 4.0 era. Therefore, this study aimed to analyze the concept mastery and critical thinking skills of German language students at Pattimura University using collaborative learning that combines Schneeball-Wirbelgruppe learning. A one-group pretest-posttest design with a sample of 13 second-semester students in the academic year 2019/2020 was used. Furthermore, an essay test was used as an instrument while the data was analyzed using descriptive methods (N-gain test) and inferential methods (paired t-test). The descriptive analysis showed that the concept mastery and critical thinking skills of students were in the high and moderate categories. The paired t-test results showed a difference between the pretest and posttest using Schneeball-Wirbelgruppe learning model. Therefore, collaborative learning has a positive impact on improving students' concept mastery and critical thinking skills in learning phonology and morphology courses. As for the implications of this research, the Schneeball-Wırbelgruppe learning model is recommended as a learning model that can be applied to other concepts in German language learning.

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1. INTRODUCTION

In the Education 4.0 era, it is imperative for all students to possess a solid understanding of key concepts, including those learning German as a foreign language. Linguistic learning concepts, particularly phonology, and morphology of the German language, differ from Indonesian, hence, challenging to comprehend. These concepts may seem dull, resulting in less engaging or passive students. Instructors need to find solutions to ease understanding of these concepts and keep students active using teaching methods that stimulate critical thinking. However, this is only possible through creating an interactive learning atmosphere to keep students actively engaged throughout the learning process. According to Boateng *et al.* [1] that by creating an interactive learning atmosphere and applying appropriate learning methods and models, students will have communication skills, computer skills, problem-solving skills, entrepreneurial skills, and critical thinking skills.

Critical thinking is among the dominant high-level thinking skills in the 4.0 Industrial Revolution. According to Doughty [2], critical thinking is an open-minded way of thinking that considers various alternatives and concludes with problem-solving. Emly [3] stated that critical thinking is a comprehensive skill to analyze arguments, draw conclusions, use inductive or deductive reasoning, evaluate, make decisions,

and solve problems. Individuals with important questioning abilities are characterized through open-mindedness, curiosity, questioning habits, and flexibility. They also seek information from various sources, have alternative problem-solving methods, and consider the consequences of a decision [4], [5]. Uribe-Enciso *et al.* [6] stated that the skill is related to intellectual discipline, integrity, and creativity. According to *Liu et al.* [7], critical thinking is a crucial competency to evaluate in university learning. Therefore, the assessment of critical thinking skills through essay tests is a solution to evaluate the learning process in the 4.0 Industrial Revolution era. Pithers and Soden [8] established that critical thinking is beneficial in empowering students to have a good mindset in learning, such as in discussions and final exams. Similarly, Franco *et al.* [9] stated that the selection of appropriate learning strategies empowers critical thinking.

Besides that, concept mastery is among the competencies in the cognitive dimension. Various factors affect the improvement of cognitive thinking skills. These include students' participation in completing all tasks [10], attitude skills in the learning process [11], the speed of processing information received in learning [12], the connection between neurobehavioral processes in the human brain [13], and parental involvement and emotions that affect cognitive skills. These factors support concept mastery and achievement of students [14]. Furthermore, Korous *et al.* [15] stated that concept formation originates from the meta-analysis of thoughts by connecting concept parts into a unified whole. According to Lestuny and Grietje [16], concept formation in German language learning is through the process of remembering and sorting words properly to make correct sentences, accompanied by enjoyable learning. Siahaan *et al.* [17] explained that the skills to remember, recognize meaning, and use past experiences can form vocabulary mastery, hence students can combine them into complete sentences. According to Friederichs *et al.* [18] concept mastery is built over time and is linked to practice or application.

