10.22633/rpge.v29iesp3.20687

Revista on line de Política e Gestão Educacional
Online Journal of Policy and Educational Management

[1] Faculty of Basic Sciences, Ly Tu Trong College, Ho Chi Minh City, Vietnam

[2] Faculty of Natural Sciences, Hong Duc University, Thanh Hoa, Vietnam

[3] Faculty of Mathematics and Applied, Sai Gon university, Ho Chi Minh city Viet Nam

[4] National Academy of Education Management, Hanoi city, Vietnam

[5] Faculty of Primary Education, Nghe An University, Vietnam.

EDITORA IBERO-AMERICANA

APPLYING SCAFFOLDING STRATEGY IN TEACHING PROBLEM SOLVING TO ENHANCE STUDENTS' LEARNING MOTIVATION IN HO CHI MINH CITY, VIETNAM

APLICAÇÃO DA ESTRATÉGIA DE SCAFFOLDING NO ENSINO DA RESOLUÇÃO DE PROBLEMAS PARA FORTALECER A MOTIVAÇÃO DOS ESTUDANTES PARA A APRENDIZAGEM NA CIDADE DE HO CHI MINH, VIETNÃ

APLICACIÓN DE LA ESTRATEGIA DE ANDAMIAJE EN LA ENSEÑANZA DE LA RESOLUCIÓN DE PROBLEMAS PARA FORTALECER LA MOTIVACIÓN DE LOS ESTUDIANTES HACIA EL APRENDIZAJE EN LA CIUDAD DE HO CHI MINH, VIETNAM

Thi Ngoc Tram TRAN[1]
tranthingoctram@lttc.edu.vn
Huu Hau NGUYEN[2]
nguyenhuuhau@hdu.edu.vn
Hoa Anh TUONG[3]
hatuong@sgu.edu.vn
Tran Trung TINH[4]
tinh.naem@gmail.com
Trinh Cong SON[5]
sontc@nau.edu.vn

How to reference this paper:

Tran, T. N. T., Nguyen, H. H., Tuong, H. A., Tinh, T. T., & Son, T. C. (2025). Applying scaffolding strategy in teaching problem solving to enhance students' learning motivation in Ho Chi Minh city, Vietnam. *Revista on line de Política e Gestão Educacional, 29*(esp3), e025070. https://doi.org/10.22633/rpge.v29iesp3.20687

Submitted: 02/09/2025
Revisions required: 10/09/2025
Approved: 17/09/2025
Published: 27/11/2025

ABSTRACT: The study addresses the challenge students face in understanding spatial distance, particularly in determining the distance from a point to a plane, an abstract concept that often leads to disorientation and loss of motivation. To counter this, the research applies a scaffolding strategy based on Vygotsky's Zone of Proximal Development to design an instructional process that supports conceptual understanding. A quasi-experimental method was implemented with two groups of 11th-grade students. Data were gathered through test scores and motivation surveys, then analyzed using descriptive statistics and paired-sample tests in SPSS 26. Results revealed that students in the experimental group achieved higher performance and demonstrated significantly greater learning motivation. These findings confirm that scaffolding effectively enhances students' ability to solve spatial distance problems, fosters confidence in their learning process, and strengthens motivation for mathematical study.

KEYWORDS: Scaffolding strategy. Distance from a point to a plane. Spatial geometry. Learning motivation. High education.

RESUMO: *O estudo aborda o desafio que os alunos enfrentam na compreensão da distância espacial, particularmente na determinação da distância de um ponto a um plano, um conceito abstrato que frequentemente leva à desorientação e à perda de motivação. Para combater isso, a pesquisa aplica uma estratégia de andaimes baseada na Zona de Desenvolvimento Proximal de Vygotsky para projetar um processo instrucional que apoie a compreensão conceitual. Um método quase experimental foi implementado com dois grupos de alunos do 11º ano. Os dados foram coletados por meio de notas de testes e pesquisas de motivação, e então analisados usando estatísticas descritivas e testes de amostra pareada no SPSS 26. Os resultados revelaram que os alunos do grupo experimental obtiveram desempenho superior e demonstraram motivação de aprendizagem significativamente maior. Essas descobertas confirmam que o andaime efetivamente melhora a capacidade dos alunos de resolver problemas de distância espacial, promove a confiança em seu processo de aprendizagem e fortalece a motivação para o estudo matemático.*

PALAVRAS-CHAVE: *Estratégia de andaime. Distância de um ponto a um plano. Geometria espacial. Motivação para aprendizagem. Ensino superior.*

RESUMEN: *El estudio aborda el desafío que enfrentan los estudiantes en la comprensión de la distancia espacial, particularmente en la determinación de la distancia de un punto a un plano, un concepto abstracto que con frecuencia provoca desorientación y pérdida de motivación. Para abordar esta dificultad, la investigación aplica una estrategia de andamiaje basada en la Zona de Desarrollo Próximo de Vygotsky con el fin de diseñar un proceso instruccional que apoye la comprensión conceptual. Se implementó un método cuasiexperimental con dos grupos de estudiantes de 11.º grado. Los datos se recopilaron mediante calificaciones de pruebas y encuestas de motivación, y luego se analizaron utilizando estadísticas descriptivas y pruebas de muestras emparejadas en SPSS 26. Los resultados revelaron que los estudiantes del grupo experimental obtuvieron un rendimiento superior y demostraron una motivación de aprendizaje significativamente mayor. Estos hallazgos confirman que el andamiaje mejora de manera efectiva la capacidad de los estudiantes para resolver problemas de distancia espacial, fortalece su confianza en el proceso de aprendizaje y aumenta su motivación para el estudio de la matemática.*

PALABRAS CLAVE: *Estrategia de andamiaje. Distancia de un punto a un plano. Geometría espacial. Motivación para el aprendizaje. Educación superior.*

Article submitted to the similarity system

iThenticate

Editor: Prof. Dr. Sebastião de Souza Lemes
Deputy Executive Editor: Prof. Dr. José Anderson Santos Cruz

INTRODUCTION

In the context of current general education reform, improving motivation to learn Mathematics remains one of the major challenges for teachers, especially at the high school level. In Vietnam, students often have difficulty learning spatial geometry topics such as the distance from a point to a plane due to their abstract, multi-step nature and the cognitive demand required for three-dimensional thinking. When lacking appropriate guidance and support, many students become passive, disoriented and easily give up on their learning tasks. Previous studies have highlighted students' cognitive difficulties in understanding parallel relationships between planes (Nam et al., 2023), and the challenge of visualizing, manipulating and understanding abstract objects in three-dimensional space is a difficult task for learners (Phuc & Tam, 2024). These findings underscore the urgent need for instructional strategies that can assist students in overcoming such barriers, especially in topics like point-to-plane distance. Moreover, effective guidance may also help learners overcome anxiety when facing the problem (Sari et al., 2024a).

The study by Duong et al. (2018) focused on solving the problem of distance from a point to a plane in many different ways by collecting and analyzing students' work. Mai and Huy (2023) only stopped at systematizing methods for calculating the distance from a point to a plane. Although these contributions offered comprehensive listings of problem types and solutions, there is still a lack of empirical studies focusing on guiding students on how to correctly determine the distance from a point to a plane in conjunction with the goal of promoting learning motivation. In real classroom contexts, some problems about the distance from a point to a plane are not easy to determine immediately, but can go through many stages such as adding auxiliary lines, finding perpendicular elements, etc.

