

DIGITAL-VISUAL DISCOVERY LEARNING IN PRIMARY MATHEMATICS: IMPLICATIONS FOR TEACHING ENGLISH TO YOUNG LEARNERS

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ABSTRACT

Digital-visual media and discovery-oriented learning can create active and multimodal classroom experiences that are potentially relevant across subject areas, including Teaching English to Young Learners (TEYL). This Classroom Action Research investigated the implementation of Discovery Learning assisted by digital-visual media with 26 fourth-grade students at SD Negeri 5 Tikala during the 2025/2026 academic year. The intervention was conducted in primary mathematics and consisted of two cycles, each involving three meetings. Data were collected through teacher and student activity observations, a learning-interest questionnaire, and classroom documentation. The findings showed a clear improvement across cycles. Learning-interest mastery increased from 69.2% in Cycle I to 84.6% in Cycle II, student activity rose from 64.3% to 92.9%, and teacher activity increased from 70.3% to 95.3%. These results indicate that the combination of guided discovery and digital-visual support was associated with stronger engagement and interest in the observed primary classroom. Because the intervention was conducted in mathematics, the study does not provide direct evidence of English-language gains. Instead, it discusses transferable pedagogical implications for TEYL, particularly the use of visual scaffolding, guided noticing, collaborative exploration, vocabulary support, and multimodal input. Future classroom action research should test these principles directly in young learners' English vocabulary, reading, listening, and speaking lessons.

Keywords: Discovery Learning, digital-visual media, Teaching English to Young Learners, learner engagement, classroom action research

INTRODUCTION

Digital technologies have expanded the range of visual, auditory, and interactive resources available to primary-school teachers. For young learners, multimodal input can make classroom tasks more concrete, sustain attention, and support meaning-making when verbal explanations alone are insufficient. This is especially relevant to Teaching English to Young Learners (TEYL), where vocabulary, reading, listening, and classroom interaction often benefit from pictures, animation, audio, and contextualized digital materials. Recent work in elementary language education shows that digital tools can support vocabulary development and reading when they are integrated with explicit guidance and purposeful tasks rather than used as decoration (Ohle-Peters et al., 2025; Lolok et al., 2026).

TEYL also requires learner-centered approaches that allow children to observe, predict, classify, discuss, test ideas, and use language for meaningful purposes. Discovery

Learning is compatible with these principles because learners construct understanding through guided exploration rather than receiving all information directly from the teacher. Recent EFL studies have applied discovery-oriented instruction to vocabulary and reading and reported positive learning and engagement patterns, including Discovery Learning for vocabulary development (Rafiq et al., 2024), Discovery Learning combined with role play for reading (Lestari & Rahmi, 2024), and Quizlet-supported guided discovery for vocabulary mastery (Clara & Napitupulu, 2026). The present classroom action research was originally conducted in a fourth-grade mathematics classroom at SDN 5 Tikala. Initial observations showed that 14 of 26 students demonstrated low learning interest, with an average interest indicator of approximately 60%. The classroom was largely teacher-centered, digital-visual resources were limited, and several students showed low concentration and passive participation. Although these problems were observed in mathematics, the underlying pedagogical issues - limited multimodal support, weak learner participation, and insufficient opportunities for guided exploration - are also relevant to young-learner English classrooms. Discovery Learning provides a structured response to these conditions through six stages: stimulation, problem statement, data collection, data processing, verification, and generalization. In language education, these stages can be adapted into activities such as observing images or short videos, predicting word meanings, collecting language examples from texts or audio, grouping vocabulary, checking interpretations with peers and teachers, and using newly learned language in sentences or short communicative tasks. The model therefore has potential relevance to TEYL when discovery is sufficiently guided and when linguistic scaffolding is adjusted to children's proficiency.

Learning interest is understood here as students' enjoyment, attention, attraction to learning activities, and willingness to participate. Interest is not static; it can be triggered by situational features and may develop through repeated meaningful engagement (Hidi & Renninger, 2006). Digital-visual media can function as one such situational trigger because images, animations, videos, and interactive presentations provide multiple representational channels. Multimedia learning research also emphasizes that visual and verbal information can support understanding when the materials are coherent and do not overload learners' cognitive resources (Mayer, 2020). Current TEFLO publications demonstrate a growing emphasis on young learners, contextual English learning, and digitally supported literacy. Rangan et al. (2026) reported improvements in elementary learners' English vocabulary through contextual learning, while Lolok et al. (2026) used e-book media in classroom action research to support young learners' reading comprehension. These studies indicate that engagement-oriented classroom interventions can be productively investigated within TEYL, but they also underline the need to connect instructional media with explicit language objectives and measurable English outcomes.