German language learning uses various collaborative teaching methods and models, such as Schneeball and word-webbing to improve writing skills [19], drama-based learning methods to enhance language mastery [20], and mind mapping to improve writing skills [21], [22]. Schneeball learning can make students active in groups while improving their learning achievement [23], [24]. These approaches are generally applied to the mastery of language skills (Hören, Sprechen, Lesen und Schreiben), vocabulary, and language structure in German language learning, including mastery of linguistic concepts. The teaching models and methods to master concepts through discussion need to be well-designed for students to develop their reasoning skills and critical thinking abilities. Therefore, instructors can use one or several models to achieve effective learning processes and maximal learning outcomes. In this study, the instructor combined Schneeball and Wirbelgruppe learning, which encourages individuals to comprehend a material or problem. The instructor forms Partnergruppen in which students discuss with their partners and make posters to master the material. Similarly, two Partnergruppen join to form a larger group where they argue, unite their opinions, and then make sketches or mind maps to create a more complete understanding of the material discussed. Therefore, understand the material or problem better, and their understanding of the concept becomes complete and broader.

The Plenum, as the end of Schneeball learning, is abolished because each member of the large groups (A, B, and C) is considered to have understood the material in their respective subgroups (A, B, and C) and is expected to explain the material. This large group is divided into several smaller groups (I-III) using Wirbelgruppe, each containing representatives from the larger group. Specifically, Group I consist of A1, B1, and C1, Group II A2, B2, and C2, Group III A3, B3, and C3 and Group IV A4, B4, and C4. Each member who has become an expert in a certain subtopic will present the results obtained from the previous group (A, B, and C) to the new group (I-IV) for an effective argument. Finally, all members have a complete experience of the series of materials discussed [25]. According to Marlena [26], Schneeball learning allows students to develop their thinking skills to ask and answer questions. Wirbelgruppe learning form expert groups. According to Manemann and Rengstorf [27], and Schmutzer [28], Wirbelgruppe learning is the formation of groups within a group. It encourages students to discuss specific topics in a large group, which is then divided into smaller groups. At least one representative from each old group forms a new group, and each group discusses its topic. In the small group, they share information about the previous material. Therefore, group discussion helps students solve problems together and improve their critical thinking skills [29]–[31]. According to Koren and Rimmar [32], this is very suitable for presenting the results of group work.

Combining Schneeball-Wirbelgruppe learning in German language learning in the phonology and morphology course is expected to improve students' concept mastery and critical thinking skills. It also supports the German language learning process in the 4.0 Industrial Revolution era. Therefore, this study analyses the concept mastery and critical thinking skills of German language students by combining Schneeball-Wirbelgruppe learning.

2. METHOD

2.1. Types of study

This is an experimental study. The independent variables are the Schneeball-Wırbelgruppe learning model, while the dependent are concept mastery and critical thinking. Furthermore, the design used a one-group pretest-posttest design as shown in Table 1.

Table 1. Study design

Subject	Pretest	Treatment	Posttest
German language education students	P_1	X	P_2

Note: P_1 is pretest before learning process; X is Learning process uses the collaboration of Schneeball-Wirbelgruppe learning; P_2 is Posttest after learning process

2.2. Research sample

This study used purposive sampling. The research sample was 13 second-semester German language education students. The teaching and learning activities are done in the even semester of the 2019/2020 academic year.

2.3. Research instruments

The study used an essay test assessment instrument to measure concept mastery as shown in Table 2 and students' critical thinking as shown in Table 3 to determine the formation of morphemes in the phonology and morphology course. The tests were given before (pre-test) and after (post-test) the implementation of Schneeball-Wirbelgruppe learning model. The assessment rubric consists of two forms, concept mastery, and critical thinking.

