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APPLICATION OF INFORMATION TECHNOLOGY IN DESIGNING GAMES FOR ELEMENTARY SCHOOL TEACHING

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Abstract:
This article discusses the use of information technology to enhance the teaching process for elementary school students through game development. It highlights the crucial role of games in engaging and motivating students, as well as improving the effectiveness of learning. By incorporating technology into game design, educators can establish an interactive learning environment that stimulates students' curiosity and encourages exploration. The article also examines the advantages of technology in education, such as personalized content, instant feedback, and diverse learning experiences. Furthermore, it presents a method for utilizing information technology to create educational games for elementary school students, supported by specific examples.

Keywords: games, elementary school students, teaching, information technology

1. Introduction

In today's technological context, many researchers argue that the future school should be more integrated with technology (Kaufman & Beghetto, 2009). The use of information technology in teaching and learning offers numerous benefits to elementary school students (Lester *et al.*, 2014; Li & Tsai, 2013; Randel *et al.*, 1992; Vos *et al.*, 2011; Wu *et al.*, 2012). It provides them with interactive and dynamic learning opportunities, enabling

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active participation in exploring and acquiring knowledge about the world. Educational games, besides aiding knowledge acquisition in lessons, also foster communication and collaboration skills in students (Smeets, 2005). Educational games can be a valuable tool for enhancing knowledge, bringing positive changes in learners, and empowering their teachers to educate effectively in the modern era (Vázquez-Vílchez *et al.*, 2021).

Using information technology to design and organize educational games for elementary school students can create diverse and engaging learning experiences (Squire, 2005, 2011; Vogel *et al.*, 2006; Vos *et al.*, 2011). Games can feature captivating graphics, music, and compelling storylines, stimulating students' curiosity and desire for exploration (Hays, 2005). Information technology allows for the development of interactive games where students can actively engage in the learning process (Dondlinger, 2007; Squire, 2003). This aids in the enhancement of skills such as logical thinking, problem-solving, and effective collaboration with peers (Barzilai & Blau, 2014). Furthermore, information technology offers immediate feedback, enabling students to assess their learning progress promptly. This insight into their strengths and weaknesses accelerates the learning journey towards achieving their objectives.

2. Literature review

Playing and enjoying play are key psychophysical traits of elementary school students. Educational games focus on creating a learning environment where content and play work together to help learners develop subject knowledge and skills, as well as enhance problem-solving abilities through overcoming challenges (Qian & Clark, 2016; Rieber, 1995).

Games in education are increasingly gaining interest in various studies. The research contexts of learning games are also diverse: the psychological impact of students while engaging in games, the effects of games on students' cognition (E. Boyle *et al.*, 2011; E. A. Boyle *et al.*, 2014); The influence of games on learning abilities in Math, statistics, computer science, psychology (Barab *et al.*, 2009; E. Boyle *et al.*, 2011; E. A. Boyle *et al.*, 2014; Chang *et al.*, 2012; Smeets, 2005). Some studies have indicated that, in the field of education, games not only aid in acquiring subject knowledge and skills but also facilitate the development of essential skills for the 21st century, such as critical thinking, creative thinking, communication, collaboration, information and communication technology... (Guan *et al.*, 2024).

Games used in learning come in various forms, ranging from traditional games that utilize simple teaching tools made from available utensils and items to modern games that incorporate advanced teaching aids like computers, software, speakers, and projectors.

Technology-based games can integrate different media types such as images, videos, audio, and text to offer a comprehensive learning experience. Many games spark students' curiosity by introducing paranormal and challenging elements (Amory, 2007), engaging all their senses and facilitating better comprehension and retention of the

lesson. In educational settings, games serve as an interactive medium designed to create a stimulating and enjoyable learning environment that encourages curiosity, discovery, feedback, and progress (Akcaoglu & Koehler, 2014; Li & Tsai, 2013; Smeets, 2005; Van Der Meij *et al.*, 2011; Vázquez-Vílchez *et al.*, 2021).