A gap remains between general classroom-engagement research and direct evidence from young-learner EFL settings. Studies conducted outside English lessons may reveal transferable principles of participation, scaffolding, and multimedia design, but they cannot be treated as evidence of language development. For this reason, the present study retains its original empirical context while explicitly limiting its claims: the mathematics intervention is used to examine how digital-visual Discovery Learning influenced classroom interest and activity, and the TEYL contribution is formulated as a pedagogical implication rather than as a measured English-learning effect.

Accordingly, this study has two purposes: first, to examine changes in fourth-grade students' learning interest and classroom activity across two cycles of Discovery Learning assisted by digital-visual media; and second, to identify pedagogical principles from the intervention that may inform future TEYL classroom action research. The study asks: (1) How did students' learning interest and classroom activity change across the two action-research cycles? and (2) What aspects of digital-visual Discovery Learning are potentially transferable to young learners' English instruction? The discussion of transferability focuses on visual scaffolding, guided noticing, collaborative exploration, vocabulary support, and multimodal task design. No English-language achievement data were collected in the present study; therefore, all TEYL implications are presented as propositions for future validation rather than direct outcomes of the intervention.

METHOD

1. Research Design

This study employed Classroom Action Research (CAR) with descriptive quantitative analysis. The design followed the cyclical model of planning, action, observation, and reflection and was implemented in two cycles, each consisting of three meetings. The empirical intervention took place in a fourth-grade mathematics class and used Discovery Learning assisted by digital-visual media. The CAR component was designed to improve classroom participation and learning interest, while the TEYL contribution of the article is interpretive: it identifies pedagogical features that may be transferred and tested in future English-language classroom action research.

The action was considered successful when: (1) at least 80% of students reached the high or very high learning-interest categories, (2) student activity reached at least 80%, and (3) no students remained in the very low interest category. If these criteria were not achieved in Cycle I, instructional adjustments were made for Cycle II through reflection on the Discovery Learning stages and the use of digital-visual media.

2. Participants / Subjects

The participants were 26 fourth-grade students in Class IV A at SDN 5 Tikala during the second semester of the 2025/2026 academic year, consisting of 10 boys and 16 girls. The class was selected purposively because initial classroom observations

indicated low learning interest and limited use of interactive digital media. The participants' English proficiency was not assessed because the intervention was conducted in mathematics; consequently, the study does not make claims about English-language achievement.

3. Instruments

The instruments used in this study included:

- a. Teacher activity observation sheets to assess the implementation of the Discovery Learning model.
- b. Student activity observation sheets to measure student engagement during the learning process.
- c. A learning interest questionnaire consisting of positive and negative statements using a Likert scale.
- d. Documentation in the form of photos of learning activities and instructional materials. The observation sheets and questionnaire were developed from the learning-interest indicators and the Discovery Learning stages used in the school context. The instruments measured teacher implementation, student participation, and learning interest. They did not measure English vocabulary, reading, listening, speaking, or other language outcomes.

4. Data Collection Procedures

Data collection was carried out through several stages:

- a. Planning stage, including the preparation of teaching modules, student worksheets, digital-visual media, and research instruments.
- b. Action stage, involving the implementation of Discovery Learning assisted by digital-visual media in mathematics lessons on fractions. The classroom process was later examined for pedagogical features potentially relevant to TEYL, but the instructional content and measured outcomes remained mathematical and motivational rather than linguistic.
- c. Observation stage, conducted by an observer to record teacher and student activities during the learning process.
- d. Reflection stage, involving the analysis of results in each cycle to determine improvements for the next cycle.

5. Data Analysis

Data were analyzed using quantitative descriptive analysis by calculating the percentage of learning implementation and students' learning interest using the formula:

$$\text{Percentage} = (\text{Obtained Score} / \text{Maximum Score}) \times 100\%$$

The results were categorized into very high, high, moderate, low, and very low criteria. Because the study used descriptive classroom-action data, terms such as improvement refer to changes in observed percentages across cycles rather than inferential statistical effects.

RESULTS AND DISCUSSION

Results

The results describe the changes in student activity, teacher activity, and students' learning interest across two cycles of Classroom Action Research. The intervention applied the Discovery Learning model supported by digital-visual media in fourth-grade mathematics lessons. Therefore, the findings should be interpreted as evidence of changes in classroom participation and learning interest in the mathematics context. Their relevance to Teaching English to Young Learners (TEYL) is discussed as a pedagogical implication rather than as direct evidence of English-language learning outcomes.

A. Cycle I

In Cycle I, student activity showed gradual improvement across the three meetings. In the first meeting, student activity reached 39.3%, which was categorized as very poor. This result indicated that many students were still unfamiliar with the Discovery Learning procedures and required considerable teacher guidance. In the second meeting, the percentage increased to 53.6%, categorized as poor. By the third meeting, student activity reached 64.3% and moved into the fair category. Although the percentage remained below the predetermined success criterion of 80%, the progressive increase suggested that students were beginning to participate more actively in classroom activities and adapt to the stages of Discovery Learning.

