



Developing a Discovery and Game-Based Learning Module on The Benefits of Friction Topic in Elementary School

Sisca Wulandari^{1*}, Diana Vivanti Sigit², Irwanto³

^{1,2,3} State University of Jakarta, Indonesia

Corresponding Author: sisca.wulandari@mhs.unj.ac.id

Abstract: This research was conducted to develop a valid, practical, and effective teaching module for the topic of friction benefits by integrating *Discovery Learning* and *Game-Based Learning* approaches. The ADDIE development model comprising Analysis, Design, Development, Implementation, and Evaluation was used as the research framework. In the analysis phase, curriculum and student needs were examined. The design phase involved the creation of module structure, learning worksheets (LKPD), and assessment instruments. The module was validated by content, language, and instructional media experts, with validation results exceeding 92%, categorized as very valid. A limited trial was conducted with fourth-grade students to evaluate practicality and effectiveness. Results showed that students found the module easy to understand and engaging, particularly through game-based learning activities. The effectiveness of the module was confirmed through pretest and posttest scores, which increased from 40.67 to 83.33, resulting in an N-Gain score of 0.72 (high category). These findings indicate that the module significantly improved student learning outcomes. It can be concluded that the developed teaching module is suitable for use in elementary IPAS classes and has the potential to enhance student engagement and conceptual understanding through interactive and discovery-based strategies.

Keywords: Module, Discovery Learning, Game Based Learning, Friction, Elementary School

INTRODUCTION

Basic education has been regarded as playing a strategic role in shaping students' critical and creative thinking abilities, as well as in building early understanding of scientific concepts. Within the context of the *Ilmu Pengetahuan Alam dan Sosial* (IPAS) subject, the topic of friction benefits is directly related to everyday phenomena and thus requires a concrete instructional approach. Unfortunately, teaching methods at the primary school level have still been dominated by traditional, teacher-centered practices, resulting in low levels of student engagement and suboptimal learning outcomes (Ulum, Mu'arifin, & Heynoek, 2021).

To address this issue, learning models that promote active student involvement have been deemed essential. The *Discovery Learning* model has been recognized for enabling

students to construct their understanding through exploratory and independent discovery activities. This model has been proven effective in improving both concept mastery and learning autonomy among elementary school students (Ulum et al., 2021).

Meanwhile, the *Game-Based Learning* (GBL) approach has offered an engaging and interactive learning experience. The use of educational games such as card games and board games has been shown to increase students' motivation, focus, and participation, creating a more dynamic classroom atmosphere (Kumar, Chang, & Al Haqh, 2024). In the Indonesian educational context, the use of educational games such as “Snakes and Ladders” has also been proven to enhance mathematics learning outcomes and student engagement (Azizah & Findrayani, 2025).

By integrating both approaches into a teaching module, IPAS learning on the topic of friction benefits is expected to become more contextual, enjoyable, and effective in enhancing students' academic achievement. Therefore, this study was undertaken to develop a teaching module that combines *Discovery Learning* and *Game-Based Learning*, ensuring that the final product is valid, practical, and effective for use in Grade IV elementary classrooms (Lasut & Bawengan, 2023; Wulandari et al., 2023).

Based on the aforementioned background, the present study was aimed at developing an IPAS teaching module on the topic of friction benefits by incorporating *Discovery Learning* and *Game-Based Learning* approaches that meet the criteria of validity, practicality, and effectiveness in improving the learning outcomes of fourth-grade elementary students.

METHOD

This study was conducted as a research and development project aimed at producing a teaching module that integrates the *Discovery Learning* and *Game-Based Learning* approaches. The development process was guided by the ADDIE model, which comprises five main stages: *Analysis*, *Design*, *Development*, *Implementation*, and *Evaluation*. The ADDIE model has been widely adopted in the development of teaching modules, e-modules, and textbooks for primary education due to its structured, simple, and comprehensive nature, covering all stages from initial design to implementation and

final evaluation (Wulandari et al., 2023). As defined by Branch (2009), the ADDIE model provides a systematic framework involving five major phases.

Research Procedure

During the Analysis stage, learning needs were identified through curriculum analysis, student characteristics assessment, and a review of the friction topic within the IPAS subject. Data were collected using documentation, interviews with teachers, and classroom observations to gain a clear understanding of existing instructional practices and learner needs.