To detect those elements, teachers need to give suggestions or guiding questions to stimulate students' ability to self-discover problems, thinking operations such as reasoning, comparison, analysis, etc. Once students become fluent with these approaches, they are more likely to develop autonomy in learning: posing questions, identifying problems, and evaluating their own solutions. These are key goals of Vietnam's National Curriculum Reform 2018, which emphasizes the development of self-study and autonomy (Ministry of Education and Training, 2018). This study aims to address the research gap by proposing the use of a simplified teaching strategy that brings students to the Actual Development Zone where students have mastered to improve students' learning motivation by enhancing their success expectancy and perceived value of the learning task.

Scaffolding has been shown to be an effective method in supporting students' approach to complex learning tasks. Scaffolding positively affects students' ability to understand mathematical concepts and the use of scaffolding in learning pathways can improve the level of geometric thinking of university students (Trimurtini et al., 2023; Waruwu & Zega, 2023). In terms of learning motivation, expectancy-value theory emphasizes that expectancy of success and perceived value of the task are important factors determining learning motivation. Students' self-efficacy and perceived value change significantly during the transition from high school to college in STEM fields (Mayerhofer et al., 2024) and these are also predictors of academic success in introductory mathematics courses (Benden et al., 2023). Specifically, this study seeks to answer the following research questions:

(1) How does the scaffolding strategy based on the actual development zone (ADZ) support students in determining the distance from a point to a plane in space?

(2) Is there a difference in learning motivation between the experimental group before and after the intervention?

(3) Is there a difference in problem-solving performance between the experimental group before and after the intervention?

LITERATURE REVIEW

Zone of Proximal Development and Actual Development Zone

Distinguishing between Zone of Proximal Development and Actual Development Zone

Vygotsky (1978) distinguishes between the Actual Development Zone (ADZ) is what learners can accomplish independently and the Zone of Proximal Development (ZPD), which includes tasks that learners can complete only with appropriate guidance or support.

According to McLeod (2025), the ZPD will continuously change and expand as children learn and acquire new skills that prepare them for increasingly complex challenges. The activity performed in the ZPD is not a passive process but a dynamic one. In this, the instructor may provide simulations, suggestions and the learner actively participates to achieve performance. This active participation ensures that learners do not merely imitating expert behavior but also develop a deeper understanding of the underlying principles and strategies (McLeod, 2025; Vygotsky, 1978).

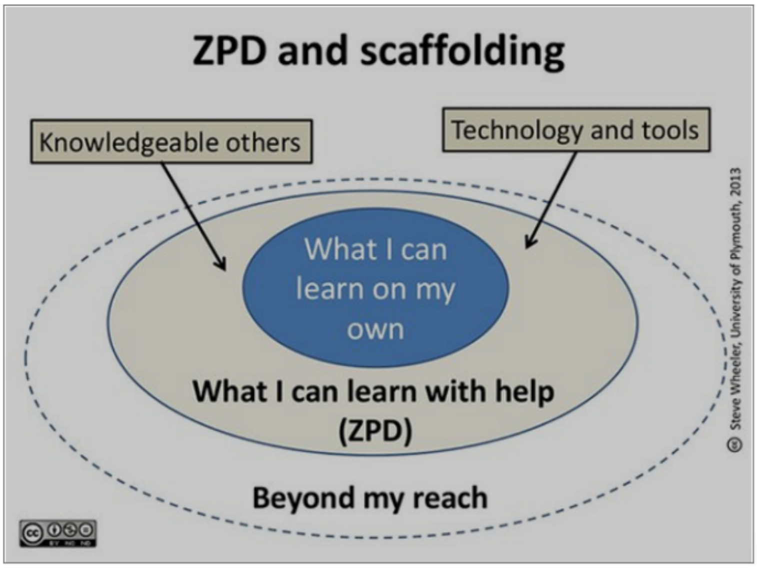
The Concept of Scaffolding

The term "scaffolding" originally refers to the temporary wooden platforms constructed for workers to stand on while building a structure (Anghileri, 2006). In educational contexts, Wood et al. (1976) define scaffolding as a process that enables a child or novice to solve problems, perform tasks, or achieve goals that would otherwise be beyond their unaided efforts. This scaffolding essentially involves adults controlling those elements of the task that are initially beyond the learner's capabilities, allowing them to focus and complete only those elements that are within their capacity (Wood et al., 1976, p. 90).

10.22633/rpge.v29iesp3.20687

According to Holton and Clarke (2006), knowledge construction is cognitive scaffolding that allows learners to reach places they would otherwise not be able to reach. More recently, Sari et al. (2024b) describe scaffolding techniques as the process of providing guidance or instructional prompts that bridge the gap between what students already know and what they need to learn. Additionally, Manaf et al. (2024) investigated the effectiveness of scaffolding in teaching probability and found that it significantly enhanced students' critical thinking skills and self-regulated learning. In the context of mathematics education, scaffolding can be understood as an instructional model comprising a structured system of support that helps students successfully tackle mathematical problems that they have not yet solved.

Figure 1
Scaffolding and zone of proximal development according to Wheeler (2013)



Note. Prepared by the authors (2025).

Learning Motivation

The Concept of Learning Motivation

Motivation to learn is understood as willingness, need, desire, promoting students' participation and achieving success in the learning process (Bomia et al., 1997,). The desire to learn is called motivation and it is influenced by a person's needs, perceptions, values, and attitudes (Darboe, 2000). Ames (1992) argued that motivation exists as part of a person's goal structure, a person's beliefs about what is important, and it determines whether a person will engage in a particular effort or not. Skinner and Belmont (1993) explain that motivated students are more likely to choose tasks at the edge of their current abilities and to fully dedicate their attention, effort when given opportunities to learn; they display positive emotions such as enthusiasm, optimism, curiosity, and interest during the action.

Expectancy – Value Theory (EVT)

Expectancy-value theory suggests that a person's achievement - related choices are strongly influenced by their expectations for success in a task and the value they place on that task (Eccles & Wigfield, 2020). In other words, EVT emphasizes that students' motivation to learn is influenced by two main factors: (1) Expectancy for succes - the extent to which students believe they can complete a task; (2) Subjective task value - the extent to which a task is important, interesting, or useful to students (Eccles & Wigfield, 2002; Eccles & Wigfield, 2006; Eccles & Wigfield, 2024).

Expectancy-value theory (Eccles, 1983; Eccles & Wigfield, 2020) is a widely used framework for measuring students' beliefs about themselves to predict achievement motivation, performance, persistence, and achievement-related choices. Students make conscious or unconscious decisions about their level of engagement, which are largely influenced by how confident they feel about succeeding in the task (Fielding-Wells et al., 2017). As such, we can argue that EVT provides a solid theoretical framework for understanding and enhancing students' motivation to approach spatial geometry problems, thereby increasing their self--efficacy. This is consistent with the findings of Lee and Song (2022), who proposed several recommendations to support learning to promote students' self-efficacy and task values. In addition, utility value interventions have a positive effect on other motivational beliefs and values, as well as the decision to continue studying courses in the intervention area (Hulleman & Harackiewicz, 2009).