Teacher activity showed a similar upward pattern. In Meeting 1, teacher activity reached 46.8%, categorized as poor. The percentage increased to 59.3% in Meeting 2 and reached 70.3% in Meeting 3. The improvement indicated that the teacher became increasingly able to organize the learning process according to the stages of Discovery Learning and integrate digital-visual media into classroom activities.

Table 1. Student and Teacher Activity in Cycle I

Meeting	Student Activity	Category	Teacher Activity	Category
Meeting 1	39.3%	Very Poor	46.8%	Poor
Meeting 2	53.6%	Poor	59.3%	Fair
Meeting 3	64.3%	Fair	70.3%	Good

The learning-interest questionnaire administered at the end of Cycle I also showed a developing pattern. Eight students were categorized as having very high learning interest, 10 students were in the high category, 5 were in the moderate category, 2 were in the low category, and 1 student remained in the very low category. Overall, 69.2% of the students achieved the mastery criterion, whereas 30.8% had not yet reached the expected level. Because the minimum success criterion for learning-interest mastery was 80%, the results of Cycle I were considered insufficient. Student activity also remained below the expected level. Consequently, reflection was conducted to identify aspects that needed improvement. The researcher then strengthened the

implementation of the Discovery Learning stages and optimized the use of digital-visual media before beginning Cycle II.

B. Cycle II

The results of Cycle II showed clearer improvement in both student and teacher activity. Student activity reached 80.3% in the first meeting, immediately entering the good category. It then increased to 83.9% in Meeting 2 and reached 92.9% in Meeting 3, categorized as very good. These results indicate that students were more actively involved in discussions, classroom tasks, and the different stages of Discovery Learning after the revisions made following Cycle I.

Teacher activity also improved substantially. The percentage reached 81.2% in the first meeting, 89.0% in the second meeting, and 95.3% in the third meeting. The final percentage was categorized as very good. The consistent increase suggests that the teacher implemented the learning sequence more systematically and was better able to use digital-visual media to support classroom interaction and student participation.

Table 2. Student and Teacher Activity in Cycle II

Meeting	Student Activity	Category	Teacher Activity	Category
Meeting 1	80.3%	Good	81.2%	Good
Meeting 2	83.9%	Good	89.0%	Good
Meeting 3	92.9%	Very Good	95.3%	Very Good

Students' learning interest also improved in Cycle II. Fourteen students were categorized as having very high learning interest, 8 students were in the high category, 3 were in the moderate category, and only 1 student remained in the low category. No students were categorized as having very low learning interest. The percentage of learning-interest mastery increased to 84.6%, while the percentage of non-mastery decreased to 15.4%.

Table 3. Comparison of Learning-Interest Mastery

Cycle	Mastery	Non-Mastery
Cycle I	69.2%	30.8%
Cycle II	84.6%	15.4%

Across the two cycles, learning-interest mastery increased by 15.4 percentage points, from 69.2% in Cycle I to 84.6% in Cycle II. Student activity also increased considerably, from 64.3% at the end of Cycle I to 92.9% at the end of Cycle II. Teacher activity rose from 70.3% to 95.3% over the same comparison. These improvements occurred alongside revisions in the implementation of Discovery Learning and more purposeful use of digital-visual media.

By the end of Cycle II, all predetermined success indicators had been achieved. Learning-interest mastery exceeded the minimum target of 80%, student activity reached the very good category, and no students remained in the very low learning-interest category. Therefore, the classroom action was concluded after Cycle II. Overall, the results indicate that the intervention was associated with stronger participation, improved classroom engagement, and increased learning interest in the observed mathematics lessons. However, these findings should not be interpreted as direct evidence of improvement in English-language skills. The potential application of Discovery Learning and digital-visual media to TEYL should instead be considered as a pedagogical transfer that requires separate empirical investigation in English-language classrooms.

Discussion

The findings show that the two-cycle intervention was associated with a progressive increase in learning interest and classroom participation. Learning-interest mastery increased from 69.2% in Cycle I to 84.6% in Cycle II, while student activity rose from 64.3% to 92.9%. Teacher activity also increased from 70.3% to 95.3%. In a classroom-action framework, these changes indicate that the combination of guided discovery, reflection between cycles, and more purposeful digital-visual support helped create a more participatory learning environment. The results should be interpreted descriptively because no inferential statistical test or comparison group was used.

The Cycle I findings suggest that students required time and teacher support to adapt to the Discovery Learning sequence. Participation remained below the success criterion even though students had begun to respond to stimulation and data-collection activities. After reflection, Cycle II placed greater emphasis on clearer instructions, more interactive visual support, and more systematic progression through the discovery stages. This iterative refinement is consistent with the logic of Classroom Action Research, in which instructional decisions are modified based on observed classroom needs rather than treated as a fixed intervention.