Table 2. Concept mastery rubric

Cognitive level	Predictor	Marking	Score
Knowledge	a. Answers contain general terms used in morphemes formation concept.	If the two predictors are met in the answer.	5
	b. Answers contain basic concept about the morpheme's formation process.	If one of the predictors is met in the answer.	3
Understanding	a. The answer is to understand the facts and principles in concept of the system of formation morphemes.	If the two predictors are met in the answer.	10
	b. The solutions comprise the key phrases used as idea approximately the morpheme formation process.	If one of the predictors is met in the answer.	5
Application	a. Answers can apply the morpheme formation concept to new situations.	If the two predictors are met in the answer.	15
	b. Answers can demonstrate the morpheme formation process correctly.	If one of the predictors is met in the answer.	10
Analysis	a. Answers contain statements according to concept of the correct morpheme formation process.	If the three predictors are met in the answer.	20
	b. Answers contain logic in giving reasons for concept of the process of forming morphemes.	If two predictors are met in the answer.	10
	c. Answers distinguish between facts and conclusions about the correct process of forming morphemes.	If one of the predictors is met in the answer.	5
Synthesis	a. Answers contain writing about the process of forming well-organized morphemes.	If the three predictors are met in the answer.	25
	b. Answers contain suggestions related to the process of forming morphemes.	If two predictors are met in the answer.	20
	c. Answers contain writing to classify objects, events, or thoughts about the process of forming morphemes.	If one of the predictors is met in the answer.	15
Evaluation	a. The answer considers the logical consistency of concept of the morpheme formation process.	If the three predictors are met in the answer.	25
	b. Answers contain conclusive considerations supported by data about concept of the morpheme formation process.	If two predictors are met in the answer.	10
	c. The answer contains a decision about an idea that contains certain criteria about the morpheme formation concept.	If one of the predictors is met in the answer.	5
	Total expected value		100

Table 3. Critical thinking rubric

Score/points	Descriptor
5	All idea of the morphemes formation system is correct, clear, and specific; solutions are supported via way of means of true reasons; true questioning flow; all idea is interrelated and integrated, grammar is right and correct; all components are seen and balanced.
4	Most concept of the morpheme arrangement handle are adjusted and clear but less particular; all of the depictions of the answers are adjusted and clear, but not particular; the great stream of considering, most concept are interrelated and coordinates; linguistic use is nice and adjust, there are minor blunders;
3	A little portion of concept of the morpheme's arrangement handle is adjust and clear; all the little portrayals of the answers are rectified and clear, but the reasons and contentions are not clear; the stream of thought is very great, and some concepts are interrelated; linguistic use is very great and redress, there are spelling mistakes; a few viewpoints that appear right.
2	Concept of the morpheme's formation procedure is much less focused, redundant, or ambiguous; the outline of the solution does now no longer support; the go with the drift of wondering isn't appropriate, idea isn't associated with every other; appropriate grammar, incomplete sentences; few elements that appear right.
1	All idea of the morpheme's formation manner is wrong or insufficient; unfaithful reasons; the glide of questioning isn't always good; terrible grammar; as an entire isn't always enough.
0	There aren't any solutions or incorrect solutions.

(Modification from Akihary and Apituley [33])

2.4. Research procedure

The study began with a pre-test, followed by learning process that collaborates Schneeball-Wirbelgruppe learning, and ended with a post-test. Furthermore, the data was collected through assessments using concept mastery and critical thinking measuring instruments. The steps of the learning models are presented in Table 4 and Figure 1.

