

Development of Guided Inquiry Learning Model Based on Educational Games to Improve Elementary Students' Science Process Skills

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Abstrak

Penelitian ini bertujuan untuk menghasilkan model pembelajaran Inkuiri Terbimbing Berbasis Game Edukasi yang dikemas dalam bentuk buku, didukung oleh game edukasi yang dapat diakses melalui platform Canva dan Wordwall. Model ini dirancang agar valid, praktis, dan efektif dalam meningkatkan keterampilan proses sains siswa di sekolah dasar. Jenis penelitian yang digunakan adalah Research and Development (R&D), dengan prosedur pengembangan model pembelajaran yang mengadaptasi model Plomp, yang terdiri dari tahap investigasi awal, perancangan, realisasi, pengujian, evaluasi dan revisi, serta implementasi. Subjek penelitian ini adalah siswa kelas V di UPT SD Negeri 214, UPT SD Negeri 99, dan UPT SD Negeri 101 Kabupaten Pinrang. Instrumen penelitian yang digunakan meliputi lembar validasi, lembar observasi, angket, dan lembar evaluasi. Penelitian ini menghasilkan produk berupa buku teks Inkuiri Berbasis Game Edukasi (IGE) dan perangkat pembelajaran yang mencakup RPP, LKPD, dan game edukasi. Hasil penelitian menunjukkan bahwa guru dan siswa sangat membutuhkan model pembelajaran yang dapat meningkatkan keterampilan proses sains dalam pembelajaran IPA. Pengembangan model pembelajaran inkuiri terbimbing berbasis game edukasi ini menghasilkan model IGE yang terdiri dari komponen sintaks, sistem sosial, prinsip reaksi, sistem pendukung, dampak instruksional, dan pengiring. Sintaks model IGE mencakup fase Activation, Playing, Exploring, dan Wrap-Up. Model IGE memenuhi kriteria validitas dan kepraktisan berdasarkan penilaian validator dan dikategorikan sangat valid. Model ini juga efektif dalam meningkatkan keterampilan proses sains siswa, terbukti dari adanya perbedaan kemampuan siswa sebelum dan setelah menggunakan model pembelajaran ini. Berdasarkan hasil analisis, model IGE dan perangkat pembelajarannya berada dalam kategori sangat praktis berdasarkan respon siswa dan guru.

Kata kunci: *Pengembangan Model Pembelajaran, Inkuiri Terbimbing, Game Edukasi, Keterampilan Sains, Sekolah dasar*

Abstract

This research aims to develop a Guided Inquiry Learning Model Based on Educational Games, presented in a book format and supported by educational games accessible via Canva and Wordwall platforms. The model is designed to be valid, practical, and effective in enhancing elementary school students' science process skills. This study uses a Research and Development (R&D) approach, adapting the Plomp model's development stages: initial investigation, design, realization, testing, evaluation, revision, and implementation. The subjects are fifth-grade students from UPT SD Negeri 214, UPT SD Negeri 99, and UPT SD Negeri 101 in Pinrang Regency. Research instruments include validation sheets, observation sheets, questionnaires, and evaluation sheets. The study produces an Inquiry-Based Educational Game (IGE) textbook and learning tools, such as lesson plans (RPP), student worksheets (LKPD), and educational games. The findings reveal a strong need among teachers and students for a learning model that enhances science process skills. The developed IGE model comprises syntax, social system, reaction principles, support system, instructional impact, and accompanying impact. The syntax includes Activation, Playing, Exploring, and Wrap-Up phases. The IGE model meets the criteria for validity and practicality, receiving high validation ratings. The model effectively enhances students' science process skills, as shown by significant improvements in student performance. The IGE model and its learning tools are deemed highly practical, based on feedback from students and teachers.