Solving the problem of distance from a point to a plane

How to determine the distance from a point to a plane in textbooks in Vietnam

The distance from a point to a plane is introduced in the 11th grade Math textbook program as follows: If H is the orthogonal projection of the point *M* on the plane(*P*) then the length *MH* is called the distance from *M* to (*P*), denoted *(d(M, (P))* (Nam et al., 2024, p. 75). We can understand that if $MH \perp (P)$ then *d(M,(P))=MH*.

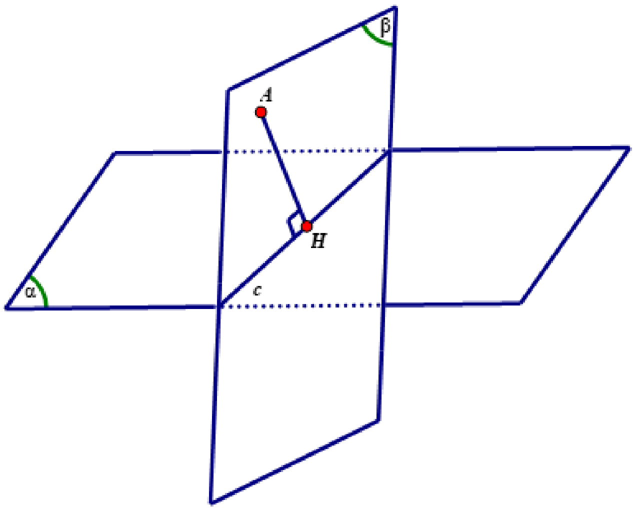
Método tradicional de determinação da distância de um ponto a um plano

To find *d(A;(α))*, we can do as follows:

- Through *A* we need to construct a plane (*β*) so that $\alpha \perp \beta$.
- Find the intersection *c* of *α* and *β*.
- Draw $AH \perp c$ at *H.*

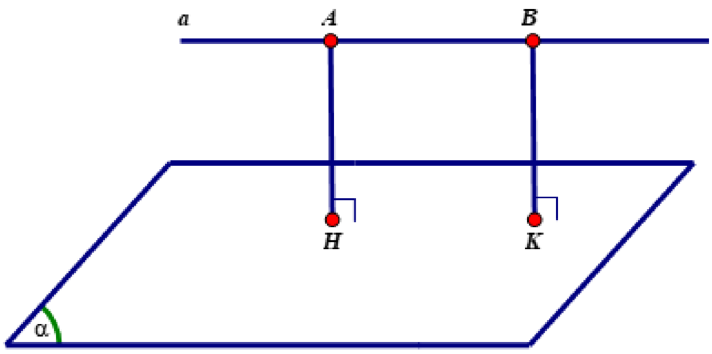
Therefore *AH = d (A;(α)).*

Figure 2
Illustration of the distance from a point A to a plane (α)(α)



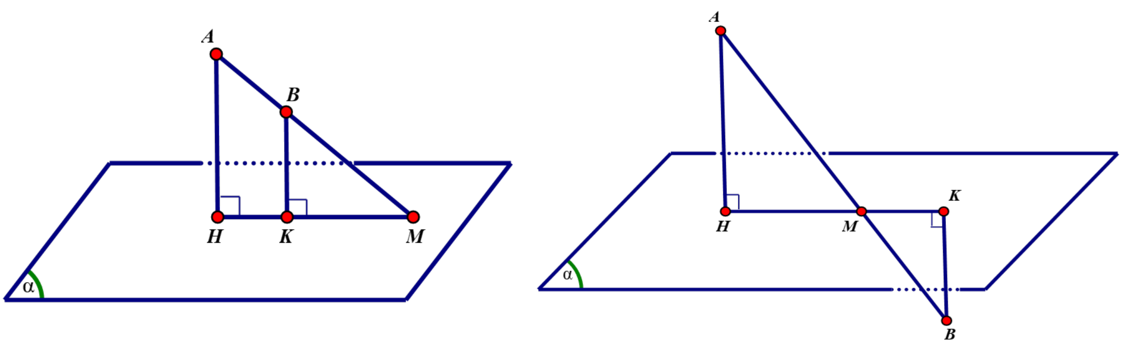
Note. Prepared by the authors (2025).

Figure 3
If AB// (α) then d(B;(α)) = d(A;(α)).



Note. Prepared by the authors (2025).

Figure 4
If AB cuts (α) at M then d(B;(α)): d(A;(α)) =MB:MA.



Note. Prepared by the authors (2025).

10.22633/rpge.v29iesp3.20687

MATERIALS AND METHODS

Participants

The research participant/ The participants in this study include 300 grade 11 students studying Mathematics in the 2024-2025 school year at Tan Binh High School and Nguyen Thuong Hien High School in Ho Chi Minh City. Based on the average mid - semester II Mathematics scores of the students (Table 6), there was no difference, we divided them into two groups:

Experimental group (150 students): taught using scaffolding strategies based on ADZ.

Control group (150 students): taught using traditional methods, without applying scaffolding strategies.

Instrument

To assess the improvement of learning motivation, the learning motivation questionnaire (EVQ) was used to assess the learning motivation of experimental group (EG) and control group (CG) students before and after the intervention. This scale was designed from the study of Wigfield & Eccles (2000), including two main components: Expectancy Belief (EB) and Task Value (TV). A test was conducted for both groups before and after the intervention to assess the performance in solving the distance problem from a point to a plane.

Procedure

Pre-intervention phase (Week 1): the EVQ survey was distributed to EG and CG to survey the current status of learning motivation of students in the two groups before the intervention.

Intervention phase (Weeks 2 and 3): EG was instructed using the scaffolding strategy, CG learned using the traditional method.

Post-intervention phase (Week 4): EVQ survey form was distributed and spatial geometry problem test was conducted for both groups.

Data collection and analysis

Data were analyzed using descriptive statistics and independent t-tests to compare the post-intervention results between CG and EG. Paired-samples t-tests were used to assess the improvement in mean scores within the EG before and after the intervention. For learning motivation variables, descriptive statistics and independent samples t-tests were applied to each item to compare differences in specific motivational indicators between the two groups after the intervention. Additionally, paired-samples t-tests were conducted on each item to

10.22633/rpge.v29iesp3.20687

examine the improvement in learning motivation within the EG. The entire analysis process was performed using SPSS version 26 software with a statistical significance level of α=0.05. This approach allows to evaluate the effectiveness of the teaching method using scaffolding in terms of both cognition and learning motivation.

RESULTS

Describe a pedagogical intervention using scaffolding strategies

The teacher guided students to master the following problem:

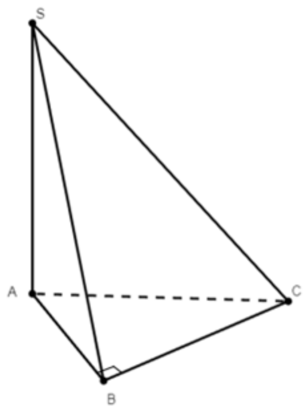
P1: Given a pyramid *S.ABC* with a right triangle *ABC* at *B*, $SA \perp (ABC)$.

P1 a): Determine the distance from point *C* to plane (*SAB*).

P1 b): Determine the distance from point *A* to plane (*SBC*).

Based on the characteristics of the Actual Development Zone (ADZ), we considered Problem P1 as the students' actual development zone. According to EVT theory, guiding students to perform proficiently within their ADZ can enhance their expectancy for success—one of the core components of EVT. At the same time, this perspective also provides a basis for addressing research question (1): "How does the scaffolding strategy based on the actual development zone (ADZ) support students in determining the distance from a point to a plane in space?".