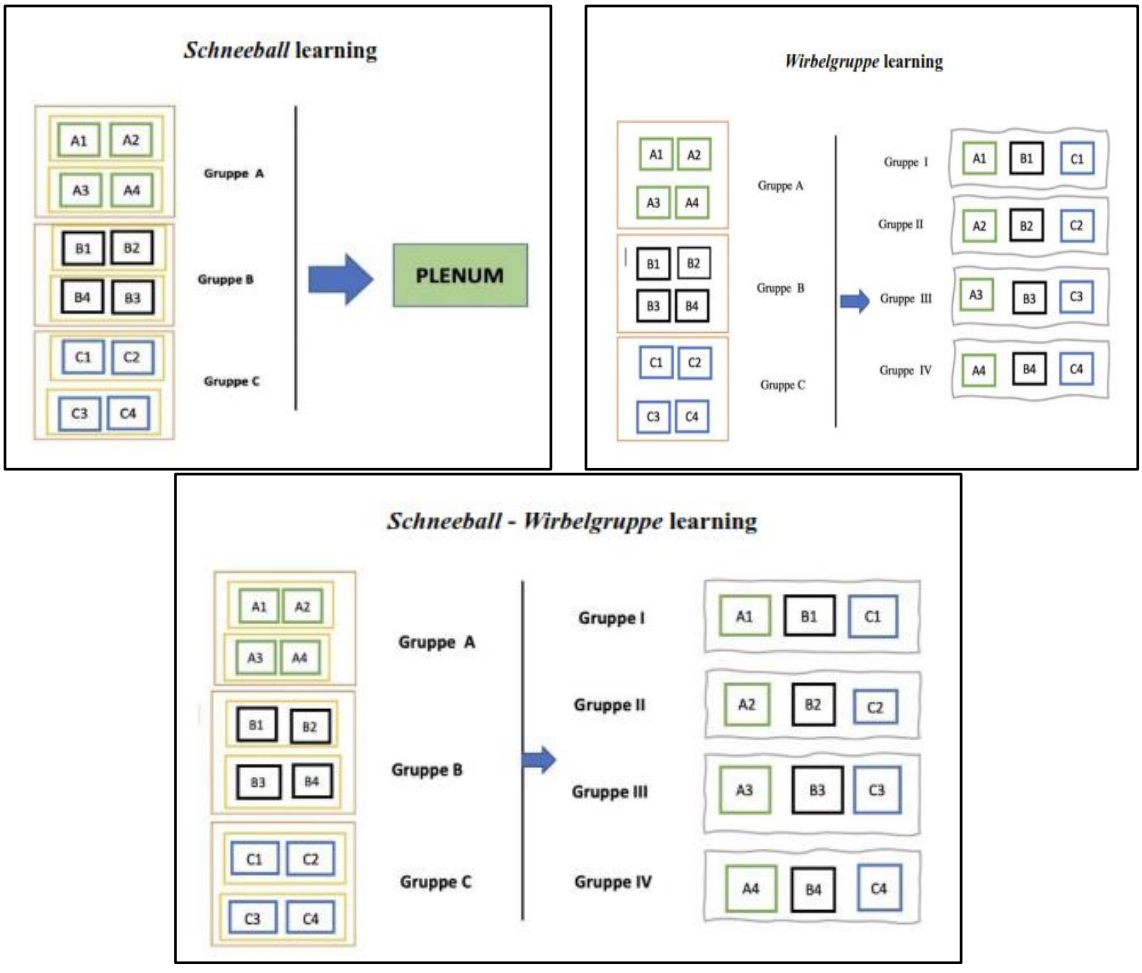

Figure 1. Schneeball-Wirbelgruppe learning model (adaptation from Funk *et al.* [25])

Table 4. Learning syntax of Schneeball-Wirbelgruppe learning

No.	Description of activities	Collaboration stages
1.	The lecturer conveys learning objectives	Schneeball
2.	The lecturer instructs each individual to learn the task regarding the morpheme-forming process that has been done (note: the individual has done the task from home). Each of them is given a topic, namely Flexion (for members A1, A2, A3, A4) or Derivation (for B1, B2, B3, and B4) or Compositum (C1, C2, V3, and C4)	
3.	The lecturer makes a *tandem/Partnergruppe* (A1 and A2; A3 and A4). Each partner has the same topic as the tasks obtained per individual. At this stage, they need to unify their understanding, make a plaque/mind mapping, and provide explanations as keywords and examples. The lecturer only accompanies them during discussions.	
4.	The lecturer forms large groups (A1 and A2, A3 and A4 become groups A, B, and C) by combining 2 *Tandem/Partnergruppe* groups that have the same topic. At this stage, each of the large groups (A, B, C) unifies their opinions and makes more complete notes. The lecturer gives these large group questions to deepen their topic knowledge. Moreover, the lecturer still accompanies each large group by providing input and questions to strengthen their understanding as they are considered experts on the topic.	
5.	The lecturer instructs members of groups A (A1, A2, A3, A4), B (B1, B2, B3, B4), C (C1, C2, C3, C4) to form a new group. Group I consist of A1, B1, C1; group II consists of A2, B2, C2; group III consists of A3, B3, C3, while group IV consists of A4, B4, C4.	Wirbelgruppe
6.	The lecturer instructs each member of groups I, II, III, and IV to present the discussion results obtained from the large groups (A, B, and C) for the new group members.	
7.	The lecturer gives sheets of paper containing questions that enlighten them on the essence of the presentation results in the group.	

