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Invention of Learning Model *PAKIM* Based Karo Culture *Nganting Manuk*

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Abstract

Education functions in shaping the character of the nation, improving the quality of human resources, advancing science and technology, developing creativity and innovation, preserving local culture and wisdom, building careers and jobs, fostering environmental awareness and improving community welfare. Based on a survey of National Exam scores for mathematics subjects in *Karo* Regency, Indonesia is still in the bad category, namely an average score of 39.56 for 2019. One of the causes of this situation is the lack of applied learning models, especially culture-based learning models. Therefore, the purpose of this research is to invent a learning model based on one of the cultures in Indonesia, namely the *Karo* culture *Nganting Manuk*. The method used in this research is development research with the Plomp model. The result of this study was the discovery of a valid, practical and effective PAKIM learning model based on *Karo* Culture. The practical PAKIM learning model, based on the model's implementation criteria, received a "high" category. The PAKIM model met two effectiveness criteria: achieving the Minimum Competency (KKM) of 86.11% and achieving a positive student response of 96.2%. This learning model has the advantage of being able to support the educational function, namely preserving local culture and wisdom because it is integrated with *Karo* culture. This research has three categories of novelty, namely invention novelty, improvement novelty and refutation novelty.

Keywords:
Karo culture; learning model; PAKIM

Abstrak

Pendidikan berfungsi dalam membentuk karakter bangsa, meningkatkan kualitas sumber daya manusia, memajukan ilmu pengetahuan dan teknologi, mengembangkan kreativitas dan inovasi, melestarikan budaya dan kearifan lokal, membangun karier dan lapangan kerja, menumbuhkan kepedulian lingkungan dan meningkatkan kesejahteraan masyarakat. Berdasarkan survei nilai Ujian Nasional mata pelajaran matematika di Kabupaten Karo, Indonesia masih dalam kategori buruk, yaitu skor rata-rata 39,56 untuk tahun 2019. Salah satu penyebab keadaan ini adalah kurangnya model pembelajaran yang diterapkan, terutama model pembelajaran berbasis budaya. Oleh karena itu, tujuan penelitian ini adalah mengembangkan model pembelajaran berbasis salah satu budaya di Indonesia, yaitu budaya Karo *Nganting Manuk*. Metode yang digunakan dalam penelitian ini adalah penelitian

pengembangan dengan model Plomp. Hasil penelitian ini adalah ditemukannya model pembelajaran PAKIM berbasis Budaya Karo yang valid, praktis dan efektif. Model pembelajaran PAKIM yang praktis, berdasarkan kriteria keterlaksanaan model, mendapat kategori tinggi. Model PAKIM memenuhi dua kriteria efektivitas: mencapai KKM sebesar 86,11% dan mencapai respons positif siswa sebesar 96,2%. Model pembelajaran ini memiliki keunggulan karena dapat mendukung fungsi pendidikan, yaitu melestarikan budaya dan kearifan lokal karena terintegrasi dengan budaya Karo. Penelitian ini memiliki tiga kategori kebaruan yaitu kebaruan temuan, kebaruan perbaikan dan kebaruan sanggahan.

Kata Kunci:
budaya Karo; model pembelajaran; PAKIM

Introduction

In Indonesia, particularly in the province of North Sumatra, *Karo* Regency has a National Examination score of 39.56, according to data from the Ministry of Education and Culture. The national exam score for mathematics in *Karo* Regency remains the lowest compared to other subjects. This low national exam score is due to the fact that many students still believe mathematics is a difficult subject to understand. This is in line with the findings of Wijaya (2019), who conducted a survey to diagnose students' thinking difficulties when learning mathematics and stated that several studies have found mathematics to be a difficult subject for many students at various levels of education. Furthermore, one of the causes of difficulty understanding mathematics is the lack of application of learning models by teachers in delivering material in class (Oktaviani et al., 2020); (Samara, 2016). This was also found in *Karo* Regency. Based on observations conducted by researchers, teachers found a lack of implementation of learning models. The learning models that have been implemented have not been optimal in solving existing problems. This gap is because mathematics is a subject that is essential for developing competitive skills in students, yet mathematics is still considered a difficult subject to understand.

As a region with a majority *Karo* population, *Karo* Regency has a culture, namely *Karo* Culture, whose customs are inherent in its residents. Residents are accustomed to activities such as deliberation to unify opinions on various issues. In mathematics learning, when linked to culture, it is known as ethnomathematics (Risdiyanti & Prahmana, 2020). Many studies from various countries have proven that culture related to mathematics learning can improve mathematics learning achievement. This has been proven by Korea and China. China was the country that ranked first in the 2018 PISA with an average score of 591. It followed Korea, which ranked in the top seven in PISA. Chinese researchers, Huang, Nong & Lai (2021), successfully improved students' mathematics abilities by implementing Chinese cultural artifacts, namely *Tulou* Architecture. Korean researchers, Kim & Chae (2016), successfully improved mathematics learning outcomes by implementing a STEAM program based on traditional Korean culture, namely the traditional music of the *Ye*, *Maek*, and *Han* tribes in Korea. However, based on research in *Karo* Regency, the use of culture in mathematics learning, especially *Karo* culture, is still not optimal.