Figure 5
Illustration of the problem model



Note. Prepared by the authors (2025).

The EG was guided through the following steps:

Step 1: Problem Modeling.

- Identify key elements such as the location of points, planes, and perpendicular lines.

Step 2: Perform analogical reasoning based on the ADZ

10.22633/rpge.v29iesp3.20687

- Identify the task that is analogous to the one within the ADZ;
- Detect missing elements in the current problem model compared to the problem within the ZPD, thereby proactively drawing additional auxiliary lines or determining projections.

Step 3: Verify and present the solution

- Recheck the reasoning steps. Then present the solution clearly, logically, and convincingly.

Pedagogical experiment

Guiding Students to Master the Problem within the ADZ

Based on Polya's (1957) problem solving process and the characteristics of procedural scaffolding, we proposed the following guiding questions to build the "scaffold" for students:

+ What does the problem need to find?

+ What information or assumptions are already provided?

+ How are the given assumptions connected to help solve the problem?

+ How should the solution be presented?

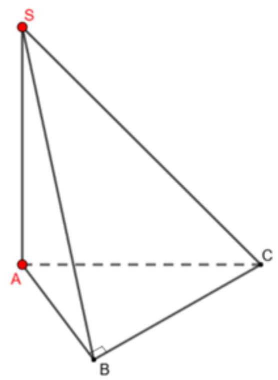
- Students work, exchange, and discuss:

+ (P1a): The problem needs to find the distance from the point *C* to (*SAB*).. The problem has provided assumptions such as: a right triangle *ABC* at *B* and *SA* ⊥*(ABC)*.. From the assumption, students can establish a drawing in which there are important points to note (Figure 6) which are the top *S* of the pyramid *S.ABC*; the foot of the height *A* starting from the top *S* is perpendicular to the base (*ABC*).

+ From the given assumption, students can deduce that in the plane (*SAB*) there are two lines *BA* and *SA* intersecting at *A*:

$\begin{cases} CB \perp BA \\ CB \perp SA \end{cases}$ *so CB* ⊥ (*SAB*). Therefore *d(C,(SAB)) = CB.*

Figure 6
Model of problem P1a



Note. Prepared by the authors (2025).

10.22633/rpge.v29iesp3.20687

(P1b): The problem requires finding the distance from the point *A* to (*SBC*).. The assumptions provided are: right triangle *ABC* at *B,SA* ⊥ (*ABC*), *CB* ⊥ (*SAB*).

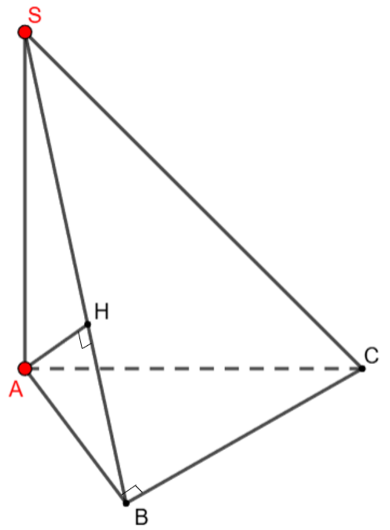
From (P1a) we can deduce *CB* ⊥ (*SAB*) so (*SCB*) ⊥ (*SAB*) (Because *CB*⊂ (*SBC*)). Draw *AH* ⊥ *SB* (Figure 6) at *H*, we argue as follows:

Two plane (*SCB)* and (*SAB*) intersect at *SB* and

$\begin{cases}(SCB) \perp (SAB) \\ AH \subset (SAB), AH \perp SB\end{cases}$ deduce AH ⊥ (*SBC*).

So *d(A,(SBC)) = AH.*

Figure 7
Model of problem P1b



Note. Prepared by the authors (2025).

The teacher illustrates the distance from point *A* to plane (*SBC*) using GeoGebra so that students can clearly see that point *H* belongs to *SB*.

+ Start the GeoGebra tool, select 3D Graphics.

+ Draw a pyramid *S.ABC* with *SA* perpendicular to the plane (*ABC*) and a right triangle ABC at B.

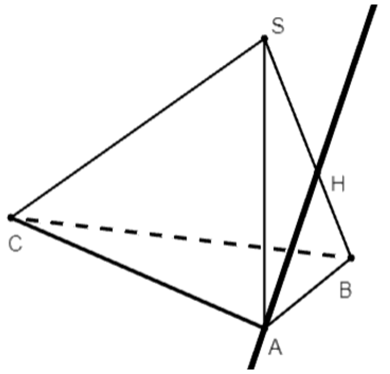
+ Select the command "*Plane through three points*" then select points *S,B,C* in turn to create a plane (*SBC*).

+ Select the command "*Perpendicular line*" then select point *A* and select the plane (*SBC*) just created. A straight line appears passing through *A* and perpendicular to (*SBC*).

+ Select the command "Intersect" then select the line just created and the line *SB*. The intersection point appears, name that point as point *H*.

Students observe the image and comment: Point *H* belongs to *SB*.

Figure 8
Illustration from GeoGebra



Note. Prepared by the authors (2025).

Representative Problems and Problem-Solving Approaches Using the Scaffolding Strategy

Problem P2: Given pyramid S.ABC with SA ⊥(ABC). Determine the distance from point *C* to (*SAB*).

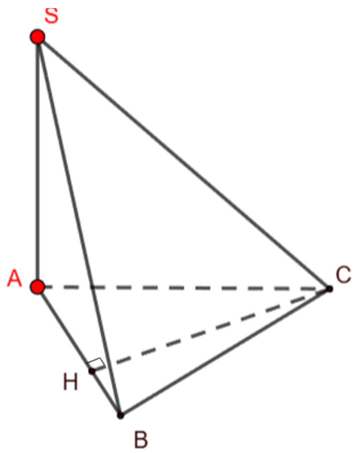
Step 1: Problem Modeling

- Students recognize the perpendicularity of *SA* and plane (*ABC*), thereby correctly place points *S,A,B,C.*

Step 2: Perform analogical reasoning based on the ADZ.

- Students recognize the similar task as P1a, discover the missing element in problem P2 which is a triangle with a non-right base at *B*. From there, students came up with the idea of drawing *CH* perpendicular to (Figure 9);
- Students establish a model of problem P2 corresponding to problem P1a (Figure 11).

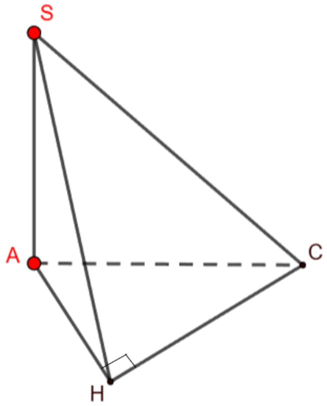
Figure 9
Model of problem P2



Note. Prepared by the authors (2025).

10.22633/rpge.v29iesp3.20687

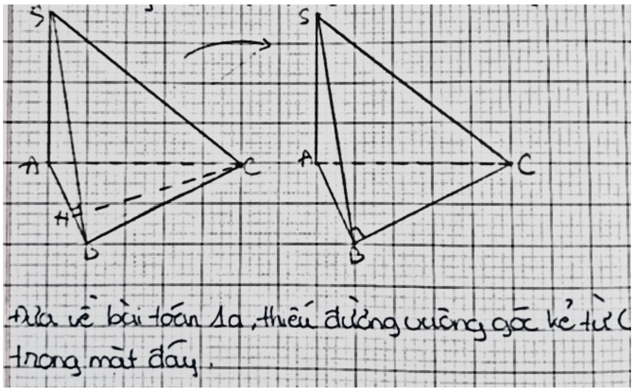
Figure 10
Problem model P2 reduces to P1a



Note. Prepared by the authors (2025).