2.5. Data analysis

The information amassed became analyzed the use of descriptive and inferential evaluation techniques. The descriptive analysis uses the N-gain test as shown in Table 5 [34], while inferential analysis utilizes the paired t-test [35]. The N-gain test was performed using Microsoft Excel, while the paired t-test was conducted using SPSS software for Windows. Before inferential analysis, normality and homogeneity prerequisite analyses are performed using SPSS software for Windows. In this case, normality analysis uses the Shapiro-Wilk test, while homogeneity analysis uses the Levene test as shown in Table 6.

$$N - gain = \frac{postest\ score - pretest\ score}{maximum\ possible\ score - pretest\ score}$$

The N-gain calculation results are then converted with the classification in Table 5.

$$t = \frac{\bar{d} - \mu d}{\frac{S_d}{\sqrt{n}}}$$

Where, d is difference between each individual/object in pairs, μ_d is mean value of the d population difference from all data pairs, $\bar{d}$ is mean value of d, S_d is standard deviation value of d, and n is Number of data pairs. The pre and post-test data for concept mastery and critical thinking has a sig value of > 0.05. Therefore, all data fulfills the normal and homogeneous requirements, hence, can be continued for the paired t-test.

Table 5. Classification of N-gain

Limit	Category
g > 0.7	High
0.3 < g ≤ 0.7	Moderate
G ≤ 0.3	Low

Table 6. Normality and homogeneity prerequisite analyses

Parameter	Normality test		Homogeneity test	
Pretest	0.199	Normal	0.606	Homogeneous
Posttest	0.200		0.601	
Precritical	0.200		0.746	
Postcritical	0.122		0.146	

3. RESULTS AND DISCUSSION

3.1. Students concept mastery

Students' concept mastery was determined through essay tests conducted at the beginning and end of learning. The difference in the pre and post-test results were calculated using the N-gain test and recorded in Table 7 as follows. From the N-gain analysis results as shown in Table 7, concept mastery taught using the collaboration of Schneeball-Wirbelgruppe learning is in the moderate and high categories. It means learning models used in studying concept of the morpheme formation process can improve concept mastery. Furthermore, a paired t-test was conducted to determine the difference before and after collaborating Schneeball-Wirbelgruppe learning on concept mastery of students as shown in Table 8.

Table 7. N-gain test of concept mastery of students

Students	Pre-test score	Post-test score	N-gain	Category
1	65	96.3	0.89	High
2	55	85.3	0.67	Moderate
3	44	73.8	0.53	Moderate
4	43	79.5	0.64	Moderate
5	43	80	0.65	Moderate
6	50	85	0.7	Moderate
7	30	80	0.71	High
8	42	75.5	0.58	Moderate
9	45	75	0.55	Moderate
10	57	96.3	0.91	High
11	40	70.9	0.52	Moderate
12	46	70	0.44	Moderate
13	63	93.1	0.81	High

Table 8. T-test of concept mastery of students

Variable	Mean	Standard deviation	Df	Sig. (2-tailed)
Concept mastery	-33.66923	6.31538	12	0.000

The paired sample t-test results as shown in Table 8 show that the significant 2-tailed is < (0.05). This means there are differences in students' concept mastery in studying the morpheme formation process before and after implementing Schneeball-Wirbelgruppe learning model. Schneeball-Wirbelgruppe collaborative learning can create a comfortable and enjoyable learning environment that allows students to focus on mastering concept learned. According to Indriani [36], Schneeball learning helps students participate in writing, promotes active the participation of students, and creates a conducive and enjoyable learning environment. Furthermore, Meilinda [37]; Afghari and Khayatan [19] established that Schneeball learning, when combined with teaching techniques or media, facilitates smoother discussions.