Keywords: *Science process skills, guided inquiry, educational games, science, elementary school.*

INTRODUCTION

The continuous transformation in the field of education aligns with the demands of the disruptive era 4.0. The digital age challenges education to innovate to achieve the national education vision, realizing education as a strong and authoritative social institution that produces high-quality Indonesian citizens amidst changing times, as outlined in Law No. 20 of 2003. The skills and competencies required in the 21st century and the industrial era 4.0 must be integrated into educational elements, from learning systems, educational units, students, to educators and educational staff (Muhammad, 2018). This aligns with the goals of the current Indonesian education curriculum, namely the 2013 Curriculum, as stated in the Ministry of Education and Culture Regulation No. 67 of 2013 on the Basic Framework and Structure of the Curriculum for Elementary Schools/Madrasah Ibtidaiyah (SD/MI). The 2013 Curriculum aims to prepare Indonesians to live as individuals and citizens who are faithful, productive, creative, innovative, and effective, and who can contribute to community, national, and global civilization.

The 2013 Curriculum is expected to bring changes to education in Indonesia. Haspen, Syafriani, and Ramli (2021) stated that the learning applied in the 2013 Curriculum

is learning that can develop knowledge, skills, and attitudes using a scientific approach. Yahya (2023) suggested that learning has various dimensions and aspects and emphasizes learning experiences, not just acquiring knowledge, but involving emotional, social, cognitive, and physical aspects. The characteristics of learning at the elementary school level are conducted with integrated thematic learning (thematic across subjects). This is done to focus attention on certain themes and to learn knowledge and develop basic competencies across subjects within the same theme.

21st-century skills are the main focus of current education, especially in science education (Kadaritna, Rosidin, and Widyastuti, 2020). Science learning at the elementary school level emphasizes the interaction between students and their environment. Important topics related to students' surroundings need to be introduced by teachers in all elementary school classes. In this effort, the approach used includes introduction, observation, and simple experiments on natural phenomena. To assist the learning process, technology and real objects can be used as aids to observe the objects being studied (Lu, Liu, Chen, and Hsieh, 2020).

Data from the Programme for International Student Assessment (PISA) indicate that Indonesia's science assessment results have been unsatisfactory. In 2006, the science score was 393, ranking 50th out of 56 countries. In 2009, the science score was 383, ranking 60th out of 65 countries. In 2012, the science score was 375, ranking 64th out of 65 countries. In 2015, the science score was 403, ranking 62nd out of 69 countries. In 2018, the science score was 396, ranking 71st out of 79 countries. In 2022, the science score was 359, a decrease of 12 points from 2018. These results show that Indonesia has not yet reached the international average score of 500 and is in the bottom 10 positions (Schleicher, 2019; Medcom, 2024).

Susilowati (2019) stated that the low science process skills of elementary school students are due to the lack of interactive and innovative teaching methods. Using project-based and technology-based learning methods can significantly improve students' science process skills. This is also supported by Mahmuda et al. (2019), who stated that integrating technology into learning can enhance elementary students' observation, classification, and conclusion-drawing skills. Priyani & Nawawi (2020) emphasized that the low science process skills can be addressed by using attractive and technologically appropriate digital learning media. Saman & Hasan (2023) showed that developing science process skills is crucial because it forms the foundation for a deeper understanding of science concepts in subsequent education levels.

The same problem occurs in elementary schools in Pinrang district. Preliminary studies through observations and written tests on 21 fifth-grade students at UPT SDN 214 Kab. Pinrang revealed that students' science process skills are low. The test on March 9, 2023, covering the topic of the food chain, showed that students' science process skills percentages were: 42.85% in observation (low category), 41.26% in classification (low category), 57.14% in measurement (moderate category), 57.14% in communication (moderate category), 41.26% in prediction (low category), and 40.47% in conclusion (low

category). The average score of students' science process skills was 45.71, categorized as low and below the Minimum Mastery Criterion of 75. The observed science process skills during the learning process were observation, communication, and conclusion. Data from interviews and observations also supported the information on teachers' perceptions of students' science process skills. The teacher perception survey showed that only 16.66% measure students' science process skills during learning, almost all teachers do not fully understand the indicators and measurement of science process skills, and only 33.33% develop science process skills through innovative learning models.

The inquiry-based learning model in the Indonesian education system can be traced from various educational policies implemented. Law No. 20 of 2003 on the national education system formulates the national education goals as efforts to develop abilities and shape the dignified character and civilization of the nation in order to educate the life of the nation (DEPDIKNAS, 2003). The aim is for students to develop into individuals who are faithful and pious to God Almighty, have noble character, are healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens.