In the Design phase, the module structure was planned based on the syntax of *Discovery Learning* and educational games. Supporting components such as student worksheets (LKPD), assessment instruments, and instructional games were also designed during this stage to ensure alignment with learning objectives.

The Development stage involved constructing the module in accordance with the design blueprint. The initial draft of the module was then validated by subject matter experts, language experts, and instructional media specialists. Revisions were made based on the feedback received from these experts. Following this, a small-scale trial was conducted through individual evaluations to test the usability and clarity of the module.

During the Implementation stage, the module was applied in an actual classroom setting involving fourth-grade students. The teacher implemented the module in teaching sessions, and its effectiveness was measured by administering pretest and posttest assessments.

The final stage, Evaluation, consisted of analyzing the module's effectiveness and practicality, as well as gathering feedback from both teachers and students. This stage was aimed at identifying areas for improvement and ensuring that the module met the intended educational goals.

Data Analysis Technique

By systematically following the ADDIE development stages, the resulting teaching module is expected to possess high quality and be effectively applicable in IPAS learning at the elementary school level. The structured nature of this model ensures that each stage contributes meaningfully to the creation of an educational product that is valid, practical, and impactful.

During the analysis phase, a comprehensive needs assessment was conducted to understand the cognitive characteristics of children aged 7–11 years, as well as the specific challenges related to disaster education in Indonesian primary schools. This phase involved a literature review of national curriculum frameworks, disaster education policies, and studies on children’s learning behaviors in high-risk areas.

In the design phase, the structure and layout of the application were carefully planned to align with the identified user needs. The design included a modular content structure covering disaster types, mitigation steps, evacuation procedures, and emergency preparation. Storyboards and wireframes were developed to outline the content flow and interaction pathways. Animated characters, icons, and color schemes were chosen to foster a positive and non-threatening learning environment.

The development phase focused on constructing the functional prototype of *MitiPedia*. Core features included: (1) animated explanations of common disasters such as earthquakes, floods, and volcanic eruptions; (2) gamified quizzes and mini-games to reinforce learning; (3) an interactive evacuation simulation to train appropriate response behavior; and (4) a “Disaster Preparedness Kit” module to introduce essential emergency supplies through engaging drag-and-drop activities. The prototype was developed to operate offline to ensure accessibility in low-connectivity regions.

The implementation phase was carried out through a small group trial, involving ten students from grades 3 to 5 in a public primary school. This pilot testing aimed to assess three main aspects: usability, content clarity, and learner engagement. Direct observation, guided play sessions, and semi-structured interviews were employed to gather both qualitative and quantitative feedback.

In the evaluation phase, data from the small group trial were analyzed alongside expert reviews from an educational technologist, a primary teacher, and a child psychologist. Based on this evaluation, minor revisions were made to improve language simplicity, icon placement, and quiz instructions.

RESULT AND DISCUSSION

RESULT

This study was conducted to develop a teaching module for the IPAS subject focusing on the benefits of friction, employing *Discovery Learning* and *Game-Based Learning* approaches. The development process was carried out using the ADDIE model, which includes the phases of *Analysis*, *Design*, *Development*, *Implementation*, and *Evaluation*. During the analysis phase, a thorough review was undertaken concerning the curriculum, student characteristics, and learning needs in Grade IV of primary school. Observations revealed that classroom instruction was still predominantly conventional, with minimal active student engagement. The concept of friction was perceived as abstract by students, indicating the need for a more contextual and engaging approach.

In the design phase, the module structure was formulated based on the syntax of *Discovery Learning* and *Game-Based Learning*, accompanied by student worksheets (LKPD), assessment tools, and evaluation instruments. During the development stage, the module was validated by four experts: a content expert, a language expert, and two instructional material experts (module and worksheet specialists). The content and language validations were carried out by lecturers from Universitas Negeri Jakarta, while the module and worksheet validation was conducted by Grade IV teachers from SD Plus Permata Ihsan. The validation results indicated a high level of validity, with scores of 92.50% from the content expert, 93.33% from the language expert, and 92.86% from the instructional materials experts each falling into the "very valid" category.

A limited trial was subsequently conducted through a one-to-one evaluation involving three Grade IV students at SD Plus Permata Ihsan. The trial results suggested that the

module was considered practical and easy to use. All participating students indicated that the module was easy to understand due to its clear language and logically sequenced activity instructions. Regarding the worksheets, students found them helpful in guiding experimental procedures on friction and in encouraging active and independent thinking. Additionally, the use of a picture card game as part of the learning process was reported to make the experience more enjoyable and less monotonous. Two out of the three students expressed interest in using similar modules in other subjects, as they felt more motivated to learn. These findings demonstrate that the module, worksheets, and supporting media fulfilled the practicality criteria from the learners' perspective.