Numerous studies have highlighted the positive impact of games on students' cognition and learning skills, providing opportunities for students to explore, challenge themselves, and enhance their motivation to learn. Games are utilized across various educational levels, including university, high school, middle school, primary school, and preschool, with each subject benefiting from games as effective tools that enhance educational outcomes, particularly influencing learners' psychology and interest in learning.

3. Research question

The article aims to analyze the application of information technology in designing educational games for teaching in Vietnamese elementary schools. Which software is appropriate for creating educational games for elementary school education? What are the steps involved in designing educational games?

4. Research content

4.1 The significance of applying information technology to design educational games in teaching for primary students

The use of information technology in designing educational games involves utilizing digital tools and software to develop games for educational use. Applying information technology to create educational games for primary students has significant implications and advantages. It not only improves educational outcomes but also fosters the holistic development of skills essential for future primary school students.

Firstly, educational games based on information technology applications often feature vibrant graphics, which are engaging and create an intriguing learning atmosphere that sparks students' curiosity. This aids in enhancing their focus and active participation in the learning process.

Games frequently incorporate elements of competition and rewards, motivating students to engage and complete tasks. They also offer immediate feedback, enabling students to promptly identify errors and make necessary adjustments.

Interactive educational games can be developed through the application of information technology, allowing students to interact with the learning material and engage in activities according to their preferences. These games can be tailored to individual students' abilities and learning pace, enabling each student to advance at their own rate. This fosters a sense of positivity and creativity among students. Moreover, students have the option to personalize the learning content based on their needs and

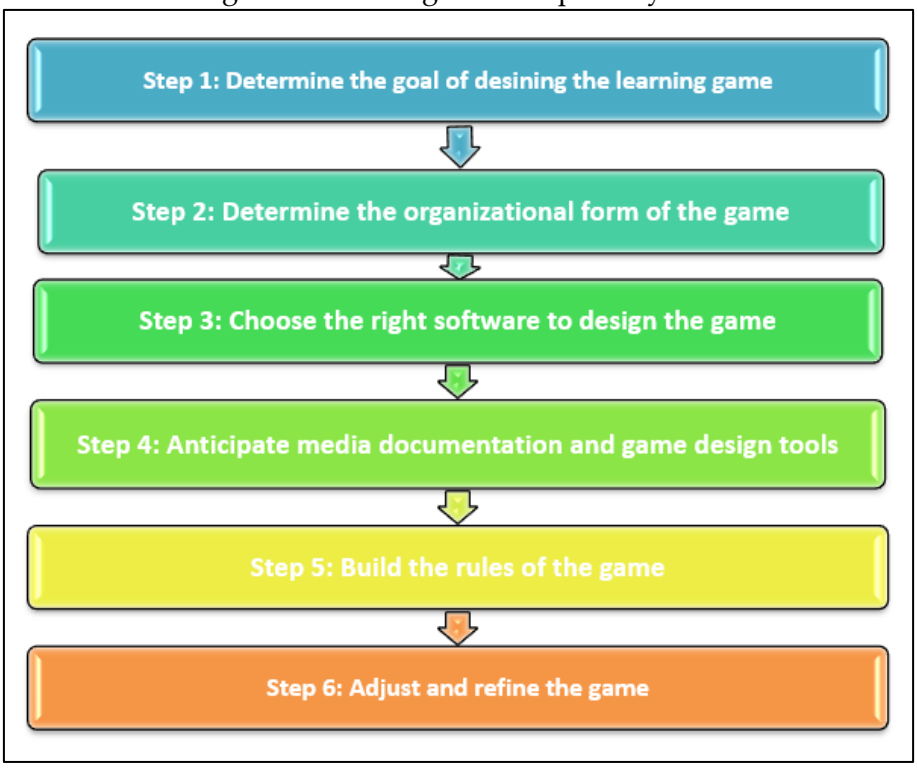
capabilities, creating a customized learning environment where each student can progress according to their own speed.