Wirbelgruppe group division technique is the best alternative to increase the engagement of students in discussing and sharing knowledge about concept being taught. Silvana *et al.* [38] reported that group discussions in Schneeball learning improve speaking skills. According to Purdiyanto *et al.* [39] concept mastery can be increased by empowering students to formulate concept-related questions and answer them according to concept learned in class through Schneeball. Additionally, students can also share their learning experiences. Hagonob and Casinillo [40] showed that concept mastery improved more for those who learned using Schneeball learning. Meanwhile, studies combining the two techniques demonstrated the role of Wirbelgruppe in Schneeball learning.

The final stage of this learning process empowers students to master concept and be ready to ask and answer questions. According to Nurmalasari and Apsari [41], the snowball that contains questions allows students to formulate and answer questions. This collaborative technique makes learning enjoyable and helps students master concept being taught. Furthermore, lecturers can anticipate Schneeball weakness regarding time management by providing specific time limits, monitoring the discussion progress, and providing support to groups to keep them actively working and achieving good results. This proves that applying the right learning model can help students understand a concept [42].

3.2. Critical thinking

Lecturers assess critical thinking through an integrated essay test with critical thinking components conducted at the beginning and end of learning process. The difference in results between the pre-test and post-test is calculated using the n-gain test, and are as shown in Table 9. The analysis using N-gain as shown in Table 9 shows that critical thinking of students taught using a combination of Schneeball-Wirbelgruppe learning is in the moderate and high categories. This indicates that learning models used to learn concept of morphology principles and morpheme classification can improve critical thinking. Similarly, the paired t-test analysis to determine the difference before and after the implementation of Schneeball-Wirbelgruppe collaborative learning on critical thinking is shown in Table 10.

The paired t-test results as shown in Table 10 show significant 2-tailed < (0.05). This indicates a difference in critical thinking in the morpheme formation process before and after the implementation of collaborative learning using Schneeball-Wirbelgruppe learning. According to Lestari *et al.* [43] and Ginting [44], Schneeball learning can empower students to actively use their critical thinking. As a result, they become more confident because of a thorough and deeper understanding of the material discussed individually (by doing tasks before class), with partners, and finally in groups. Schneeball learning collaborate with Wirbelgruppe, which enhances critical thinking development during learning process. This

is because students train to ask and answer questions from their peers, which improves their critical thinking ability when answering questions on the final test than before starting learning process. This was also shown by Priyambodo *et al.* [45] that the collaborative learning model (ethno-ECLIPSE) improves students' critical thinking abilities.

According to Sipayung *et al.* [46] Schneeball learning can empower students to solve problems, reason, communicate, and be more confident. Besides that Schneeball learning empowers all students and improves their social skills as they need to communicate, discuss, and work well in teams [47]. These components can give students more critical thinking abilities through collaborative Schneeball-Wirbelgruppe learning. According to Subiyantari *et al.* [48]; Nurmalia [49], Wirbelgruppe technique conditions students to present their material, exchange ideas, and argue critically. That is because they understand the material discussed in the previous group. Therefore, this method is among the critical thinking empowerment students' tools because students train to argue critically in their original and expert groups.

Table 9. Results of critical thinking analysis

Students	Pre-Test score	Post Test score	N-gain	Category
1	60	95	0.88	High
2	40	81	0.68	Moderate
3	38	70	0.52	Moderate
4	32	80	0.71	Moderate
5	44	80	0.64	Moderate
6	34	86	0.79	Moderate
7	46	85	0.72	Moderate
8	38	75	0.6	Moderate
9	42	77	0.6	Moderate
10	38	90	0.84	High
11	38	75	0.6	Moderate
12	34	75	0.62	Moderate
13	40	90	0.83	High

Table 10. Results of paired t-test on critical thinking

Variable	Mean	Standard deviation	Df	Sig. (2-tailed)
Critical thinking	-41.15385	6.98625	12	0.000

4. CONCLUSION

This study shows that combining Schneeball-Wirbelgruppe learning model can empower concept mastery and critical thinking skills of German language students. The stages in this collaboration support each other and are unified to provide a significant influence before and after implementing concept mastery and critical thinking skills of students. Therefore, the follow-up to this study is to test these collaboration stages on various German concepts to empower other language competencies.

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