During the implementation phase, the module was utilized by the teacher as a guide for instruction, while students engaged in explorative and enjoyable learning activities. Classroom observations indicated a higher level of student engagement and a more dynamic learning environment compared to previous lessons. To assess the effectiveness of the module, a *pre-experimental design* was employed using a one-group pretest-posttest model. Students were given a pretest before, and a posttest after, the learning intervention with the module.

The results showed an increase in the average score from 40.67 in the pretest to 83.33 in the posttest. This reflected a mean gain of 42.66 points, indicating a significant improvement in students' understanding of the friction topic. The N-Gain Score was calculated at 0.72 (or 71.9%), which falls into the "high" category according to Hake's (1998) classification. This outcome suggests that the module was highly effective in enhancing student learning outcomes in the targeted subject matter.

Based on the findings from the validation, practicality testing, and effectiveness analysis, it can be concluded that the *Discovery Learning* and *Game-Based Learning*-based teaching module developed in this study successfully met all three core criteria: it was valid in terms of content, language, and design; it was practical for classroom use; and it was effective in improving student learning outcomes on the topic of friction.

MODUL AJAR KURIKULUM MERDEKA IPAS FASE B SD KELAS IV	
INFORMASI UMUM	
A. IDENTITAS MODUL	
Penyusun	: Sisca Wulandari
Institusi	: SD Plus Permata Ihsan
Tahun Penyusunan	: 2025
Jenjang Sekolah	: SD
Mata Pelajaran	: Ilmu Pengetahuan Alam dan Sosial (IPAS)
Fase B / Alokasi / Semester	: 4 (Empat) / 11 (Genap)
Topik	: Gaya dan Gerak/ Manfaat Gaya Gesek
Abstrak Waktu	: 3 JP x 35 Menit (1 x Pertemuan)
B. CAPAIAN PEMBELAJARAN	
Peserta didik mampu mengamati, menyelidiki, dan menjelaskan berbagai bentuk gaya: gesekan, tarik, gerak, gravitasi, dan magnet), pengaruh gaya terhadap gerak benda, serta memanfaatkan dalam kehidupan sehari-hari.	
C. KOMPETENSI AWAL	
1. Siswa mengenal berbagai jenis gaya sederhana 2. Siswa memahami bahwa gaya mempengaruhi gerak 3. Siswa melakukan aktivitas eksplorasi dasar tentang gerak benda 4. Siswa mengetahui hubungan antara gaya dan perubahan arah atau kecepatan gerak suatu benda.	
D. PROFIL PELAJAR PANCASILA	
1. Beriman, bertakwa kepada Tuhan Yang Maha Esa dan berakhlak mulia, 2. Bergotong-royong, 3. Berakhlak kritis, dan 4. Kreatif.	
E. SARANA DAN PRASARANA	
Buku IPAS kelas IV SD Kurikulum Merdeka Topik : Manfaat Gaya Gesek • Proyektor • Laptop • LKPD	
Perlengkapan yang dibutuhkan peserta didik: • Alas dan sticky notes • Kelereng • Permukaan benda (kain flanel, kertas busata, kertas amplas kasar)	