The game prompts students to think creatively to overcome challenges, fostering the growth of critical thinking skills. Through educational games, students frequently receive immediate feedback on their performance, aiding them in recognizing their strengths and weaknesses and learning how to enhance their study skills. Young students in elementary school are introduced to technology and software at a young age through educational games, enabling them to cultivate 21st-century skills like critical thinking, creativity, collaboration, communication, and digital skills.

4.2 The process of applying information technology to design educational games for primary students

To design an educational game based on the application of information technology, we can follow the following six steps:

Diagram 1: The process of applying information technology to design educational games for primary students



- **Step 1:** Determine the goal of designing the game

Defining the goal of the educational game is a crucial and essential step in the game design and development process. It acts as a guide, ensuring that every aspect of the game is focused on achieving specific educational objectives. Clear learning goals will direct the entire design process, enabling teachers to concentrate on the important and relevant content of the lesson.

To establish the game's goal, teachers must first evaluate the age, education, and psychological traits of elementary school students. Subsequently, they should pinpoint their students' needs and interests to guarantee the game's relevance and engagement. It is particularly important to examine the curriculum, pinpoint and choose suitable lesson goals for game design. Identify the knowledge and skills that the game will assist students in developing, articulating them in specific, clear, and measurable terms. When setting game design objectives, teachers should employ the SMART model (Specific, Measurable, Achievable, Relevant, Time-bound) to define goals efficiently.

- **Step 2: Determine the organizational form of the game**

This is a crucial step in shaping the structure and experience of student play. Deciding on the organizational form of the game involves how the game is structured and presented to the player. The organization form impacts how players engage and experience the game, as well as how they can achieve the game's objectives.

To begin with, the teacher must grasp the game's objective and the specific students involved in the game. Depending on the number of participants in the educational game, teachers can arrange them individually, in groups, or as a whole class. Moreover, it can be based on the teaching environment, allowing teachers to organize games within the classroom or outside.

When selecting the type of educational games, teachers should consider factors such as classroom characteristics, school facilities, student numbers, and learning capabilities. Some questions teachers should consider when deciding on the organizational type include: What are the students' ages and levels? Are there adequate support facilities in the classroom for all students? Is the game area spacious or limited? How many students will participate? Who will oversee and assist in organizing the game? Will students be more engaged playing individually or in groups while learning? Will individual or group play promote and support student development? When choosing the type of educational game, teachers must address and respond to all the above questions to ensure that the game aligns with educational objectives and caters to the needs and abilities of all students in the classroom.

- **Step 3: Choose the right software to design the game**

Software is the key tool for transforming ideas into educational games. Selecting the appropriate software is crucial for game development. To make the right choice, educators should first define the game's specific objectives, gameplay format, number of players, environment, classroom space, and technical support platform. They should assess each software's performance based on factors like compatibility with classroom settings, graphics and sound quality, appropriateness for students' proficiency level, and technology usage skills. Some commonly utilized software for creating games for elementary school students include Kahoot, Quizlet, Scratch, Classcraft, Plickers, Wordwall, and Nearpod. By considering the game's objectives, organization format, software features, compatibility with classroom settings, graphics and sound quality,

appropriateness for students' proficiency level, and technology usage skills, educators can choose the most suitable game for design.

- **Step 4: Anticipate media documentation and game design tools**

This step focuses on planning and preparing the necessary materials and tools for the game design process. Choosing media materials and game design tools enables teachers to offer clear guidelines and resources essential for effective game design. This entails specifying the required content, graphics, music, and other media that teachers must prepare.

In this stage, considering the objectives, organizational structure, and game software utilized, the teacher precisely outlines the materials and tools needed for the game. This may involve game tutorials, visual and audio templates, and software tools that support the game in achieving educational goals. Subsequently, the teacher moves on to gather the essential materials and resources for designing the game to ensure alignment with the game's goals and organizational structure.

In the age of technology 4.0, educators can conveniently utilize the internet and search engines like Google Chrome and Bing, or specialized platforms such as Google Scholar educational materials search engine to explore documents and IT tools related to keywords like "educational materials," "mobile apps," "educational software," "learning games," "e-learning," and "e-learning" for relevant matches.