The increase in learning interest can also be interpreted through interest-development and multimedia perspectives. Situational interest may be triggered when learning activities provide novelty, meaningful challenge, and accessible representations (Hidi & Renninger, 2006). Digital-visual media can contribute to these conditions by combining verbal explanation with pictures, animation, and other visual cues. Mayer (2020) emphasizes that multimedia support is most useful when the visual and verbal elements are relevant to the learning goal and are designed to manage rather than increase cognitive load. Although the present data were collected in mathematics, Discovery Learning itself has documented applications in EFL. Rafiq et al. (2024) reported positive vocabulary outcomes and learner responses following discovery-oriented instruction, while Lestari and Rahmi (2024) used Discovery Learning within classroom action research for English reading. More recently, Clara and Napitupulu (2026) reported vocabulary gains from Quizlet-based Guided Discovery Learning. These studies strengthen the pedagogical

plausibility of transferring discovery principles to language instruction, but they do not convert the mathematics findings of the present study into English-learning evidence.

For Teaching English to Young Learners, the most transferable feature is the interaction between guided discovery and multimodal scaffolding. The stimulation stage can use pictures, short videos, songs, or illustrated situations to activate prior knowledge and introduce language in context. Problem statement can invite learners to predict meanings, identify patterns, or formulate simple questions. Data collection can involve reading short texts, listening for key words, or gathering expressions from multimodal input. Data processing can include sorting vocabulary, matching words and pictures, sequencing events, or comparing sentence patterns. Verification can occur through peer discussion, teacher feedback, or digital checking, while generalization can require learners to use new vocabulary or structures in short oral or written products.

This transfer is supported by recent young-learner studies. Ohle-Peters et al. (2025) showed that digital support can contribute to elementary learners' vocabulary acquisition, although outcomes depend on instructional design and learner characteristics. Within TEFLO, Rangngan et al. (2026) demonstrated the value of contextual English vocabulary learning with elementary students, and Lolok et al. (2026) reported gains in young learners' reading comprehension through e-book-supported classroom action research. Together, these studies suggest that digital media are most useful when they are connected to explicit language objectives, teacher scaffolding, and opportunities for active meaning-making.

The present study therefore contributes to TEYL only at the level of pedagogical implication. English vocabulary, reading, listening, speaking, pronunciation, grammar, and communicative performance were not measured. The learning-interest questionnaire was administered in a mathematics context, so the observed increase in interest cannot be assumed to transfer automatically to English lessons. This limitation is important because subject matter, linguistic difficulty, teacher language use, and learners' prior English proficiency may substantially alter how children respond to the same discovery and multimedia techniques.

Future research should directly implement the digital-visual Discovery Learning sequence in primary EFL classrooms and measure both engagement and language outcomes. Classroom action research could examine vocabulary retention, reading comprehension, listening comprehension, or speaking participation while retaining the same cyclical process of planning, action, observation, and reflection. Such studies should also report the type of digital media used, the degree of teacher scaffolding, and the specific language objectives for each discovery stage. In this way, the current classroom findings can function as a cautious cross-subject pedagogical starting point rather than as a substitute for direct TEFL evidence. Overall, the intervention illustrates how structured exploration and digital-visual support can increase participation and learning interest in a primary classroom. Its relevance to TEYL lies in the design principles - guided discovery, multimodal scaffolding, active participation, and reflective refinement - that can be tested directly in English-language lessons.

CONCLUSION

This Classroom Action Research found progressive improvements in learning interest, student activity, and teacher implementation after two cycles of Discovery Learning assisted by digital-visual media in a fourth-grade mathematics classroom. Learning-interest mastery increased from 69.2% in Cycle I to 84.6% in Cycle II, while student activity increased from 64.3% to 92.9% and teacher activity from 70.3% to 95.3%. The Cycle I results did not yet meet the predetermined success criteria, which led to revisions in classroom procedures and the use of digital-visual support. Following these adjustments, Cycle II achieved the target for learning interest and student activity, and no students remained in the very low interest category. The improvement should be understood as a descriptive classroom-action pattern rather than a statistically tested causal effect. For TEFL, the main contribution is pedagogical rather than evidential. The study suggests that visual stimulation, guided exploration, collaborative data processing, verification, and learner-generated generalization may be adaptable to Teaching English to Young Learners. These principles are consistent with recent EFL work on discovery-oriented vocabulary and reading instruction and with digitally supported young-learner literacy research. However, the present intervention did not teach or assess English; therefore, it cannot support claims about vocabulary mastery, reading comprehension, speaking, listening, or other language outcomes. Future studies should implement the same digital-visual Discovery Learning cycle directly in primary EFL classrooms and evaluate both learner engagement and measurable English-language development. This would provide the direct TEYL evidence required to confirm the transferability proposed in this article.

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