Teachers can organize students by groups to explore models made of hand-bent zinc to simulate pyramids in spatial geometry. Direct manipulation of the model helps students visualize key elements such as the top, sides, base and perpendicular lines. This hands-on experience helps them connect the physical model to the well-mastered model in the ADZ. This is a form of physical scaffolding combined with cognitive scaffolding, creating favorable conditions for students to develop spatial geometric thinking in a more flexible and profound way[1].

Figure 11
The image of students explaining how they relate to the ADZ



Note. Prepared by the authors (2025).

Step 3: Verify and present the solution

Students check again by reasoning: draw *CH* perpendicular to *AB*, we have *CH* is also perpendicular to *SA*. so *CH* will be perpendicular to plane (*SAB*). So the distance from *C* to (*SAB*) is *CH*.

After checking by logical reasoning, students present the solution again (Figure 12):

In plane (*ABC*), draw $CH \perp AB$ at *H*.

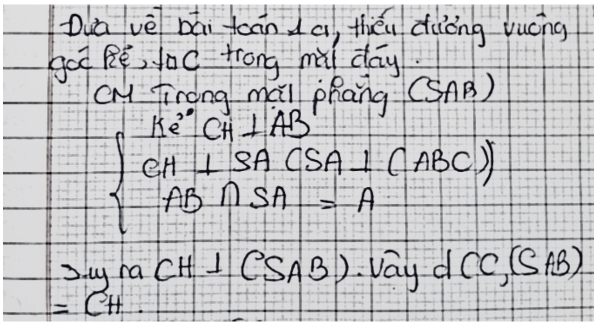
[1] Link video: https://drive.google.com/file/d/1ed_DGLf30ItNNYEOCWIh3mKvZpHICB9/view?usp=sharing.

In plane (*SAB*) there are two lines *SA* and *AB* intersecting at *A*:

$\begin{cases} CH \perp AB \\ CH \perp SA \end{cases}$ deduce $CH \perp (SAB)$

Therefore $d(C,(SAB)) = CH$.

Figure 12
The image shows students explaining how to do something and presenting their solution



Note. Prepared by the authors (2025).

Problem P3: Given pyramid *S.ABC* with $SA \perp (ABC)$. Determine the distance from point *A* to (*SBC*).

Step 1: Problem Modeling.

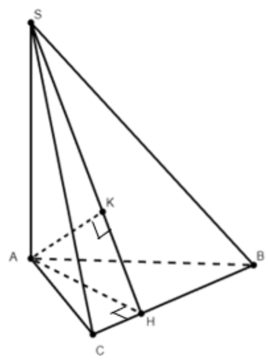
- Students recognize the perpendicularity of *SA* and plane (*ABC*), thereby placing the correct positions of points *S,A,B,C.*

Step 2: Perform analogical reasoning based on the ADZ.

- Students recognize the similar task as P1b, and discover the missing element in problem P3, which is that the base triangle is not right at *C*. From there, students come up with the idea of drawing *AH* perpendicular to *BC*, then drawing *AK* perpendicular toSH (Figure 13).

Students establish a model of problem P3 corresponding to problem P1b (Figure 15).

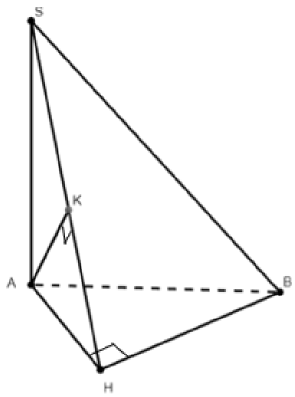
Figure 13
P3 problem model



Note. Prepared by the authors (2025).

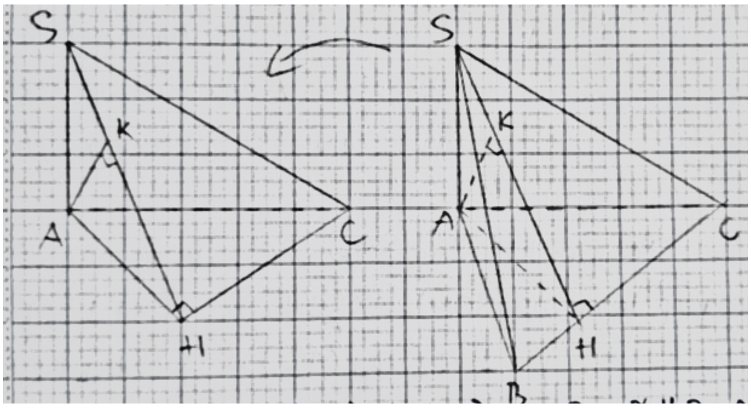
10.22633/rpge.v29iesp3.20687

Figure 14
The P3 problem model reduces to P1b



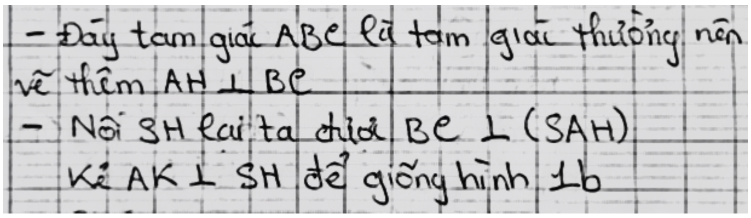
Note. Prepared by the authors (2025).

Figure 15
Students convert problem model P3



Note. Prepared by the authors (2025).

Figure 16
The image of students explaining how they relate to the ADZ



Note. Prepared by the authors (2025).

Step 3: Verify and present the solution

Students check again by reasoning: draw *AH* perpendicular to *BC*, we have *BC* is also perpendicular to *SA*, so *BC* is perpendicular to plane (*SAH*), so plane (*SAH*) is perpendicular to plane (*SBC*). *SH* is the intersection of two planes (*SAH*) and (*SBC*) so line *AK* is perpendicular to *SH*, then *AK* is perpendicular to plane (*SBC*). So the distance from *A* to (*SBC*) is *AK*.

After checking by logical reasoning, students present the solution again (figure 17):

- In the plane (*ABC*), draw $AH \perp BC$ at *H*.
- In plane (*SAH*) there are two lines *SA* and *AH* intersect at *A*:

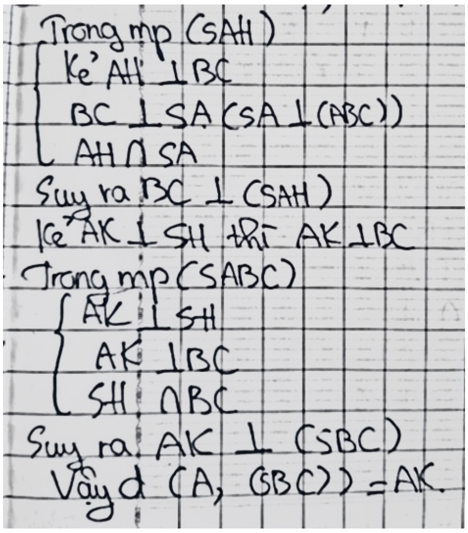
$\begin{cases} BC \perp AH \\ BC \perp SA \end{cases}$ deduce $BC \perp (SAH)$) so that $(SBC) \perp (SAH)$.