• Pengantar/meteran • Kartu gambar QR • HP Sembar belajar: Buku IPAS dan lingkungan sekitar	F. TARGET PESERTA DIDIK • Siswa kelas IV/SD, 15 siswa.
	G. MODEL/ METODE PEMBELAJARAN • Metode Pembelajaran : Discovery and Game Based Learning • Pendekatan : Proses • Metode Pembelajaran : Tanya Jawab, Diskusi, Eksperimen, Game
KOMPETENSI INTI	
A. TUJUAN PEMBELAJARAN	
1. Melaui menonton video dan eksperimen mini, siswa mampu menjelaskan konsep gaya gerak secara logis. 2. Melalui game kartu gambar QR, siswa mampu mengasah minimal 2 manfaat gaya gerak dalam kehidupan sehari-hari. 3. Melalui eksperimen, siswa dapat melakukan percobaan sederhana untuk mengamati gaya gerak. 4. Melalui eksperimen dan game kartu gambar QR, siswa dapat menemukan sikap aktif dan kerjasama dalam pembelajaran.	
B. PEMAHAMAN BERMAKNA	
Gaya gerak adalah gaya yang berperan penting dalam kehidupan sehari-hari karena dapat membantu dan meningkatkan gerak benda. Manfaat penguasaan dan kerja sama dalam eksperimen serta permainan, siswa dapat memahami manfaat gaya gerak secara logis dan aplikatif. Bekerja sama dalam gaya gerak yang membantu benda bergerak, seperti saat rem sepeda dikayuh untuk menghentikan laju. Gaya gerak juga mencegah kita tergelincir, misalnya ketika kita berjalan dengan sepatu yang memiliki sol kasar. Semua contoh ini menunjukkan bahwa gaya gerak sangat penting dan bermanfaat dalam berbagai aktivitas sehari-hari.	
C. PERNYATAAN PEMANTIK	
1. Pemantik kamu terpencil atau betah bos? Mengapa ini bisa terjadi? (Mengajak siswa berpikir tentang peran pemantik dan gerakan) 2. Apa yang terjadi jika kamu sedang atau mobil tidak bekerja karena tidak ada gas? (Mengondisi siswa menyadari manfaat gaya gerak dalam keselamatan)	

D. KEGIATAN PEMBELAJARAN		
Tahapan	Kegiatan	Alokasi Waktu
Pendahuluan	1. Guru memberi salam, menanyakan kabar siswa (rotasi) 2. Guru mengajak siswa berdoa. Dua disiplin diri siswa yang diajarkan oleh guru (berhenti dan bertanya kepada Tuhan Yang Maha Esa dan berakhlak mulia) 3. Guru mengajarkan siswa mengapa diri agar saja untuk belajar dan menumbuhkan motivasi kegiatan pembelajaran 4. Guru memberikan apersepsi: Guru menunjukkan demonstrasi singkat Mengidentifikasi kelengkapan di rumah, kemudian bertanya: Kenapa kelengkapan itu penting? Apakah kamu terkejut saat lupa bawa? Mengapa bisa terjadi? Mengapa saja guru? Apakah guru guru? siapa guru guru? Apakah guru guru? siapa menumbuhkan?	15 menit
Kegiatan Inti	5. Guru memberlakukan tugas pembelajaran: - Melalui menonton video dan eksperimen mini, siswa dapat mengidentifikasi konsep gaya gerak secara lokal - Melalui game kartu gambar GQ, siswa dapat mengidentifikasi minimal 2 rumus gaya gerak - Melalui eksperimen mini, siswa dapat melakukan percobaan sederhana untuk menguji gaya gerak - Melalui eksperimen mini dan game kartu gambar GQ, siswa dapat mengidentifikasi sikap aktif dan Kerjasama dalam pembelajaran.	15 menit
Kegiatan Inti	Kegiatan 1 Memanusi Video dan Permainan Ayal Guru 1. Guru menyanyikan video pendek tentang Apa itu gaya gerak dan bagaimana dalam kehidupan sehari hari 2. Guru dan siswa melakukan tanya jawab tentang isi video. Kegiatan 2 Eksperimen Mini – Gases Seru Yal! 1. Siswa membuatkan kelompok 2. Setiap kelompok terdiri dari 5 orang (Total ada 15 siswa) 3. Siswa diaduk bersama kelompoknya 4. Simulasi	25 menit