Furthermore, the Ministry of Education and Culture Regulation No. 81A on Curriculum Implementation emphasizes that students must have the competence to think intelligently (Kemendikbud, 2013). Therefore, analytical thinking and argumentative skills need to be instilled from an early age to prepare them to solve various problems they face. The Ministry of Education and Culture Regulation No. 103 of 2014 reinforces that the inquiry learning model is one of the main references in implementing the 2013 Curriculum. This model aims to shape students' attitudes, knowledge, and skills by encouraging their active involvement in the learning process through investigation and discovery.

Additionally, the Minister of Education, Culture, Research, and Technology's Decree No. 56/M/2022 on Guidelines for Curriculum Implementation in the Context of Learning Recovery introduces the implementation of the Independent Curriculum starting in the 2022/2023 academic year. This curriculum emphasizes developing students' character and scientific attitudes, such as curiosity, perseverance, cooperation, and critical thinking (Mendikbudristek, 2022). The inquiry model fits well with this approach, as through direct experience in investigating natural phenomena, students can develop these scientific attitudes and character traits. These policies provide a solid foundation. Using educational games in the guided inquiry model can increase interactivity and student engagement in the learning process. With adequate facilities such as WiFi, laptops, and computers available in schools, the use of educational games can be optimized. Interactive educational games like Wordwall can attract students' attention and increase their interest and motivation to learn. Through this approach, students not only learn scientific concepts in depth but also develop critical and analytical thinking skills, in line with the goals of the curriculum and national education policies.

A study by Susila, Wiarta, and Agustika (2021) showed that the guided inquiry learning model assisted by educational games positively affects learning outcomes. Additionally, research by Devi, Aisyah, and Wijayanti (2022) showed that using educational

games as chemistry learning media based on guided inquiry effectively enhances students' science process skills. These studies demonstrate the potential of educational games as attractive and effective learning media in developing students' science process skills in chemistry subjects.

From these studies, it can be concluded that the application of educational games is effective in improving students' science process skills in elementary schools. In this context, educational games can be an effective tool to enhance students' science process skills. Educational games can make learning more interesting and enjoyable for students, helping them learn in a more interactive and practical way. Well-designed educational games can stimulate students' curiosity, help them solve problems, and develop critical and creative thinking skills.

Based on the rationale and the low science process skills and science learning outcomes of elementary school students, it is deemed important to conduct research titled "Development of Guided Inquiry Learning Model Based on Educational Games to Improve Elementary Students' Science Process Skills."

METHODS

This research employs a development research method, commonly known as Research & Development (R&D). The R&D method is used to produce specific products and test the effectiveness of these products (Sugiyono, 2019). This study does not reconstruct new theories but generates a product in the form of a learning model that is valid, reliable, effective, and practical through field trials. The research and development in this study refer to the Plomp model, which consists of five phases: a) Phase 1: Preliminary Investigation, b) Phase 2: Design, c) Phase 3: Realization/Construction, d) Phase 4: Test, Evaluation, and Revision, and e) Phase 5: Implementation (Plomp, 2007).