Draw $AK \perp SH$ at *K*, two planes (*SBC*) and (*SAH*) intersect at *SH*:

$\begin{cases} (SBC) \perp (SAH) \\ AK \perp SH \end{cases}$ deduce $AK \perp (SBC)$.

Therefore $d(A,(SBC))=AK$.

Figure 17
The image shows students explaining how to do something and presenting their solution.



Note. Prepared by the authors (2025).

Post-experiment survey results

Results of the survey on learning motivation between the experimental and control groups

To assess students' learning motivation after being taught using the scaffolding strategy, a questionnaire was developed based on Eccles and Wigfield's Expectancy - Value Theory (2002). This survey focused on two key components: (1) Expectancy for success, which reflects the extent to which students believe they can successfully complete the learning task; (2) Subjective task value, which indicates how interesting, useful, or important students perceive the learning content to be. Responses were measured using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), based on the following items:

10.22633/rpge.v29iesp3.20687

Q1: I believe I can make an effort to solve problems involving the distance from a point to a plane;

Q2: I feel interested in learning about distances in spatial geometry;

Q3: I believe the skills I learn from this lesson will be useful in my future life or career;

Q4: Understanding this topic makes me feel that I am making progress in learning spatial geometry problems.

Reliability Analysis

To ensure the validity of the EVT-based model, Cronbach's alpha coefficients were calculated separately for two constructs: expectancy for success (Items Q1 and Q2) and subjective task value (Items Q3 and Q4). When analyzed separately (Table 1), the CG reported a Cronbach's alpha of *α=.954* for expectancy for success, and *α=.887* for task value. The EG reported a Cronbach's alpha of *α=.905* for expectancy for success, and *α=.899* for task value. When analyzing both groups together (Table 2), the reliability coefficients were *α=.930* for expectancy for success and *α=.893* for task value. All results are within the good reliability level (*α>.80*) according to the standard of Nunnally and Bernstein (1994). This method has been adopted in recent studies to measure psychological constructs, such as in Nagle (2021) for measuring motivation, and Hart (2023) for examining the latent structure of well-being. This shows that the items in each measurement group are consistent with the concept of learning motivation, confirming the scale's appropriateness for further statistical analysis.

Table 1
Separate reliability analysis for CG and EG: Mean, Standard Deviation, and Cronbach's Alpha coefficients for two constructs of the Expectancy–Value Questionnaire

Scale	Group	N	Mean	SD	Cronbach's Alpha
Expectancy for success. Q1: I believe I can make an effort to solve problems involving the distance from a point to a plane. Q2: I feel interested in learning about distances in spatial geometry.	CG	300	2.3300	.90397	.954
	EG	300	2.3500	.90751	.905
Subjective task value. Q3: I believe the skills I learn from this lesson will be useful in my future life or career. Q4: Understanding this topic makes me feel that I am making progress in learning spatial geometry problems.	CG	300	2,5567	.78879	.887
	EG	300	2.6000	.75403	.899

Note. Prepared by the authors (2025).

10.22633/rpge.v29iesp3.20687

Table 2

Combined analysis for both CG and EG: Mean, Standard Deviation, and Cronbach's Alpha coefficients for two constructs of the Expectancy–Value Questionnaire.

Scale	N	Mean	SD	Cronbach's Alpha
Expectancy for success. Q1: I believe I can make an effort to solve problems involving the distance from a point to a plane. Q2: I feel interested in learning about distances in spatial geometry.	600	2.3400	.90504	.930
Subjective task value. Q3: I believe the skills I learn from this lesson will be useful in my future life or career. Q4: Understanding this topic makes me feel that I am making progress in learning spatial geometry problems.	600	2,5783	.77127	.893

Note. Prepared by the authors (2025).

The mean learning motivation scores of the EG were compared with those of the CG using SPSS version 26 to determine the statistically significant difference between the two groups. To assess whether the intervention had any impact on students' learning motivation, we used descriptive statistics to compare the mean scores of each item in the motivation scale for both groups before the intervention. The results obtained all Sign. values were greater than 0.05 (Table 3), indicating that there was no statistically significant difference between the two groups. Furthermore, the Levene test results were all higher than 0.05, indicating that there was no difference in variance in the answers of the two groups. In other words, the learning motivation of the two groups was equivalent at the time before the intervention, indicating that the sample was appropriate for conducting the experiment.

Table 3

Results of Independent Samples t-Test for Questions Q1 to Q4 in the Pre-Intervention Survey

Group Statistics					
Questions	**Group**	**N**	**Mean (M)**	**Std. Deviation**	**Std. Error Mean**
Q1	CG	150	2,38	.87216	.07121
	EG	150	2,44	.86296	.07046
Q2	CG	150	2,28	.93493	.07634
	EG	150	2.26	.94429	.07710
Q3	CG	150	2,44	.90101	.07357
	EG	150	2,47	.78318	.06395

Q4	CG	150	2,67	.63981	.05224
	EG	150	2,72	.70375	.05746

t-test for Equality of Means

Questions	**t**	**df**	**Mean difference**	**Sig. (2-tailed)**
Q1	-.599	298	-.06000	.550
Q2	.184	298	.02000	.854
Q3	-.342	298	-.03333	.733
Q4	-.687	298	-.05333	.493

Levene's Test for Equality of Variances

Questions	**F**	**Sig.**
Q1	.136	.712
Q2	.101	.751
Q3	3.042	.082
Q4	.000	.999

Note. Prepared by the authors (2025).

After implementing the scaffolding strategy, we conducted paired-samples t-tests on the EG for each question from Q1 to Q4 in the EVT scale, to compare learning motivation before and after applying the scaffolding strategy. The results showed a significant increase in all four questions of the EVT scale. Moreover, the correlation coefficients were all greater than 0.07 and P-Value < 0.05. This indicates that the average scores of the factors in learning motivation at the pre- and post-intervention times had a strong relationship and had significant changes. The results are detailed as follows (Table 4):

+ Q1: t(149) = -38.23; Sign. (2-tailed) < .001; r = 0.809
+ Q2: t(149) = -42.38; Sign. (2-tailed) < .001; r = 0.739
+ Q3: t(149) = -90.22; Sign. (2-tailed) < .001; r = 0.946
+ Q4: t(149) = -40.40; Sign. (2-tailed) < .001; r = 0.781

These findings provide an answer to research question 2, affirming that the use of scaffolding strategies in teaching the distance from a point to a plane by guiding students from their ZPD to their ADZ significantly enhanced their learning motivation, shown through two factors in EVT: success expectancy and task value (Figure 18). This result is completely consistent with the study of Puntambekar & Hubscher (2005) that "scaffolding" is clearly effective in helping students handle complex tasks and supporting step-by-step knowledge construction.