There is a learning model that can achieve high expectations of mathematics learning outcomes for students in *Karo* Regency, namely ICAP. However, according to Krockenberger (Bina et al., 2022), who conducted research on this model, the weakness of the ICAP model is the rather difficult development of cognitive abilities in group situations when applying this model. Therefore, the solution to this weakness is to create a new learning model based on the ICAP model and *Karo* culture, called the PAKIM (Passive, Active, Constructive, Interactive, and Conclusion) model of *Karo* Culture. This research is novel because it integrates the ICAP model with local *Karo* cultural wisdom to create a new learning structure that is more contextual and relevant for students in the region. The PAKIM model not only modifies the ICAP stages but also combines them with *Karo* cultural values, rituals, and interaction patterns, resulting in a unique, authentic, and previously undeveloped learning model. Thus, this research provides a new contribution in the development of local culture-based learning models to improve mathematics learning outcomes.

Karo culture is anthropologically classified into six *Batak* groups, but the *Karo* people still emphasize their identity as *Karo*, not *Batak* (Sitepu & Ardoni, 2019). The Karo people have strong characteristics, such as clan structure, language, red traditional clothing, kinship system, customs, beliefs, and the shape of traditional houses. One important tradition in this culture is *nganting manuk*. The PAKIM learning model based on *Karo* culture is composed of passive, active, constructive, interactive, and concluding stages, which are adapted from a series of activities in the *nganting manuk* tradition. This traditional stage pattern can be reflected as a systematic learning model structure. In practice, *nganting manuk* is a continuation of the *maba belo selambar* event in the wedding procession. This tradition serves to discuss various matters such as the distribution of dowry money (*gantang tumba*) to the woman's family, the status of *sukut*, *kalimbubu* triad (triad), *anak beru* (children), determining the type of party, giving *luahada kalimbubu* (a gift), and discussing food, guest lists, and *ose* (clothing) (Christianti et al., 2013). After the deliberation process is complete, the decisions are read out again before all participants eat chicken (*manuk*) together. The stages of this event begin with the opening (passive), the host's instructions (active), the deliberation process (constructive and interactive), and then the announcement of the results (concluding). In addition to being a traditional ritual, this activity embodies social values that govern the behavior of the *Karo* people and can serve as inspiration for developing learning models. In line with this, the principles of constructivism theory emphasize that knowledge is built through social experiences, dialogue, and meaningful activities, as seen in the deliberation process in the *nganting manuk* tradition. The process of interaction and negotiation of meaning between traditional roles reflects how students also build understanding through active and collaborative engagement. Thus, this tradition naturally represents the knowledge construction mechanism that forms the basis of constructivism theory in learning.

In the context of this research, the *nganting manuk* tradition is not only understood as a cultural heritage, but also as a source of relevant pedagogical structures for inventing a PAKIM learning model based on *Karo* culture. The purpose of this research is to examine in depth the values, interaction dynamics, and communication patterns in this traditional activity so that it can be applied as a learning model that is contextual, meaningful, and close to the lives of students and

in accordance with constructivist theory. The urgency of this research lies in the urgent need to present a learning model that not only improves academic competence but also strengthens character education and local cultural literacy amidst the current homogenization of modern education. By utilizing the social values and interaction structures in nganting manuk, this research attempts to address the problem of the lack of structured local wisdom-based learning models that can be implemented in mathematics and other subjects so that students no longer consider mathematics a difficult subject to understand.

Methods

The research sites were randomly selected from two public senior high schools in *Karo* Regency, North Sumatra namely State Senior High School 1 Kabanjahe and State Senior High School 1 Berastagi, because the difference in average mathematics national exam scores between these two schools was not significant. The national exam scores at State Senior High Schools 1 Kabanjahe and Berastagi were 55.11 and 41.68, respectively. The research was conducted in the 2022-2023 academic year. The research subjects in this study were teachers and students who were the targets of data collection. The data were obtained from a series of processes developing the *Karo* Cultural PAKIM learning model. The research subjects were randomly selected students and teachers of SMA Negeri 1 Kabanjahe and SMA N 1 Berastagi in *Karo* Regency.

The research procedure for developing the Karo Culture-based PAKIM learning model was found by modifying the Plomp model, namely following four of the five development steps of the Plomp model. These steps are preliminary investigation, design, realization/construction, test, evaluation and revision (Rahman et al., 2020). The preliminary investigation stage was carried out by observing the problems of learning mathematics in senior high schools (SMA) in *Karo* Regency. Then do an analysis of the theories learning models and knowledge about *Karo* culture to find solutions to the problems of learning mathematics in high schools throughout *Karo* Regency. The ICAP learning model was found in which the learning steps were in accordance with the activity steps at the *nganting manuk* traditional ceremony in *Karo* Culture.

The ICAP learning model based on previous research is able to overcome problems in learning mathematics. However, this model has drawbacks, namely when group work takes place the teacher has difficulty coordinating students so that group work is formed in an orderly, disciplined and trusting manner. The way to overcome this deficiency is to modify and add learning syntax that is integrated with the *nganting manuk* customary activities. So that a new learning model is formed that did not exist before. The modifications made were integrating the learning model with the concept of *nganting manuk*. The additions made were the Concluding stage which was not present at the ICAP learning model stage. The Concluding Stage is also the closing of the *nganting manuk* customary activities. So, with the Concluding stage, the name of the new learning model is the *Karo* Culture PAKIM Model.