	Guru mempersiapkan video singkat kelompok digedipkan di permukaan berkilau 4. Identifikasi Masalah Mengapa kelompok lain memilih lebih cepat di atas atau mengapa di atas karpet? Siswa diminta melakukan prediksi sendiri. 5. Pengumpulan Data Siswa melakukan eksperimen, misal dengan kelompok. Siswa mengamatinya jarak tempuh dan kecepatan. 6. Pengolahan Data Mencatat hasil pengamatan di LKPD. Siswa mencocokkan tabel hasil pada LKPD. Membandingkan hasilnya. Menginterpretasikannya dengan menjawab Pertanyaan dalam LKPD. 7. Pembekalan Kelompok mendiskusikan hasil eksperimen Kelompok menerima produk awal sebagai satu tidak. 8. Generalisasi Siswa menyimpulkan dan guru mengaitkan hasil konsep Gaya gesek, bergantung pada jenis permukaan benda.	
	Kegiatan 2 Game "Tebak Manfaat Gaya Gesek" 20 menit 1. Siswa berputar ke belakang (swivel). 2. Setiap kelompok diberikan waktu minimal 2 kartu Gambar QR secara acak. 3. Setiap kelompok dapat satu bariscode yang ada di kartu Gambar QR satu per satu. 4. Setiap kelompok menuliskan penemuannya di LKPD. - Apa manfaat gaya gesek dalam video? - Mengapa dapat terjatuh? - Bagaimana jika tidak ada gaya gesek? 5. Guru per satu kelompok maju untuk mempresentasikannya.	
	Kegiatan 3 Reflektif Interaksi 10 menit 1. Siswa melakukan refleksi pada sticky note dan ditempatkan di dinding dan perwakilan siswa menyampaikan pengamatan.	
Kegiatan Penutup	1. Berapa siswa yang sudah membuat kesimpulan / rangkuman hasil belajar selama ini? (berdasarkan hasil pengamatan) 2. Berapa yang menjawab tentang waktu yang telah dipelajari (tempur hasil) 3. Guru memberi kesempatan kepada siswa untuk menyimpulkan pembelajaran yang telah dipelajari 4. Melakukan penilaian hasil belajar. 5. Guru memberikan tugas rumah. Carilah 3 benda dan kegiatan di rumah yang menunjukkan manfaat gaya gesek, lalu ceritakan pada pertemuan berikutnya.	20 menit

	6. Pembelajaran ditung dengan dua yang dipinjam salah satu siswa dan guru mengikuti kegiatan pembelajaran dengan salah.
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E. ASESMEN/PENILAIAN

Asesmen Formatif (terlampir)

- Penilaian pengetahuan melalui tes tulis tentang konsep gaya gesek dan manfaatnya
- Penilaian keterampilan melalui instrumen penilaian keterampilan Ketika siswa melakukan eksperimen ini.
- Penilaian sikap melalui instrumen observasi kerjasama kelompok dan perilaku dalam berkelompok

F. REFLEKSI

Refleksi Guru

- Apakah siswa mencapai tujuan pembelajaran?
- Apakah metode pembelajaran yang digunakan sudah efektif?
- Apakah materi yang disampaikan sudah sesuai dengan kebutuhan siswa?

Refleksi Siswa

- Apa yang sudah dipelajari hari ini?
- Apa yang masih belum dipahami?
- Menurut kalian, materi mana yang paling sulit?
- Apakah sangat kalian akan meminta bantuan untuk memahami materi ini?

LAMPIRAN (Link Video Youtube dan 1 KFD)

PENGAYAAN (Untuk siswa yang sudah melebihi Kriteria Ketuntasan Minimal)

TP 1

- Membuat poster atau infografis tentang jenis-jenis gaya dan penyelesaiannya.
- Meminta cerita pendek siswa yang memuat peristiwa gaya gesek dalam kehidupan sehari-hari.

TP 2

- Membuat komik strip yang menggambarkan situasi manfaat gaya gesek.
- Diskusi kelompok kecil membandingkan gaya gesek di berbagai permukaan berdasarkan hasil observasi pribadi (misalnya: lantai marmer vs tanah).

TP 3:	- Mengukur gaya gesek menggunakan benda dan permukaan berbeda, lalu menghubungkan hasil dan menyimpulkan faktor yang memengaruhinya. - Membuat laporan eksperimen dalam bentuk mini vlog atau slide presentasi digital.
TP 4:	- Mengaji fasilitator kelompok saat ujian eksperimen atau contoh melalui kepiemaningan dan kerja sama. - Membuat refleksi video atau jurnal digital tentang pengalaman kerja sama, tantangan dan solusi yang diemikan selama pembelajaran. - Melakukan proyek mini kelompok membuat alat bantu pengamatan gaya gesek sederhana (misalnya: paper goseer mini dengan bebugi alas).
REMEDIAL <i>(Untuk siswa yang belum mencapai Kriteria Ketuntasan Minimal)</i>	
TP 1:	- Menonton kembali video pembelajaran dengan lembar panduan yang disediakan (berisi poin-poin penting yang harus diperhatikan). - Kelompok kecil dengan guru pendamping untuk merekonstruksi pemahaman konsep gaya gesek menggunakan media konkret (contoh: menggeser benda di berbagai permukaan).
TP 2:	- Siswa diberi lembar aktivitas mengocokkan gambar dengan manfaat gaya gesek (drag-and-drop atau cutting-paste). - Pendampingan individu: guru memberi contoh konkret lalu meminta siswa mengemukakan manfaat gaya gesek dari kegiatan sehari-hari yang mereka (misalnya: sepeda berkeci, karpet menahan selendang).
TP 3:	- Pendampingan langsung oleh guru saat siswa mengulang eksperimen mini (misalnya: mengukur koefisien gesek di permukaan berbeda). - Siswa diberi lembar kerja eksperimen versi dipersempit (fokus mencatat hasil dan menarik kesimpulan).
TP 4:	- Guru mengorganisir kelompok kecil dan memberi peran jelas kepada setiap anggota (misal: pencatat, pengukur, pelapor) untuk memastikan partisipasi. - Refleksi bersama menggunakan gambar atau cerita pendek, lalu siswa diminta membuat atau menceritakan contoh sikap adil dan kerja sama.
BAHAN BACAAN GURU dan Siswa	
- Buku Siswa Ilmu Pengetahuan Alam dan Sosial Kelas IV SD - Buku Panduan Guru Ilmu Pengetahuan Alam dan Sosial Kelas IV SD	