Table 4

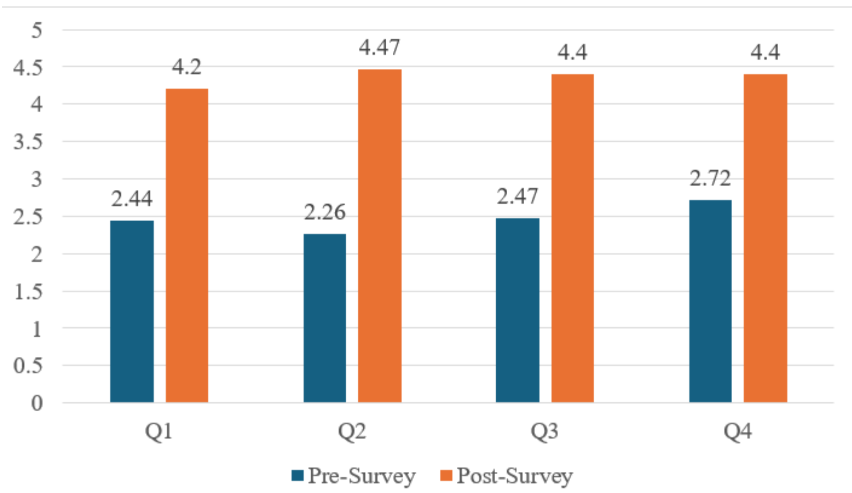
Results of Paired-Samples t-Test for questions Q1 to Q4 on the EVQ Scale in the EG before and after intervention

Paired Samles Statistics						
Question	**Group**	**Mean**	**N**	**SD**		
Q1	CG	2,44	150	.86		
	EG	4.20	150	.93		
Q2	CG	2.26	150	.94		
	EG	4,47	150	.74		
Q3	CG	2,47	150	.78		
	EG	4,40	150	.80		
Q4	CG	2,72	150	.70		
	EG	4,40	150	.81		
Paired Sample test						
Pair	**Mean Difference**	**SD**	**t**	**df**	**Sig. (2-tailed)**	**Correlation**
Q1	-1,76	.56	-38,23	149	.001	.809
Q2	-2,21	.64	-42,38	149	.001	.739
Q3	-1,93	.26	-90,22	149	.001	.946
Q4	-1,68	.51	-40,40	149	.001	.781

Note. Prepared by the authors (2025).

Figure 18

Average learning motivation scores from Q1 to Q4 of the EG before and after intervention

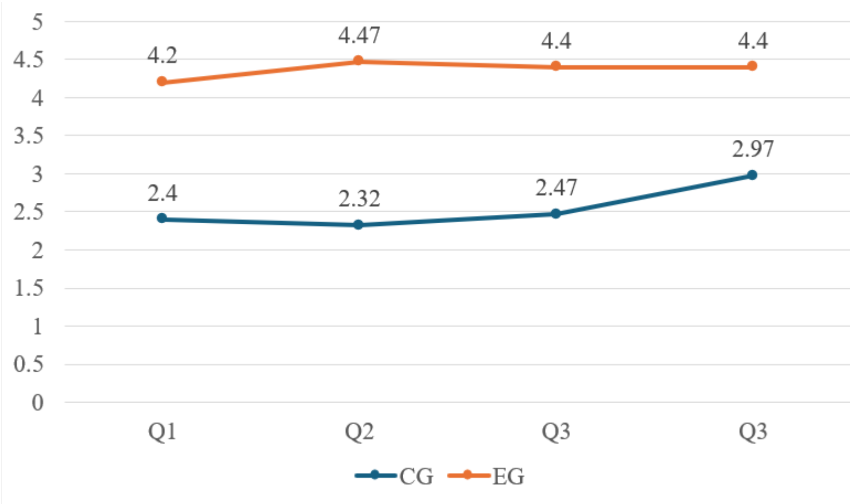


Note. Prepared by the authors (2025).

10.22633/rpge.v29iesp3.20687

Figure 19

Average learning motivation scores of CG and EG after intervention



Note. Prepared by the authors (2025).

Furthermore, the comparison results of the mean scores from Q1 to Q4 of CG and EG after the intervention all had significant differences in statistical significance (Table 5), specifically the Sig.(2-tailed) value = .000 < 0.05.

Table 5

Independent samples t-test results for Q1 to Q4 between CG and EG after the intervention

Group Statistics					
Question	**Group**	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Q1	CG	150	2.4000	.85922	.07015
	EG	150	4.2000	.93407	.07627
Q2	CG	150	2.3200	.87715	.07162
	EG	150	4.4667	.73882	.06032
Q3	CG	150	2.4667	.90980	.07429
	EG	150	4.4000	.80268	.06554
Q4	CG	150	2.9667	.69915	.05709
	EG	150	4.4000	.81100	.06622

t-test for Equality of Means				
Question	**t**	**df**	**Mean difference**	**Sig. (2-tailed)**
Q1	-17.370	298	-1,80000	.000
Q2	-22.925	298	-2,14667	.000
Q3	-19.516	298	-1,93333	.000
Q4	-16.395	298	-1,4333	.000

Note. Prepared by the authors (2025).

10.22633/rpge.v29iesp3.20687

Performance assessment results after intervention using the "scaffolding" strategy

The test scores of the CG and the EG (Table 6) before the intervention were compared using SPSS version 26 software to check whether there was a statistically significant difference between the two groups. The descriptive statistics show that the average score of the CG (M=6.84) and that of the EG (6.72) did not differ significantly, as the Sign. (2-tailed) = .0501 > 0.05. Furthermore, the Sig. = .317 > 0.05 in the Levene test showed that there was no difference in variance between the two groups. Thus, it can be concluded that the difference in mean scores between the two groups was not statistically significant. That is, the level of the two selected groups was the same, suitable for conducting the experiment.

Table 6
Independent samples t-test results of mean scores of CG and EG before intervention

		Group Statistics		
Group	**N**	**Mean (M)**	**Std. Deviation**	**Std. Error Mean**
CG	150	6,84	1.50203	.12264
EG	150	6,72	1,58059	.12905
		t-test for Equality of Means		
t	**df**	**Mean difference**	**Sig. (2-tailed)**	
.674	298	.12000	.501	
		Levene's Test for Equality of Variances		
F	**Sig.**			
1.004	.317			

Note. Prepared by the authors (2025).

To evaluate the effectiveness of the intervention, a post-intervention performance assessment test was administered to both the EG and CG. The test was designed to test the understanding and application of knowledge about distances from points to planes in spatial geometry. Both groups of students were given the same problem under similar conditions to compare learning outcomes and determine the impact of the scaffolding strategy on geometric problem-solving performance. The problem was given as follows:

Problem 4: Given a regular pyramid *S.ABC*, *O* is the center of triangle *ABC*. the center of triangle *O* to (*SBC*) and the distance from point *A* to (*SBC*).

10.22633/rpge.v29iesp3.20687

The scale is designed with a total score of 10 points, in which the first task has the highest score of 7 points, illustrated as follows:

Table 7
Grading scale for students solving problem P4

	Correct distance is identified, logical presentation.	Correct distance is identified but the presentation is not logically coherent or complete.	Distance not determined or incorrectly determined.
d(O,(SBC))	4,0-7,0	0-4,0	0,0
d(A,(SBC))	2,0-3,0	0-2,0	0,0

Note. Prepared by the authors (2025).

The results of the post-intervention test score analysis (Table 8) showed that the mean test score of the experimental group after the intervention (Mean = 8.55) was significantly higher than that before the intervention (Mean = 6.72), with Sign. (2-tailed) = 0.000 < 0.05. Furthermore, the correlation coefficient r=.863 showed a strong correlation between the pre- and post - intervention test scores of EG. This proves the research question (3) that the teaching method using scaffolding not only enhances learning motivation but also contributes to improving the performance in solving three-dimensional geometry problems.