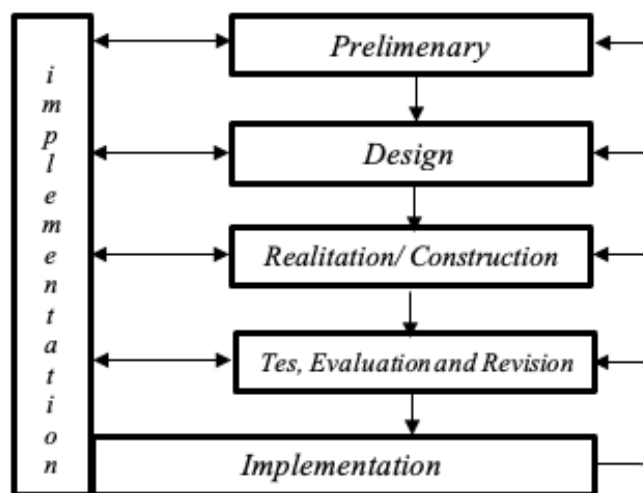


Figure 1 Plomp Development Model

The subjects of this study are three elementary schools in Pinrang Regency for limited trials and field trials, including classroom teachers. The elementary schools selected for this research include fifth-grade students and their respective homeroom teachers from three chosen schools: UPT SD Negeri 214 Pinrang, UPT SD Negeri 99 Suppa, and UPT SD Negeri 101 Pinrang. The instruments used to collect data in this development research are validation sheets, observation sheets, teacher and student response questionnaires, and evaluation sheets. The data collection techniques used include science process skills tests, observations, questionnaires, and field notes.

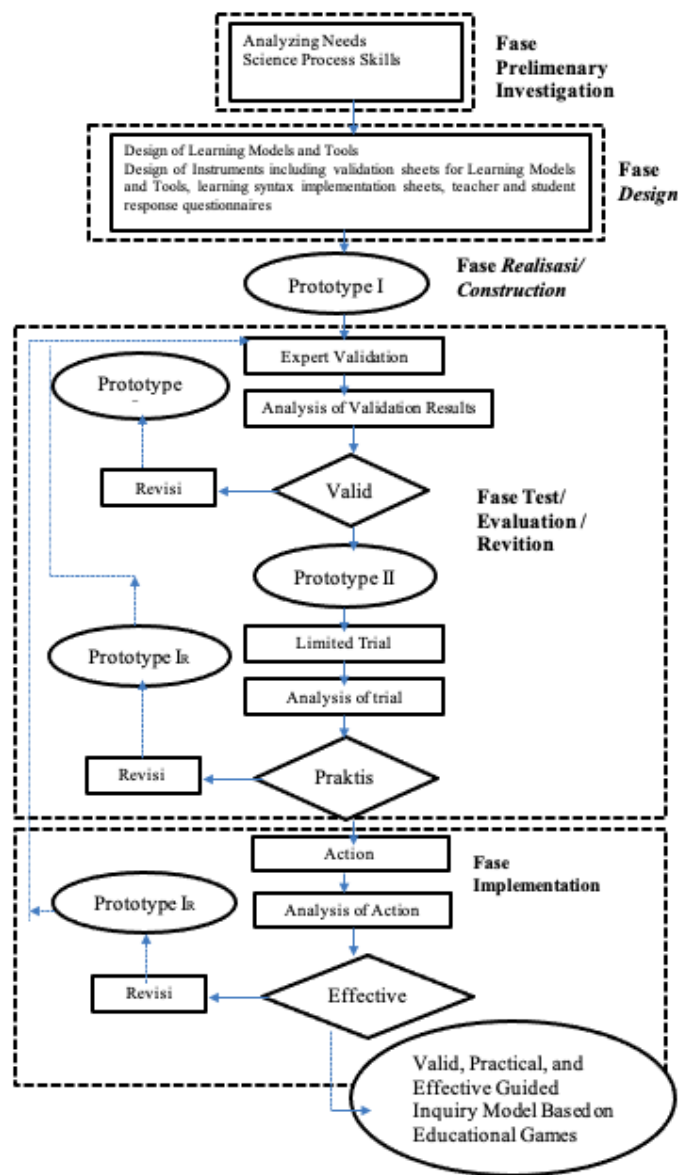


Figure 2 Development Process for a Guided Inquiry Model Based on Educational Games

RESULTS AND DISCUSSION

The results obtained at each phase related to the process of developing the model are outlined below:

Phase-1: Initial Investigation

In this phase, the researcher aimed to address the first research question, which was the description of the needs for a guided inquiry model based on educational games. The initial activities involved analyzing the existing curriculum in elementary schools and its relation to science subjects. The 2013 Curriculum integrates three science subjects—Physics, Biology, and Chemistry—into one subject known as science, to enhance students' understanding of the interrelationships between different scientific fields and to promote scientific thinking.