The image shows the front cover of a student worksheet (LKPD) for Class IV SD. The cover has a bright yellow background with decorative orange and blue wavy borders. At the top right, the text 'Kelas IV SD' is written in a black, sans-serif font. The title 'LKPD' is prominently displayed in large, bold, orange letters, with 'Manfaat Gaya Gesek' (Benefits of Friction) written below it in a smaller black font. A white rectangular box with a light blue border contains the text 'Dimiliki oleh: Kelas:'. In the bottom left corner, the author's name 'Dibuat oleh: Sisca Wulandari' and the supervisor's name 'Dosen Pembimbing: Prof. Dr. Diana Vivanti Sigit, M.Si. Dr. Irwanto, S.Pd., M.Pd.' are listed. The bottom right corner features a colorful illustration of a boy and a girl riding a bicycle, with a large yellow pencil character with a face and arms positioned above them. There are also some small blue and green abstract shapes in the top left corner.

Gaya Gesek

Eksperimen Mini
(Gesek Seru Yuk!)
Berbasis Discovery Learning
(25 menit)



Gaya Gesek

Game
(Tebak Manfaat Gesek)
Berbasis Game Based Learning
(20 menit)



1-9 Teaching Module and Student Worksheet Benefits of Friction

DISCUSSION

The findings of this study indicated that the development of a teaching module based on *Discovery Learning* and *Game-Based Learning* for the topic of friction benefits significantly improved the learning outcomes of fourth-grade elementary students. This improvement was reflected in the increased student scores during the field trials, as well as the positive responses received from both teachers and students regarding the learning process. The observed improvement demonstrated the effectiveness of a student-centered and exploratory learning strategy in facilitating students' understanding of abstract concepts within IPAS. These results were aligned with the findings of Putra, Wiyanto, and Linuwih (2020), in which *Discovery Learning* was found to significantly enhance students' critical thinking skills and mastery of scientific concepts.

Through the implementation of *Discovery Learning* in the module, students were enabled to engage in a constructive learning experience involving observation, exploration, and conclusion-making activities. According to Kurniawati (2022), students' active involvement in constructing their own knowledge positively affects both cognition and learning motivation. This was reflected in the present study, where students were observed to display high levels of interest and enthusiasm throughout the learning process. Additionally, the findings of Arofah and Wulandari (2023) emphasized that elementary students frequently struggle with understanding instructional directions, become easily bored, and fail to grasp material when it is not delivered in an engaging and exploratory manner. These findings further support the necessity of adopting *Discovery Learning* as a means of fostering more meaningful learning experiences.

In terms of *Game-Based Learning*, the integration of game elements into the module was found to significantly enhance student engagement and motivation. It was emphasized by Kumar, Chang, and Al Haqh (2024) that an interactive and enjoyable learning environment encourages students to remain focused and enthusiastic. In this context, educational games also served as effective formative assessment tools. Sugara et al. (2023) concluded that digital educational games play a significant role in

improving students' classroom participation and concentration. These results were consistent with the experience in this study, where students were reported to be more motivated when the learning sessions included digital games relevant to the topic of friction benefits.