The design phase is carried out by designing a learning model with its components, namely first designing a syntax in which the learning stages are synchronized with the stages of the *nganting manuk* customary activities, secondly designing a social system or learning environment where in this situation all activities, interactions and communication between teachers and students, students

and students norms that are in accordance with *Karo* culture are applied when carrying out the *nganting manuk* traditional ceremony, thirdly designing the principle of reaction, namely giving a picture to the teacher how to treat students who certainly have perception, imagination, attention and reasoning power then giving an idea of how the teacher should behave when responding to any behavior that shown by students during the learning process. Fourth, designing a support system, namely all facilities or conditions needed so that the designed learning model can be carried out properly and correctly, such as class arrangement, instructional systems, learning tools, learning facilities and infrastructure and learning media.

The realization/construction stage has already produced an initial script (prototype 1) of the *Karo* Culture-based PAKIM learning model as a concrete manifestation (realization) of the results of the model design. Then the syntax of the Karo Culture PAKIM learning model that has been designed is tested for validity and practicality using validity and practicality test instruments.

In the test, evaluation and revision phase, the model syntax was obtained which had been tested for the validity of the content and constructs as well as their practicality by experts. After obtaining a valid and practical model syntax, a small group test (only 1 class) was conducted to see its effectiveness. Effectiveness is seen from the completeness of student learning in small group trials. Then evaluate whether the syntax of the model has achieved learning mastery. If learning completeness has not been achieved, revisions are made to which parts have not been achieved. The entire series of development stages above are summarized in the following diagram:

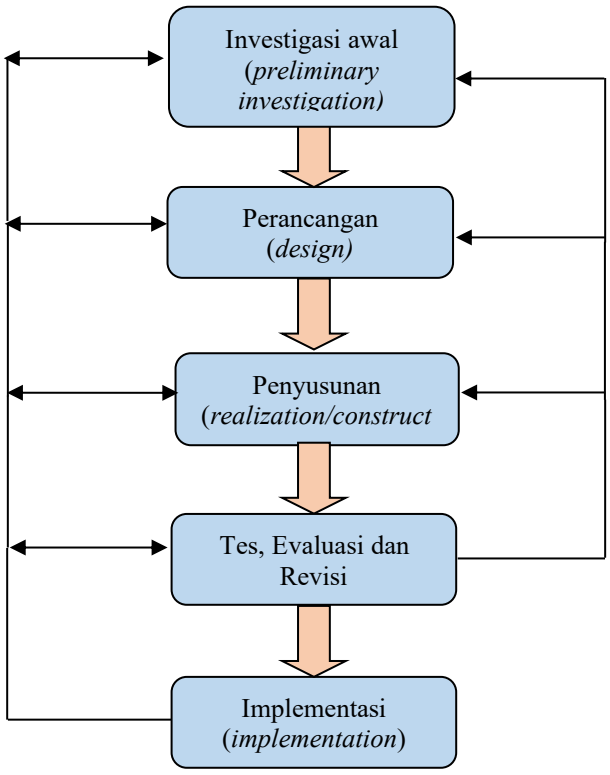

Figure 1. Plomp model research steps

Result and Discussion

Result of Research

The preliminary investigation of this research began with a study of field observations regarding mathematics learning problems that occurred in senior high schools in *Karo* Regency and observations of previous research results related to mathematics learning in *Karo* Regency. The data from the field observations were used as the basis for developing the PAKIM learning model. Second, a field pre-trial regarding *Karo* Culture *nganting manuk* which will be integrated into the syntax of the PAKIM learning model. The initial investigation conducted on mathematics learning was at SMA Negeri 1 Kabanjahe, namely a survey of student competencies in mathematics subjects and a survey of student responses. The results of the student competency analysis were that the mathematical communication skills of students at SMA Negeri 1 Kabanjahe were still low. There were observational data using student communication ability tests, only 38.9% of students obtained scores in the range of 75-100 or who achieved learning completeness or KKM at SMA Negeri 1 Kabanjahe. The results of the pre-survey on Teacher and Student responses through interviews and Google forms regarding mathematics learning, namely teachers had not optimally implemented varied learning models, especially those based on Culture.

The results of the PAKIM learning model design in the second stage of the Plomp model development steps, namely syntax, are the stages of activities carried out in learning according to a particular model. According to Joyce, Weil and Calhoun (2015), there are five general stages in a learning model, namely preparation, presentation, practice, reinforcement and evaluation. The PAKIM learning model based on *Karo* Culture that was found has its own uniqueness, namely consisting of passive, active, constructive, interactive and concluding stages.