Based on questionnaires and interviews with teachers, it was found that few respondents used guided inquiry models and educational games in classroom instruction. Interviews revealed that current teaching methods were predominantly direct instruction in line with the teacher's book of the 2013 Curriculum. Some challenges encountered included students' low confidence in asking and answering questions, which was attributed to their lack of preparedness before the learning process. This affected students' ability to communicate and argue systematically in class discussions, which were based on weak scientific theories and concepts. Furthermore, students found it difficult to present and compile reports of scientific investigations and were less trained in engaging in argumentative class production and interactive discussions. This resulted in students' scientific process skills being at varying levels: observing (49.26%, sufficient), classifying (24.44%, poor), measuring (59.44%, sufficient), communicating (60%, sufficient), concluding (26.11%, poor), and predicting (37.04%, poor). The average score for students' scientific process skills was 41.56, categorized as low and below the Minimum Mastery Criteria of 75. Additionally, teaching methods in science included lectures (50%), discussions (20%), question-and-answer (20%), demonstrations (5%), assignments (15%), experiments (10%), and others (20%). According to the questionnaire results, about 60% of students were unfamiliar with the Inquiry Learning model, and 80% had never been taught using educational game media.

Phase-2: Design

The components of the guided inquiry learning model based on educational games consist of syntax, social system, reaction principle, support system, instructional impact, and accompanying impact. The phases in this model combine guided inquiry phases with educational games. Below is the design prototype of the guided inquiry model based on educational games:

a. Design of the Guided Inquiry Model Based on Educational Games (IGE) The IGE model is a development from the guided inquiry model integrated with educational game media. This was developed due to the advantages of the guided inquiry model in science

learning, with the help of educational games expected to improve students' scientific process skills.

b. Design of Learning Devices

1.Lesson Plan (RPP): The researcher developed learning devices based on the 2013 Curriculum guidelines, first determining the Core Competencies (KI) and Basic Competencies (KD) in the lesson plan and defining the indicators to be achieved in the student activity sheets (LKPD) during the learning process.

2.Educational Game Media and Student Activity Sheets (LKPD): The educational game media and LKPD developed contain contextual problems related to the students' environment. These problems are designed to help students connect the concepts being learned with their environment and are solved in groups. The educational game media and LKPD provide activities for students to work on in groups to discover the concepts being studied, aligned with the phases of the guided inquiry model based on educational games (IGE). The three main contents of the educational games are designing investigations/experiments, virtual labs, and building new knowledge.

Phase-3: Implementation

The activities in this phase are the realization of the model designed in phase-2, consisting of the realization of (a) learning syntax; (b) social system; (c) reaction principle; (d) support system; (e) instructional impact.

a. Learning Syntax The phases in the revised guided inquiry learning model based on educational games consist of four phases: Activation, Playing, Exploring, and Wrap-up.

1.Activation Phase: This phase prepares students by formulating problems related to the material and creating hypotheses. It provides students time to think and incubate their thoughts, based on Thorndike's connectionism learning theory.

2.Playing Phase: This phase modifies guided inquiry and educational games. Students are directed to design experiments, conduct investigations, and build new knowledge virtually through educational games using applications like Canva and Wordwall.

3.Exploring Phase: In this phase, students carry out experiments designed in the Playing Phase, verify problem statements based on observed phenomena, and construct new knowledge through interactive game-based questions.

4.Wrap-up Phase: This phase summarizes key points and actions taken during the learning session, reviews what has been done, makes conclusions, and plans future steps.

b. Social System The social system describes the roles of students, the interaction between teachers and students, and the expected targets. The guided inquiry learning model based on educational games focuses on students' scientific activities, providing opportunities for students to construct knowledge and understanding through scientific activities, collaboration with peers, and interactive discussions. Teachers act as facilitators and guides, monitoring and managing the learning activities to ensure smooth implementation.

c. Reaction Principle The IGE learning model emphasizes student activity, with the teacher in a consultative role and decisions made by students. Teachers frequently provide opportunities and assistance for students to ask questions and construct knowledge, responding to diverse learning abilities and providing immediate feedback.

d. Support System The support system includes additional requirements for the learning model beyond skills, such as learning devices and resources, and non-physical conditions necessary for implementing the IGE model. Physical requirements include lesson plans, LKPD, educational game media, and assessment instruments, while non-physical requirements include students' readiness to learn, teachers' ability to manage learning, effective communication between teachers and students, and conducive learning conditions.

e. Instructional and Accompanying Impacts Instructional impacts of using the guided inquiry learning model based on educational games in science learning include mastery of learning materials with the achievement of core competencies and basic competencies planned in the lesson plan, thereby improving students' scientific process skills. Accompanying impacts include increased student motivation and activity in learning, independence in learning, social skills such as responsibility, honesty, cooperation, respect for others' opinions, and the ability to apply scientific process skills through practical investigations.