The effectiveness of interactive media in supporting science learning was further confirmed by Setiani et al. (2023), who demonstrated that the use of digital learning tools, such as laptops, facilitated better understanding of the material. These findings suggest that both digital and conventional media, when designed to be engaging and contextually relevant, can contribute meaningfully to student learning improvement. The demand for attractive instructional media was also highlighted in a case study by Azizah, Wakinah, and Wulandari (2023), which revealed that first-grade students at SDN Pasir Gadung had difficulty concentrating and were easily distracted. It was shown that unengaging instructional designs could result in low student responsiveness and participation.

Methodologically, the integration of *Discovery Learning* and *Game-Based Learning* was found to promote a dialogic, participatory, and reflective learning process. Teachers were positioned as facilitators, while students actively constructed their knowledge through enjoyable and exploratory activities. Lasut and Bawengan (2023) stated that the combination of exploratory strategies and game-based elements not only enhanced concept retention but also helped to build student confidence. In a study by Sumirah et al. (2023), it was shown that students with lower achievement and less responsibility in learning required more flexible and creative approaches to learning. The module presented in this study served as a concrete example of how active and engaging strategies could address such educational challenges.

The significance of innovation in instructional design was also highlighted by Wulandari (2015), who emphasized that contextual learning, particularly when closely linked to students' real-life experiences, tends to be more effective. In a more recent study, Wulandari et al. (2025) advocated for the use of Project-Based Learning-based flipbook media to support the *Merdeka Curriculum* and reinforce student character development. The core principles of such a model—namely active student involvement

and the strengthening of local context were well reflected in the module developed in this study, which promoted thematic and experiential learning.

This research also supported the findings of Nurhillal et al. (2023), who compared two cooperative learning models at the secondary level and demonstrated that instructional approaches positioning students as active subjects led to better learning outcomes. While their study was conducted at a different educational level, the participatory principles applied showed similar success in enhancing students' conceptual understanding and social skills, as observed during the implementation of the friction module.

Considering the results from the pretest and posttest, classroom observations, and teacher and student feedback, it can be concluded that the module was successful not only in quantitative terms but also qualitatively contributed to transforming students' learning behaviors. These findings were reinforced by Pacheco (2024), who stated that interactive media can serve as effective tools in bridging students' understanding of complex scientific concepts. Therefore, the *Discovery Learning* and *Game-Based Learning*-based module can be deemed highly appropriate for IPAS learning in elementary schools and holds substantial potential for replication across various subjects and educational levels.

In accordance with the recommendation by Gomez et al. (2022), it is suggested that this module be tested further on a larger scale to confirm its effectiveness at the national level. This step is crucial in reinforcing educational innovation under the *Merdeka Curriculum* and achieving a learning environment that is active, enjoyable, and aligned with 21st-century competencies.



Figure 10 Research at SD Plus Permata Ihsan

CONCLUSION

Based on the results of the conducted research and development, the teaching module that incorporates *Discovery Learning* and *Game-Based Learning* for the topic of friction benefits has been proven to be appropriate for use in Grade IV elementary school instruction. The module underwent a comprehensive validation process by subject matter experts, language specialists, and instructional material evaluators, including worksheets (LKPD), with evaluation scores exceeding 92%. These results indicated that the module was classified as highly valid. The high level of validity reflects that the module's content, language, and structure were aligned with the learning objectives of IPAS and the developmental characteristics of elementary students.

In terms of practicality, an individual trial was carried out, through which it was observed that students were able to understand the module content effectively. The activities embedded within the worksheets and the designed educational games successfully encouraged active participation during the learning process. Student responses indicated that the activities were enjoyable, easy to follow, and contributed to increased motivation for learning. These findings suggest that the module was not only practical for teachers to implement in the classroom, but also capable of positively stimulating student engagement and enthusiasm for learning.

The module's effectiveness was also demonstrated through the comparison of pretest and posttest results, which revealed a significant improvement in students' learning outcomes. The average pretest score of 40.67 increased to 83.33 in the posttest, resulting in an N-Gain score of 0.72, which is categorized as high. This indicated that the actual use of the module had a substantial impact on students' conceptual understanding of friction benefits and contributed to a more meaningful and contextual learning experience.

Therefore, it can be concluded that the developed teaching module is valid, practical, and effective for implementation in IPAS learning at the elementary school level. The integration of *Discovery Learning* and *Game-Based Learning* was found to significantly enhance the overall quality of instruction.

For future development, it is recommended that similar modules be applied to other topics and grade levels, as well as tested on a broader scale to maximize their benefits and further support the transformation toward active learning under the *Merdeka Curriculum* framework.

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