The realization (drafting) or development stage is the activity carried out after the design is complete. In the third stage of the Plomp model, the initial script (prototype-1) of the PAKIM learning model is produced, with the syntax shown in the following image:

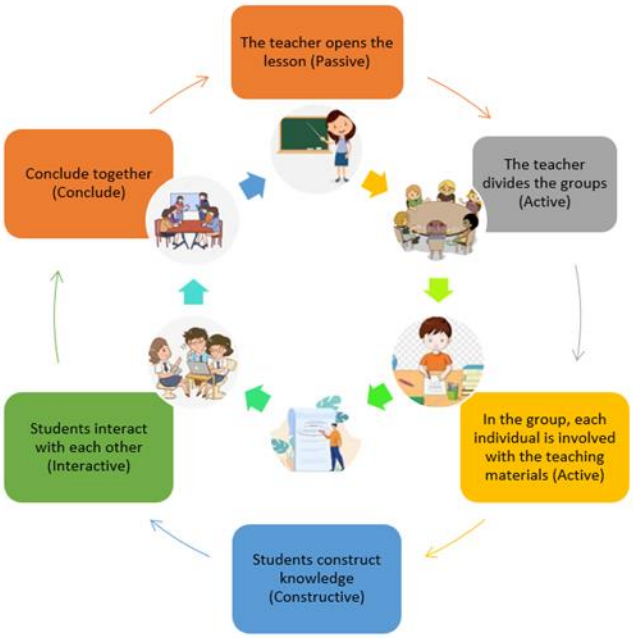

Figure 2. PAKIM Learning Model Syntax Design Results

The realization of the social system that occurs in the PAKIM learning model is the existence of social interaction between students in the same group in developing knowledge in an interactive mode and drawing conclusions. They discuss the knowledge they have built with each other with other group members based on interactions with learning media. The implementation of the principle of management reactions in learning using the PAKIM model demonstrates the role of the teacher as an instructor, motivator, mediator, and evaluator during the learning process. The teacher, as an instructor, provides direction to students regarding the rules of the learning system using the PAKIM model. The implementation of the PAKIM learning model support system is the components involved and required for the successful implementation of the PAKIM-BK learning model. Instructional and Supporting Impacts of the PAKIM Learning Model

The instructional impact of the PAKIM learning model is the improvement of students' mathematical communication skills through learning with the PAKIM model on SPLTV material. The supporting impact of the PAKIM learning model is that students have high cooperation and collaboration skills, discipline with time, good communication skills, and mutual respect. Through PAKIM learning, students develop an awareness of the *Karo* cultural norm *nganting manuk*, which states that all humans must respect one another. This ensures that traditional ceremonies can be carried out smoothly and achieve positive results.

In the Testing, Evaluation, and Revision phase, validation was conducted on prototype-1 of the PAKIM learning model. The purpose of this phase was to assess the quality of the implementation of the PAKIM learning model design. After this phase was completed, a decision was made based on careful consideration. This phase involved verifying the prototype-1 of the PAKIM learning model developed and the instruments. Validation was conducted with expert and practitioner considerations and analysis of the validation results. Field trials were then conducted.

Validation of the PAKIM learning model conducted by experts and practitioners is reviewed based on 1) Content, namely the assessment aspects monitored in the model rationale, supporting theory, development objectives, syntax, social systems, management reaction principles, support systems, instructional impacts and accompanying impacts, learning implementation, learning environment and management tasks, and evaluation. 2) Construct, namely the assessment aspects monitored in the model syntax starting from passive, active, constructive, interactive and concluding. The results of the analysis of the data obtained from the distribution of research instruments, namely the validation of the *Karo* Culture-based PAKIM learning model *nganting manuk* are presented in the table below. This validation was carried out by 5 experts in the field of mathematics education. The validation results obtained are:

Table 1. PAKIM Learning Model Content Validation Results

No	Rated aspect	Validator average
1	Rational Model	4
2	Supporting Theory	4
3	Development Goals	4.1
4	Syntax	4.17
5	Social System	4.12

6	Management Reaction Principle	4.07
7	Support System	4.08
8	Instructional Impact and Accompanying Impact	4
9	Implementation of Learning	4.12
10	Learning Environment and Management Tasks	4.03
11	Evaluation	4.1
	Total average	4.07

Source: Research data, 2025

Based on the results of the tabulation analysis of the five validators in Table 1, so if the average value of all aspects and all validators is 4.07, it is referred to the criteria for determining the level of validity of the content of the PAKIM learning model instrument format according to Retnawati (2016), then the content validity of the PAKIM learning model is valid. Because the average value (4.07) is in the range of $4 \leq Ip < 5$. Then the validity of the *Karo* Culture-based PAKIM model construct *nganting manuk* can be seen in the following table:

Table 2. Results of the Validation of the PAKIM Learning Model Construct

No	Rated aspect	Validator average
1	Passive	4.68
2	Active and Constructive	4.16
3	Interactive	4.36
4	Conclude	4.3
	Total average	4.4

Source: Research data, 2025

Referring to Table 2 above, the average construct validation score for the PAKIM learning model across all aspects and validators is 4.4. This average score is broken down into 4.68 for the passive mode, 4.16 for the active and constructive mode, 4.36 for the interactive mode, and 4.3 for the inferencing mode. Therefore, when referring to the validity assessment level, the construct validity of the PAKIM learning model is valid, as it falls within the range of $4 \leq 4.4 < 5$ (Retnawati, 2016).

The results of content and construct validation indicate that the *Karo* culture-based PAKIM learning model *nganting manuk* is valid. The validation results from experts and through improvements made by the researcher according to the validators' suggestions, it can be concluded that the PAKIM learning model meets validation standards. This means that the developed PAKIM learning model has a strong theoretical foundation in terms of both content and construction.