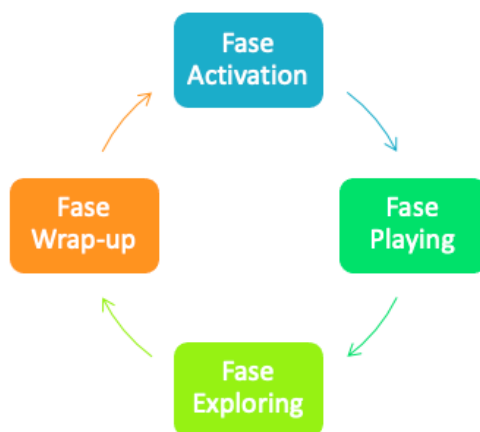


Figure 3 The phases in the IGE model

Phase-4: Testing, Evaluation, and Revision

Activities in this phase focus on two aspects: assessing the validity of teaching materials through small group trials and evaluating the practicality of the model using teacher and student response questionnaires and observation of the implementation of the learning syntax.

a. Validation of the Model and Learning Devices During the validation stage, the product is reviewed by two expert reviewers and one practitioner. The purpose of this stage is to produce a usable IGE model book and learning devices. Through the validation process, validators provide suggestions for improving the Teacher Response Questionnaire, resulting in revisions to the product. The recapitulation of the validation scores for the learning model and the average validation scores for the learning devices are presented in Figure 4.

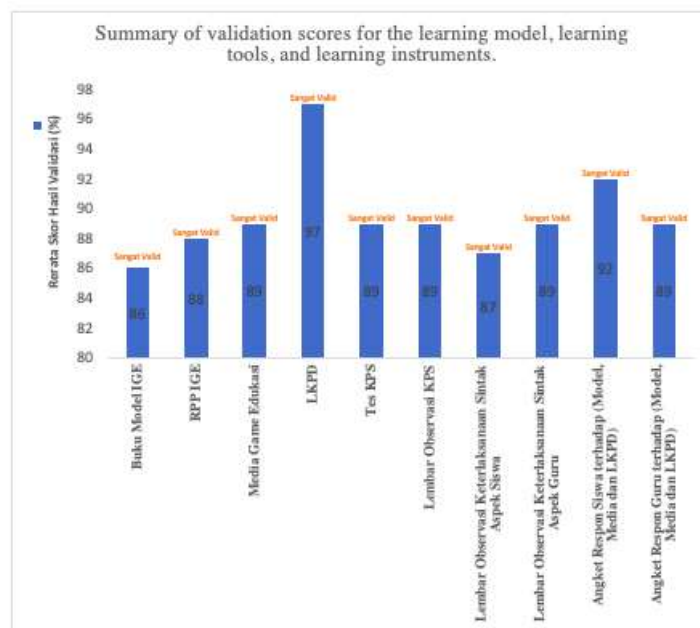


Figure 4 Recapitulation Chart of Validation Scores for the Learning Model, Learning Devices, and Learning Instruments

The validity of the model can be assessed based on two criteria: (a) the developed model is based on a strong theoretical foundation; (b) the model has internal consistency. Based on the expert and empirical validation results, the model and learning tools have met the validity criteria. The expert assessment for the IGE learning model falls within the valid category. Similarly, the evaluation of the learning tools and research instruments also falls within the valid category. The LKPD and Educational Game Media developed are aligned with the learning demands as they are structured based on the learning model established in the lesson plans. Empirical validation results and test reliability of the research variables indicate that the test instruments are valid, have very high reliability, possess moderate difficulty levels, and have good discrimination indices.