- **Step 5: Build the rules of the game**

Game rules are the essential foundation of a game, defining the rules and guiding players on how to play and how to interact with the game. Building game rules helps create a logical and consistent structure for the game, helping players understand and participate in the gaming experience coherently and engagingly. It also plays an essential role in creating balance and challenge for players, ensuring that the game is not too easy or too difficult.

In order to develop appropriate game rules, first of all, teachers need to clearly define the goals of the game, the form of organization, the software used, and existing materials and facilities. From there, the basic rules players must follow when participating in the game must be determined. This includes rules about the number of teams playing, scores, how to move, and how to interact with objects in the game. In addition, extra rules can be added to prevent exceptional circumstances or make the experience enjoyable for students when participating in the game.

- **Step 6: Adjust and refine the game**

This step plays an important role in ensuring the quality and perfection of the game before it is held in the classroom. Reviews help identify the strengths and weaknesses of the game, which can then be adjusted and improved to meet the player's wishes. Through this process, the game can be adjusted to ensure that it best meets the learning objectives.

To evaluate the learning game after design, teachers can test it on a small group of students or consult with colleagues in person or online. This feedback can help teachers initially identify outstanding issues and strengths of the game. Based on feedback and evaluation, teachers can adjust and improve parts of the game, such as visuals, music or rules and prepare the necessary materials and facilities to be able to organize games for students.

4.3 Example of information technology application for designing games for elementary school students

We designed the learning game "School Safety" using lesson 7: Practice: Survey on school safety, Grade 3 Natural and Social subjects of Vietnam (Ministry of Education and Training, 2018).

- **Step 1: Determine the goal of designing the game**

After the lesson, students can Demonstrate safety on campus or the area around the school; Distinguish between safe and unsafe areas; Develop a survey plan for the safety of classrooms, fences, playgrounds, or the area around the school according to the form; Safety surveys related to school facilities or the area around the school as assigned by the team; Make reports, present survey results, and give recommendations to the school to overcome and limit possible risks; Make recommendations to the school to overcome and limit possible risks.

- **Step 2: Determine the organizational form of the game**

Game organization form based on the characteristics of the classroom, the school facilities, the number of students, and the cognitive abilities of students at a decent level, we decided to organize the educational game in the form of a group. This game is for Vietnamese 3rd graders, with the number of students from 35 to 40. The teacher will be the one who runs the game, takes on the role of advisor, and supervises the activities that take place. To support the game, the classroom needs a projector and computer.

These technology devices will help teachers present materials and instructions effectively for the entire classroom. The game will take place in the space of the classroom, taking advantage of available resources and creating an interactive learning environment for students. Choose to organize games in the form of groups with the desire to encourage collaboration, communication, and teamwork among students. It encourages active participation and provides opportunities for students to learn from each other and develop their social and cognitive skills.

- **Step 3: Choose PowerPoint software to design the game**

Currently, there are various popular software options, often utilized, for creating games aimed at elementary school students such as Kahoot, Quizlet, Scratch, Classcraft, Plickers, Wordwall, Nearpod. We have opted for Powerpoint software to develop the

"School Safety" game due to factors like the objectives, game organization, and software features. Powerpoint fulfills our needs with numerous advantages.

Firstly, Powerpoint is widely used software and highly familiar to teachers and students. This simplifies its utilization and adjustment to students' technological proficiency levels. It provides a straightforward and user-friendly interface that aids teachers and students in focusing on game design and content creation. Powerpoint offers a variety of tools and features that enhance graphics and sound. Teachers can incorporate effects, graphics, images, and sounds into games to enhance interactivity and appeal. Powerpoint is adaptable to classroom settings, as it can operate on various platforms and operating systems, from personal computers to projectors. Moreover, PowerPoint can create dynamic, captivating educational games ranging from simple to intricate.