The following are the results of the practicality assessment of the PAKIM learning model. The assessment aspects consist of syntax with 3 sub-aspects, social systems with 7 sub-aspects, and management reaction principles with 6 sub-aspects. The assessments for all aspects by experts and practitioners can be seen in the following table:

Table 3. Results of Validation of the Practicality of the PAKIM Learning Model by Experts

No	Rated aspect	Validator average
1	Syntax	4
2	Social System	4.4
3	Management Reaction Principle	4.38
	Total average	4.26

Source: Research data, 2025

Based on the data in table 3 of the experts validation results for the practicality of the PAKIM learning model above, the average validation of all validators is 4.26, with details of the average value of all validators for the practicality of syntax being 4, for the practicality of the social system being 4.34 and for the practicality of the principle of management reaction being 4.38. So the overall average of the validators is 4.4 if referring to the criteria for determining the level of practicality of the learning model that has been determined is $4 \leq PA < 5$ then $4 \leq 4.26 < 5$ so that the PAKIM learning model has a high level of practicality. The results of the practicality of the PAKIM learning model assessed by observers during the field trial of the PAKIM learning model are summarized in the following table:

Table 4. Results of Practitioners Observations on the Practicality of the PAKIM Learning Model

No	Rated aspect	Validator average
1	Syntax	4.2
2	Social System	4.7
3	Management Reaction Principle	4
	Total average	4.3

Source: Research data, 2025

Based on the data summarized in Table 4, the average practitioner assessment for all assessment aspects was 4.3. Referring to the criteria for assessing the practicality of the learning model, this score falls into the high category. Because there was consistency between expert and practitioner assessments regarding the model's practicality or implementation, it fell into the high category. Therefore, it can be concluded that the *Karo* culture-based PAKIM learning model *nganting manuk* is practical and usable for use in learning.

The effectiveness of the PAKIM learning model in the trial was assessed from two aspects: learning completion and student response after the lesson. The results of the analysis of learning completion data of class X students of SMA Negeri 1 Kabanjahe on the material of Three Variable Linear Equation Systems (SPLTV) while using the PAKIM learning model can be seen in the chart below:

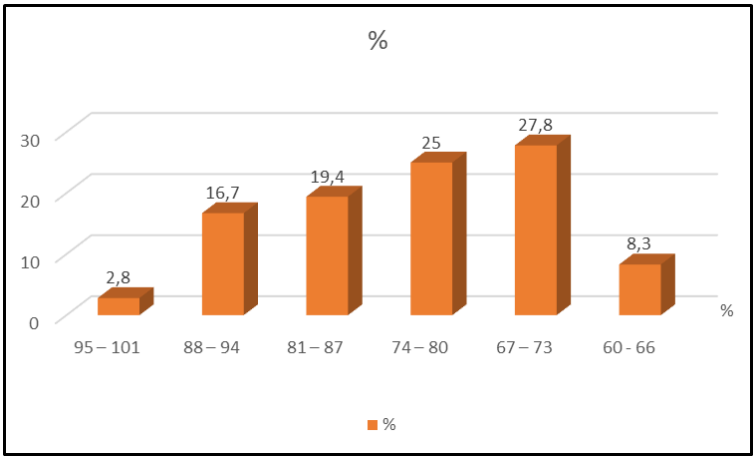

Figure 2. Results of data analysis of the PAKIM learning model
Source: Research data, 2025

According to Figure 3, graphically, the percentage of students who obtained or achieved the KKM score is much more or higher than those who did not achieve the KKM score. Details of student scores ≥ 70 are 2.8% (1 person) in the 95-101 interval, 16.7% (6 people) in the 88-94 interval, 19.4% (7 people) in the 81-87 interval, 25% (9 people) in the 74-80 interval and 22.22% (8 people) in the 67-73 interval. The total number is 31 people or 86.11% (≥ 80%) who achieved the minimum completion criteria in mathematics learning using the *Karo* culture-based PAKIM learning model *nganting manuk*. This means the model is effective in the mathematical communication ability test component. Then, descriptive statistics on the achievement of mathematical communication abilities are summarized in the following table:

Table 5. Descriptive Statistics of Mathematical Communication Ability Test Data

No	Rated aspect	Validator average
1	Syntax	4.2
2	Social System	4.7
3	Management Reaction Principle	4
	Total average	4.3

Source: Research data, 2025

According to table 5, the details of students' mathematical communication skills showed a better change between the pretest and posttest. This means that there was progress in the results of the mathematical communication ability test after being given the intervention of the *Karo* culture-based PAKIM learning model *nganting manuk* in learning. It can be seen that the minimum and maximum scores before and after the implementation of the learning model were 33 and 78 with 60 and 97. This means that there was an increase of 19 points in the maximum score between before and after the implementation of the learning model. Then there was also an increase in the average between the pretest and posttest, namely from 49.72 to 77.47. The

average posttest had reached the KKM score while the average pretest had not reached the KKM.