b. Practicality of the IGE Model and Tools After the validation process, the researcher revised the model according to the feedback provided by each validator. Subsequently, a limited trial was conducted on the Guided Inquiry-based Educational Game learning model, named the IGE learning model. This trial aimed to determine the model's practicality. Table 1 Recapitulation of the Implementation of Learning Syntax in the Teacher Aspect

Table 1 Recapitulation of Teacher Response Questionnaire Results

No	Usage Response	Average Score (%)	Category
1	IGE Model	92	Very Practical
2	Educational Game Media	92	Very Practical
3	LKPD	87	Very Practical

At the end of the fourth meeting, the author distributed questionnaires aimed at understanding the students' responses to the IGE model, educational game, and LKPD used, as well as assessing the practicality of the model and tools developed by the researcher. The recapitulation of the students' questionnaire responses is presented in the table below.

Table 2 Recapitulation of Students' Response Questionnaire Results

No	Response	Average Score (%)	Category
1	IGE Model	84	Very Practical
2	Educational Game Media	89	Very Practical
3	LKPD	84	Very Practical

The research results indicate that the developed IGE learning model was implemented well. This can be seen from the observation results of the learning syntax consistency conducted by observers. The observations showed that the IGE learning syntax was implemented consistently. The practicality results of the IGE model indicate that the learning stages, social system, and reaction principles were well executed. Additionally, the practicality aspect can also be seen from the students' and teachers' responses to the IGE learning model.

The recapitulation results of students' responses to the IGE learning model showed positive responses. From the students' response data, it was found that the IGE learning model was attractive and enjoyable, easy to follow in learning, encouraged independent learning, increased learning motivation, and provided interesting and entertaining learning experiences, thus motivating students to actively engage in science learning. The developed learning tools also received very positive responses from students. Therefore, the model and learning tools produced meet the practicality criteria.

Phase 5: Implementation

This phase focuses on analyzing the effectiveness of the developed model and tools. To assess the effectiveness of the developed model and learning tools, a T-test was used.

Prior to the T-test, prerequisite tests, namely normality and homogeneity tests, were conducted.

The normality test calculation results are as follows.

Table 4 Normality Test Analysis Results

	Statistic	Df	Sig	Statistik	df	Sig
<i>pretest</i>	0,107	60	0,084	0,968	60	0,110
<i>post-test</i>	0,110	60	0,067	0,951	60	0,018

Source: Researcher's Data Processing

The homogeneity test calculation results in the research can be seen in Table 5

Table 5 Homogeneity Test Analysis Results

Levene Statistic	df1	df2	Sig.
1,376	1	118	0,243

Source: Researcher's Data Processing

The N-gain test analysis results are presented below.

Table 6 N-Gain Test Results

N	Minimum	Maksimum	Mean	Std. Deviation
60	0,00	1,00	0,5009	0,24680

Based on Table 6, the N-gain test results show that the average (mean) score before and after using the IGE model is 0.5009. This indicates a change or improvement before and after applying the IGE model in learning. A learning model is considered effective if the N-gain score obtained is > 0.3 or at least in the medium category (Dewi et al., 2022). Based on the N-gain score results, it can be concluded that the IGE model is effective in improving students' scientific process skills (KPS).

The T-test was used to assess the effectiveness of the IGE model in improving students' KPS.

Hypothesis to be Tested:

- H_0 : P-Value ≥ 0.05 , there is no significant difference in students' scientific process skills.
- H_a : P-Value < 0.05 , there is a significant difference in students' scientific process skills.

Testing Criteria:

- Accept H_0 if P-Value ≥ 0.05 ; reject H_0 if P-Value < 0.05 .

The data analysis results using the T-test showed a t-value = 4.627 and a p-value = 0.000, so the p-value $0.000 < 0.05$, thus H_0 is rejected and H_a is accepted. Based on these results, it can be interpreted that there is a significant difference in students' KPS between the pretest and posttest. This indicates a significant effect of the treatment given, or it can be interpreted that there is a significant difference in students' KPS before and after using the IGE learning model. Based on the data analysis results, it can be concluded that H_0 is

rejected and H_a is accepted. This shows that the IGE model effectively improves students' KPS in the heat transfer material.