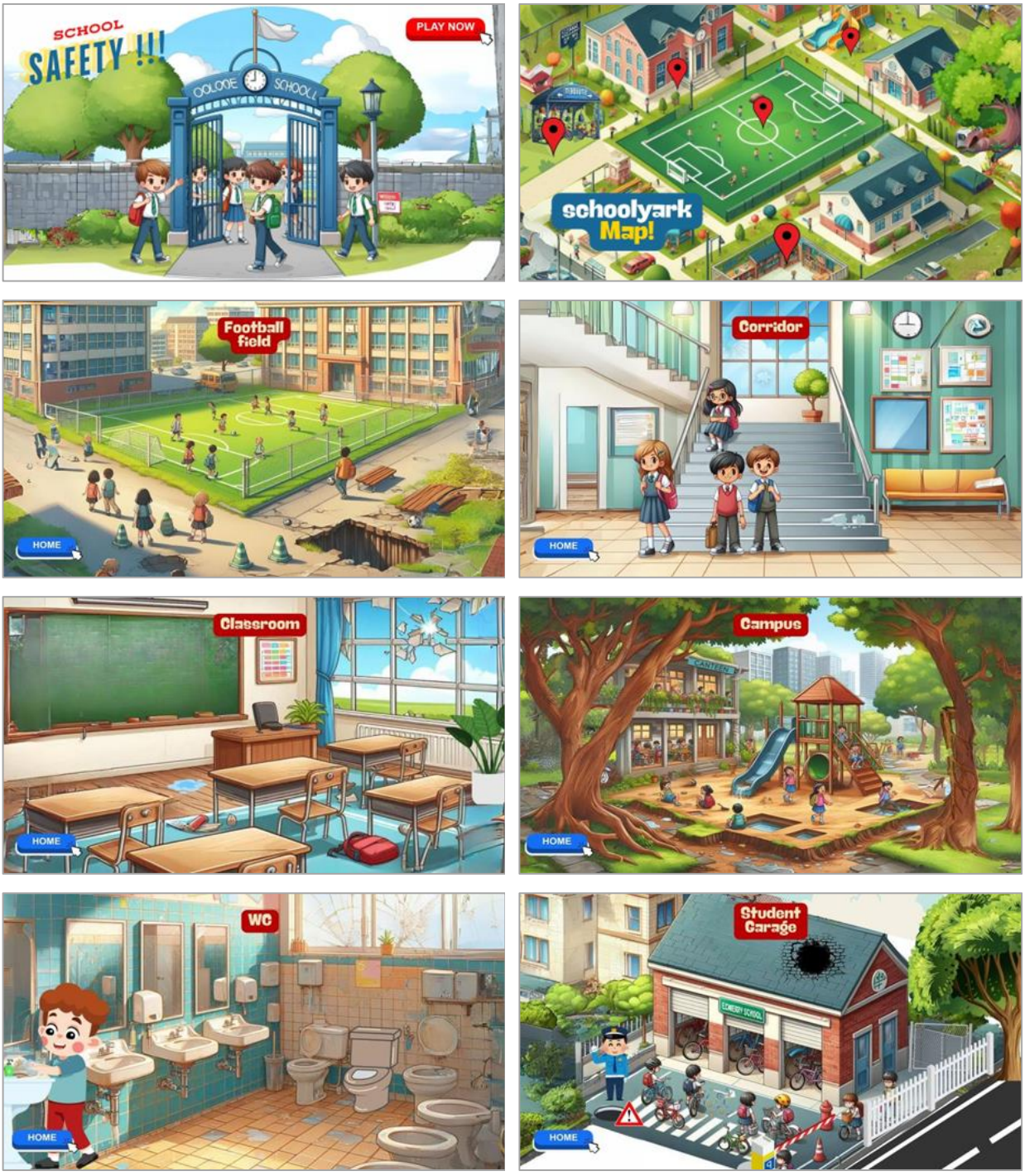
- **Step 4. Selection of media materials and game design tools**

Based on the objectives, organizational framework, and gaming software utilized, educators utilize the Bing document search engine to find suitable IT resources and tools. Educators who utilize Microsoft Copilot within Bing leverage artificial intelligence (AI) to create visuals for games, such as game backgrounds and graphic designs. The backgrounds featured in the game "School Safety" are generated by AI according to the teacher's specifications of 5 distinct zones, encompassing safe and unsafe locations.