Discussion

Based on student responses to the implementation of the PAKIM learning model, 96.2% of students generally responded positively to the PAKIM model. 91.7% of students expressed interest in the learning material because it was taught using the PAKIM model. 34 students, or 96.6%, expressed interest in participating in the learning process because they enjoyed the very different classroom atmosphere. 35 students, or 97.2%, expressed interest in participating in future learning using the PAKIM model. Furthermore, 35 students, or 97.2%, expressed interest in participating in further learning using the PAKIM model. Furthermore, 97.2% of students stated that the learning activities they participated in helped them understand cultural values. The average percentage for all components was 96.2%, referring to the criteria for determining the student response rate, which requires a minimum of 80% of the subjects studied to respond positively to the learning components. Therefore, the student response rate in the response category is positive. This means that the *Karo* culture-based PAKIM learning model *nganting manuk* is effective for the student response component, or attractiveness. After analyzing the data in the trial, it was concluded that the PAKIM learning model was effective for both quality standards for measuring the effectiveness of the model, namely the mathematical communication ability test and student responses.

The difference between the PAKIM-BK learning model and other learning models is that the syntax of the PAKIM model is integrated with *Karo* culture, namely *nganting manuk*. This model directs students to role-play according to the steps of the *nganting manuk* traditional ceremony during class. Therefore, this new model integrated with *Karo* culture is the subject of new research. The PAKIM model's management reaction principle is unique in that it directs students in the *Anak Beru* group to receive assistance from the *Senina*, *Sembuyak*, and *Kalimbubu* groups. Then, in stages, students in the *Senina* group receive assistance from *Sembuyak* and *Kalimbubu* students. The *Sembuyak* group also receives assistance from the *Kalimbubu* group, and then the *Kalimbubu* group receives assistance from the teacher. Another unique feature of this model is the syntax of the conclusion process. There are three stages in the conclusion process: when students are with their peers, between groups, and between the entire group and the teacher.

The following is a summary of the three types of novelty based on this research that is Invention Novelty. Invention novelty in this study refers to the discovery of a new learning model that did not exist before. Second is, Improvement Novelty. Improvement novelty in this study relates to the refinement of the existing learning model, namely ICAP. The PAKIM-BK model was developed by refining discussion learning, which was previously hampered by a lack of trust and mutual respect among group members. Third is, Refutation Novelty. Refutation novelty emerged in this study as a rebuttal to Piaget's and Vygotsky's theories. The PAKIM learning model contains elements that bridge the gap between opposing constructivist learning theories. While Piaget, like Vygotsky, emphasized students' cognitive role in learning, Piaget focused more on individual cognitive development and the process of constructing knowledge through developmental stages (Flavell, 1963). Meanwhile, Vygotsky emphasized the role of social interaction and cultural

influences. The bridge to reconcile these two views is a comprehensive package of the PAKIM learning model. Although these stages occur in groups, students individually participate in the passive, active, and constructive stages, then collaborate in the interactive and conclusion stages. Therefore, this study found that the theory of student cognitive development emphasizes individual cognitive development as well as the role of social interaction and cultural influences.

The results of the analysis of all research instruments on the validity, practicality and effectiveness of the *Karo* Culture-Based PAKIM learning model *nganting manuk* show results that are in accordance with theories about learning. Understanding mathematics can be facilitated by applying culture-based learning or ethnomathematics. In line with this statement, Risdiyanti and Prahmana (2018) said culture and cultural values can bridge mathematics as learning in the classroom and in everyday life. In this study, it was found that the traditional *Karo* ceremony, namely *nganting manuk* inspired a learning model that could be applied in teaching mathematics in the classroom. This is because the style or steps of the *nganting manuk* traditional ceremony reflect an organized, structured, disciplined, respectful and mutual cooperation deliberation activity. These five indicators are needed in learning mathematics in class and can be used as an appropriate reference in understanding mathematics. This is supported by Muhtadi's research (2017) which says that culture can inspire mathematics learning. Then Alfiyani (2025) said that learning based on tradition or culture can improve students' conceptual understanding of the lesson.

Learning model is basically a form of learning that is illustrated from beginning to end specifically presented by the teacher. The learning model applied by the teacher can help students improve students' learning capabilities, sometimes slowly and sometimes drastically. Important thing is that learning can make a big difference in students. The learning model PAKIM based *Karo* culture is a role-playing learning model. This type of learning model is a learning model in which students practice a role (Joyce & Weil, 2015). This type of learning model has also been designed by Sunardi (2023) and the results are effectively used in classroom learning. This is also supported by other researchers, namely Puspitaningrum (2019), who found that the role-playing learning model was more effective in improving students' abilities.

One of the problems facing education in Indonesia is the weak learning process (Santoso & Herlina, 2020). The current learning process lacks encouragement for children to develop their thinking skills. This problem can now be addressed with the PAKIM learning model, which, in its implementation, strongly encourages students to be active, interactive, and constructive, as well as to draw conclusions during the learning process. These procedures are embodied in the traditional *nganting manuk* ceremony. This means that students are encouraged to take ownership of the learning process, particularly the active use of learning media or learning tools such as student books, interactive thinking in constructing ideas or knowledge, and mutual respect in group interactions, thereby building maximum knowledge in an efficient time. This is in accordance with Munafiah's and Khoirul (2023) statement which states that the role of the teacher is as a source of learning, as a guide, facilitator, manager, motivator and evaluator.