The IGE model is a development of the inquiry model aimed at building and developing scientific thinking skills in the teaching process. This approach emphasizes active student participation, allowing them to learn independently in problem-solving. In the context of "inquiry," the teacher's role is more as a learning guide and facilitator, who determines the problems to be solved by students. The teacher's main responsibility is to choose interesting problems for students to solve independently. The teacher is also responsible for providing the necessary learning resources for students to solve these problems. Although teacher guidance and supervision remain important, direct teacher intervention in students' activities in solving problems should be minimized (Sudjana, 2000). This approach provides space for students to develop critical and creative thinking skills independently.

One of the phases in IGE, the activation phase, aims to develop students' abilities to explain and solve problems through the process of questioning and hypothesis-making, thus training scientific process skills. This aligns with Bundu (2006), where one of the objectives of science learning in elementary school is for students to have the ability to develop knowledge, ideas, and apply the concepts obtained to explain and solve problems encountered in daily life.

The investigation design, inquiry, and new knowledge construction are designed to be as interesting as possible through the game features in the IGE model. The game itself is designed using the Wordwall application, making it easy for teachers to apply. The game design is adjusted to the material with the help of the Canva application. These two supporting applications are very easy to use, so the product in the form of educational games in the IGE model can be used and structured according to the learning material.

This learning model aims to involve students more in the inquiry process and introduce scientific procedures directly. The IGE model has proven effective in improving students' KPS. This can be seen from the T-test and N-gain test results. The use of the IGE model in science learning has been proven effective in improving students' KPS. This is evidenced by the average KPS scores being higher after using the IGE model than before using the IGE model. The findings show that students are enthusiastic about the learning process through educational games. This aligns with McPherson (2023) who argue that every individual needs to be motivated to conduct inquiry to realize the importance of the inquiry process and scientific procedures.

The guided inquiry-based educational game model has proven effective in improving elementary school students' KPS. This research shows that using educational games in science learning can improve students' KPS. Well-designed educational games can increase student engagement and motivation to learn. Game elements such as challenges, rewards, and active interaction can make the learning process more interesting and enjoyable. The IGE model helps students develop scientific process skills gradually. With teacher guidance, students can focus more on developing skills such as observing, classifying, measuring, making inferences, and predicting. Studies show that students who learn through the guided

inquiry-based game approach have significant learning outcome improvements before and after using the model. This is because the learning model allows students to explore and discover concepts independently with directed guidance.

This model aligns with constructivism theory, emphasizing that students construct their own knowledge through active learning experiences. In the activation phase, students face real problems that must be solved, encouraging them to think critically and analytically. The elements in educational games in the playing and exploring phases are designed to support students' cognitive processes. This allows students to learn through direct experience and reflection on their actions in the game. Research by Byun & Joung (2018) shows that digital educational games can improve K-12 students' mathematics performance, while Riopel et al. (2019) found that digital educational games positively impact science learning. Tsai & Tsai (2020) argue that effective game design in educational games can support science learning, and Yu et al. (2022) show that augmented reality in STEM education through digital game-based learning can enhance students' learning experiences.

By applying the IGE model, elementary school students' scientific process skills can significantly improve, creating a more interactive and effective learning experience.

CONCLUSION

The needs analysis results show that teachers and students highly need a learning model that can improve scientific process skills in science learning. The development results of the guided inquiry-based educational game learning model resulted in the IGE learning model. The IGE model components consist of syntax, social system, reaction principles, support system, instructional and accompanying impacts. The IGE model syntax consists of the Activation, Playing, Exploring, and Wrap-Up phases. The IGE model meets the validity and practicality criteria based on validator assessments and is in the very valid category. Thus, the IGE model can improve students' scientific process skills. Furthermore, the model and learning tools are in the very practical category based on students' and teachers' responses. The IGE learning model is effective in improving students' scientific process skills. Based on the analysis conducted, there is a difference in students' abilities before and after using the learning model. IGE, which means that the developed learning model is effective in improving students' scientific process skills.

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