Through the images below, teachers utilize them as a tool for the game. Students engage in the game in groups, collectively identifying safe and unsafe places in the selected area.

Subsequently, the teacher employs PowerPoint software to enhance the visuals in the game by adding effects such as sounds, hyperlinks, etc. Moreover, when determining the team sequence, the teacher utilizes the Wheel of Names software to randomly select the participating teams' order.

The utilization of artificial intelligence (AI) brings numerous benefits. This technology enables teachers to generate high-quality images based on their specifications. Providing detailed requirements results in more transparent and more realistic images. An added advantage is that most AI software is freely available, offering teachers cost savings and easy access to advanced technology.



The Wheel of Names software also provides several advantages. Its user-friendly interface is intuitive and highly customizable, offering many options. Teachers can swiftly create a wheel of fortune based on the names of the participating teams, promoting fairness and excitement in the random and impartial selection of team orders.

- **Step 5: Build the rules of the game**

The game "School Safety" follows these rules: Teachers will utilize the Wheel of Names software to randomize the order of play groups. The first group selected will be able to

pick the location they wish to explore in the game. Subsequent groups will follow suit until the final group. Once the location in the simulated school is chosen, each group will encounter an engaging challenge. Within 30 seconds, the team must identify safe and unsafe spots in that area. Students must rely on observation, safety knowledge, and creativity to achieve optimal results. Points will be awarded for each correct answer and deducted for incorrect ones. Ultimately, the team with the highest point total will emerge as the victor, showcasing intelligence, observation skills, and exceptional teamwork.

- **Step 6: Adjust and refine the game**

After finishing the game, we assess, modify, and enhance to elevate the game's quality. Here is a summary review of the game's strengths and weaknesses:

A. Advantage:

- The game utilizes artificial intelligence (AI) for image design, presenting vivid, appealing visuals that capture students' interest.
- It generates excitement and engagement among students, facilitating quick engagement in the lesson and fostering learning motivation.
- Leveraging free software for game design reduces costs and enhances game accessibility.
- The game is innovative and fresh, enabling students to explore diverse and engaging learning approaches.

B. Limitation:

- Game design may be time-consuming due to the necessity of managing and organizing in-game elements.
- Teachers require proficient information technology skills, particularly in artificial intelligence and PowerPoint, to implement this game.

5. Conclusion

Utilizing information technology in designing educational games is an effective approach to enhancing the learning experience for elementary school students. Incorporating technological elements into the games makes the learning process more interactive and enjoyable, fosters learning motivation, and encourages active student participation. The article thoroughly examines the advantages and procedures of applying information technology in educational game design, supported by specific examples. These findings and recommendations affirm that integrating technology in primary education is not just a trend but necessary to address modern learning needs. Moving forward, ongoing research and advancement of information technology applications in education will further enhance and broaden the effectiveness of teaching and learning, contributing to establishing a creative and positive learning environment for students.

Conflict of interest statement

The authors declare no conflicts of interest.

About the Author(s)

Dr. Hang Nguyen Thi Thu is a lecturer at Thai Nguyen University of Education in Vietnam. She obtained her PhD in Educational Theory and History from the Vietnam Institute of Educational Sciences in 2013. Dr. Hang is an author of textbooks for primary school students in Vietnam. Her primary research focuses on integrated teaching, STEM education for primary school students, and teacher training.

Ninh Ngoc Anh, Ngo Thu Huyen, Lanh Thi Quynh Chau and Do Thi Linh are students in High-Quality Class K56, Department of Primary Education, Thai Nguyen University of Education. They are students with many positive achievements in scientific research on teaching elementary school students.

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