Another element that enhances the success of the PAKIM model is the students' ability to reconstruct and develop their knowledge through the learning patterns established by the PAKIM model. The PAKIM model provides clear instructions to students step by step and links them to the culture and experiences that have been

inherent in the students for a long time. This is supported by Abdu's (Abdu et al., 2021) statement that learning will be more easily understood by students if it is linked to their experiences or existing knowledge. This is also supported by Lin (2020); Hsieh (2020); and Tai (2020) who argue that what teachers provide will be more easily understood by students if the material presented is related to their daily lives.

The implementation of the PAKIM learning model uses the interaction pattern of Karo Culture so that the learning process facilitates students to share knowledge and information found, then help each other. Students are active in learning, students are disciplined in thinking independently utilizing the experience and knowledge they already have, then interact with each other to exchange ideas, ask each other. Each group understands their respective roles and duties, such as the *kalimbubu* will appreciate if other groups need help and ask them. The *anak beru* tau group asks for help from the *senina* group, if it is not solved, the *senina* group may recommend the *sembuyak* group, if it is not solved, it may also be recommended to the *kalimbubu* group. *Senina* can only ask for help from *sembuyak* or *kalimbubu*, and *sembuyak* can only ask for help from *kalimbubu*. And if everyone experiences a deadlock, the teacher is willing to help. This is in line with Li and Xue (2023) that when students work together in completing group assignments, they provide encouragement and assistance to their group mates who need help. Then the groups formed with peers will have a direct influence on students' understanding of mathematics (Arthur et al., 2022).

Conclusion

Based on the series of studies conducted on the development and discovery of the *Karo* Culture–based PAKIM learning model *nganting manuk*, it can be concluded that this learning model meets the aspects of validity, practicality, and effectiveness, making it feasible to be used as a reference for mathematics learning models. The development of this culturally grounded model not only offers a more contextual learning approach for students but also provides a solution to various persistent issues in mathematics learning, both nationally and particularly in *Karo* District.

Analysis results from the five validators show that the average score across all instrument aspects is 4.07, this score falls into the valid category. This indicates that the content of the PAKIM instrument is appropriate and can be used as an accurate measurement tool in the model development process. The construct validity results show an average score of 4.4, which also falls into the valid category ($4 \leq 4.4 < 5$). These findings confirm that the structure and components of the PAKIM model are logically and systematically arranged and aligned with the underlying learning theories. Regarding expert practicality validation, the PAKIM model obtained an average score of 4.26, categorized as practical ($4 \leq PA < 5$). Overall, experts view the model as easy to implement and applicable to real classroom settings. The practitioner assessments resulted in an average score of 4.3, indicating a high level of practicality. This shows that teachers, as the direct implementers, find the model clear, easy to use, and relevant to student learning needs. In terms of effectiveness, there was a significant increase in students' scores from the pretest to the posttest, namely from 49.72 to 77.47. The average posttest score exceeded the minimum mastery criterion (KKM), while the pretest score did not. This demonstrates that the PAKIM model effectively improves students' mathematical abilities.

Overall, the *Karo* Culture–based PAKIM learning model *nganting manuk* has been proven to be valid, practical, and effective, and it holds strong potential as an innovative learning model capable of addressing the challenges of mathematics education in Indonesia.

References

Abdu, R., van Helden, G., Alberto, R., & Bakker, A. (2021). Multimodal dialogue in small-group mathematics learning. *Learning, Culture and Social Interaction*, *29*, 100491. https://doi.org/10.1016/j.lcsi.2021.100491.

Alfiyani, N., Syawaludin, M., & Jumaidi, S. (2025). Pendekatan Pembelajaran Kontekstual Berbasis Tradisi Riyaya Unduh-Unduh sebagai Penguat Karakter Berkebinekaan Global. *Jurnal Humanitas: Katalisator Perubahan dan Inovator Pendidikan, 11*(3), 551–565. https://doi.org/10.29408/jhm.v11i3.30520.

Arthur, Y. D., Appiah, S. K., Asante, K. A., & Asare, B. (2022). Modeling student ' s interest in mathematics : Role of history of mathematics , peer- assisted learning , and student ' s perception. *EURASIA Journal of Mathematics, Science and Technology Education*, *18*(10). https://doi.org/10.29333/ejmste/12458.

Bina, N. S., Ramadhani, R., Sihotang, S. F., Nasution, R., Utama, P., Utara, S., Pembelajaran, M., & Matematis, K. (2022). *Pengaruh Model ICAP Terhadap Kemampuan Komunikasi Matematis*. *4*(2), 195–203. https://doi.org/10.37058/jarme.v4i2.4955.

Christianti, A., Ginting, B., Surya, E., Matematika, J. P., Lokal, K., & Wisdom, L. (2013). *Peranan Model Pembelajaran Problem Based Learning (PBL) Bebasis Kearifan Lokal Budaya Karo " Aron dan Runggu " Dalam Meningkatkan Keterampilan Berfikir Kritis*. https://www.researchgate.net/publication/351449571.

Hsieh, F. P., Chen, Y. A., Hung, J. F., & Tsai, C. Y. (2020). The effects of the trip model on students' science reading ability and marine conservation learning interest. *Journal of Baltic Science Education*, *19*(3), 374–387. https://doi.org/10.33225/jbse/20.19.374.

Huang, Y., Nong, J., & Lai, P. (2021). The Ethnomathematics of Chinese Tulou Building Architecture as Geometry Teaching Material in Elementary School. *Journal of Teaching and Learning in Elementary Education (Jtlee)*, *4*(2), 148. https://doi.org/10.33578/jtlee.v4i2.7881.

Joyce, B., & Weil, M. (2015). *Models of Teaching Fifth Edition*. Routledge. https://doi.org/10.4324/9781003455370.

Kim, H., & Chae, D. H. (2016). The development and application of a STEAM programbased on traditional Korean culture. *Eurasia Journal of Mathematics, Science and Technology Education*, *12*(7), 1925–1936. https://doi.org/10.12973/eurasia.2016.1539a.

Li, J., & Xue, E. (2023). Dynamic Interaction between Student Learning Behaviour and Learning Environment: Meta-Analysis of Student Engagement and Its Influencing Factors. *Behavioral Sciences*, *13*(1). https://doi.org/10.3390/bs13010059.

Lin, Y. R., Fan, B., & Xie, K. (2020). The influence of a web-based learning environment on low achievers' science argumentation. *Computers and Education*, *151*(July). https://doi.org/10.1016/j.compedu.2020.103860.

Muhtadi, D., Sukirwan, Warsito, & Prahmana, R. C. I. (2017). Sundanese ethnomathematics: Mathematical activities in estimating, measuring, and making patterns. *Journal on Mathematics Education*, *8*(2), 185–198. https://doi.org/10.22342/jme.8.2.4055.185-198.

Munafiah, M., & Khoirul, A. (2023). Peran Guru dalam Mengembangkan Sikap Sosial Melalui Pembelajaran IPS di MTS MIftahussalam 1 Wonosalam Demak. *Pendidikan Anak Usia Dini Undiksha*, *10*(1), 478–487. https://doi.org/10.15294/sosiolium.v5i1.63257.

Oktaviani, U., Kumawati, S., Apriliyani, M. N., Nugroho, H., & Susanti, E. (2020). Identifikasi Faktor Penyebab Rendahnya Hasil Belajar Matematika Peserta Didik di SMK Negeri 1 Tonjong. *Jurnal Riset Dan Inovasi Pendidikan Matematika (Math Locus)*, *1*(1), 1–6. https://doi.org/10.31002/mathlocus.v1i1.892.

Puspitaningrum, J. I., Untari, M. F. A., & Listyarini, I. (2019). Keefektifan Model Pembelajaran Role Playing Terhadap Kemampuan Berbicara. *Mimbar PGSD Undiksha*, *7*(3), 296–304. https://doi.org/10.23887/jlls.v2i1.17324.

Rahman, A. A., Nasryah, C. E., Kristanti, D., Darhim, & Fauzan, A. (2020). The feasibility of pbl-reathnomath model to train hots of elementary school students. *Advances in Mathematics: Scientific Journal*, *9*(11), 9887–9908. https://doi.org/10.37418/amsj.9.11.99.

Retnawati, H. (2016). *Analisis Kuantitatif Instrumen Penelitian*. Parama Publishing

Risdiyanti, I., & Prahmana, R. C. I. (2018). Ethnomathematics: Exploration in Javanese culture. *Journal of Physics: Conference Series*, *943*(1). https://doi.org/10.1088/1742-6596/943/1/012032.

Risdiyanti, I., & Prahmana, R. C. I. (2020). *Ethnomathematics (Teori dan Implementasinya: Suatu Pengantar)*. UAD Press.

Samara, D. (2016). Pengaruh Penerapan Model Pembelajaran Dan Motivasi Belajar Terhadap Hasil Belajar Siswa Pada Mata Pelajaran Ips Di Smp Negeri Model Terpadu Madani Palu. *Katalogis*, *4*(7), 205–214. https://media.neliti.com/media/publications/154749-ID-none.pdf.

Santoso, & Herlina, M. (2020). Pengaruh Pembelajaran Problem Based Instruction Terhadap Kemampuan Berpikir Kritis Mahasiswa Program Studi Pendidikan Biologi Fkip Umb. *Diklabio: Jurnal Pendidikan Dan Pembelajaran Biologi*, *4*(1), 65–70. https://doi.org/10.33369/diklabio.4.1.65-70.

Sitepu, S. E., & Ardoni, A. (2019). Informasi Budaya Suku Karo Sumatera Utara. *Ilmu Informasi Perpustakaan Dan Kearsipan*, *8*(1), 413. https://doi.org/10.24036/107314-0934.

Tai, K. W. H., & Wei, L. (2020). Bringing the outside in: Connecting students' out-of-school knowledge and experience through translanguaging in Hong Kong English Medium Instruction mathematics classes. *Elsevier*, *95*, 1–51. https://doi.org/10.1016/j.system.2020.102364.

Wijaya, A., Retnawati, H., Setyaningrum, W., & Sugiman. (2019). Diagnosing Students ' Learning Difficulties in the Eyes of Indonesian Mathematics Teachers. *Journal on Mathematics Education*, *10*(3), 357–364. https://jme.ejournal.unsri.ac.id/index.php/jme/article/view/3799/312.