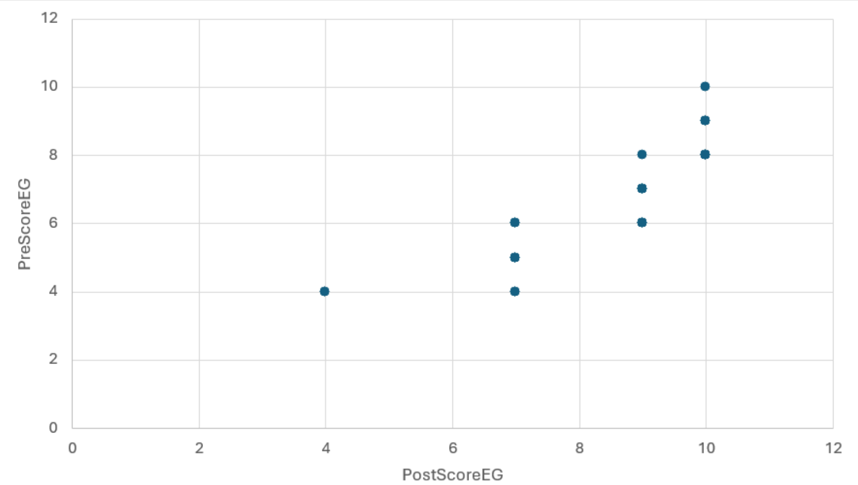
Table 8
Paired samples t - test results of the mean scores of the EG before and after the intervention

Paired Samles Statistics						
	Mean	**N**	**SD**			
Pre – Score of EG	6.7200	150	1.58059			
Post – Score of EG	8.5467	150	1.57406			
Paired Sample Test						
	Mean difference	**SD**	**t**	**df**	**Sig. (2-tailed)**	**Correlation**
Pre – Score of EG-Post – Score of EG	-1.82667	.82533	-27.107	149	.000	.863

Note. Prepared by the authors (2025).

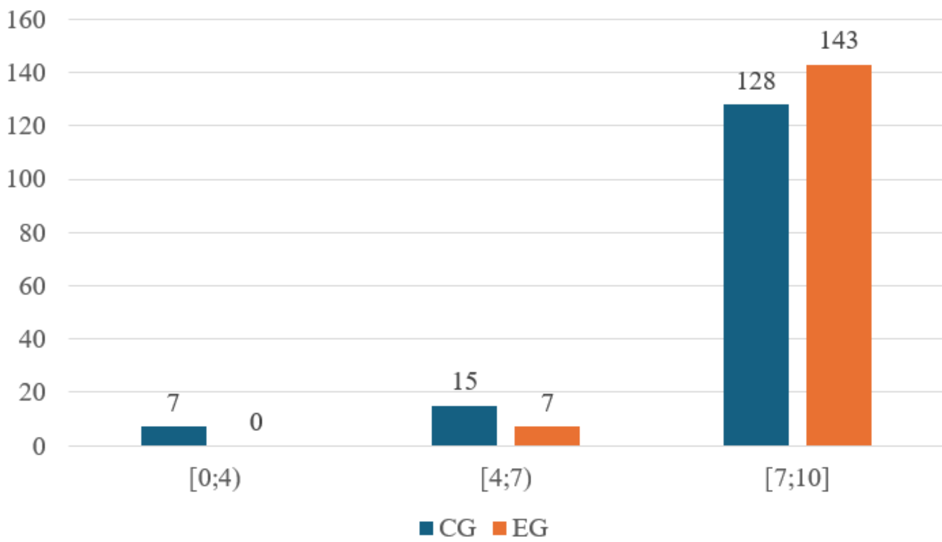
In addition, Figure 20 shows that many students in the EG group improved their scores compared to before the intervention, and no student had a lower score than before. This proves that the scaffolding method brings about uniform effectiveness.

Figure 20
Image of pre - and post - intervention test score distribution of EG group



Note. Prepared by the authors (2025).

Figure 21
Postintervention test score distribution of CG and EG



Note. Prepared by the authors (2025).

The results of the postintervention test score distribution (Table 9) of CG and EG show a significant difference. Notably, in the EG group, no students scored from 0-4, which shows that 100% of EG students correctly determined the distance from the point *O* to the plane (*SBC*), In contrast, 7 students (4.67%) in the CG failed to identify the correct distance from the point O to the plane (*SBC*). With the score range [4;7], CG had 15 students (10%) who determined the distance from the point *O* to the plane (*SBC*) but did not present a good solution, however, EG only had 7 students (4.67%). The number of students in EG who achieved a score of [7-10] was 143 students (95.33%) higher than CG with 128 students (85.33%),

10.22633/rpge.v29iesp3.20687

this is the score level of students who correctly determined the distance from the point *O* to the plane (*SBC*) combined with presenting an accurate and logical solution and from there could determine the distance from the point *A* to the plane (*SBC*).

Table 9
Distribution of postintervention test scores of the CG and EG

Score range	Frequency	
	CG	EG
[0;4)	7	0
[4;7)	15	7
[7;10]	128	143

Note. Prepared by the authors (2025).

Furthermore, the independent samples t-test results of the post-intervention test scores of CG and EG (Table 10) showed a significant difference through the value Sig.(2-tailed) = .000 < 0.05.

Table 10
Independent sample t-test results of the postintervention test scores of CG and EG

Group Statistics				
Group	**N**	**Mean (M)**	**Std. Deviation**	**Std. Error Mean**
CG	150	6.4533	1.75165	.14302
EG	150	8.5467	1.57406	.12852
t-test for Equality of Means				
t	df	Mean difference	Sig. (2-tailed)	
-10.887	298	-2.09333	.000	
Levene's Test for Equality of Variances				
F	Sig.			
1.699	.193			

Note. Prepared by the authors (2025).

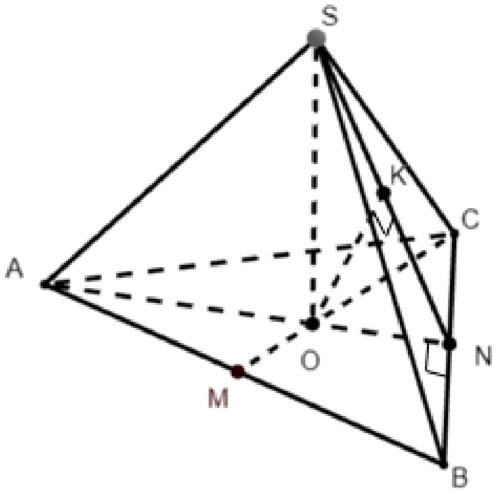
Experimental group followed the "scaffolding" strategy

Let *N* is the midpoint of *BC*. Recognize the perpendicularity of *SO* and plane (*ABC*); properties of equilateral triangle *ABC*, thereby place the correct positions of the points *S,A,B,C,O,N.*

Recognizing the similar task is P1b, checking the elements in problem P4 is complete with the assumptions of problem P1, so we only need to draw a line *OK* perpendicular to *SN*.

Because *AO* intersects plane (*SBC*) at *N* so $\frac{d(A,(SBC))}{d(O,(SBC))} = \frac{AN}{ON} = \frac{3}{1}$
Therefore *d(A,(SBC)) = 3.d(O,(SBC)) = 3.OK*

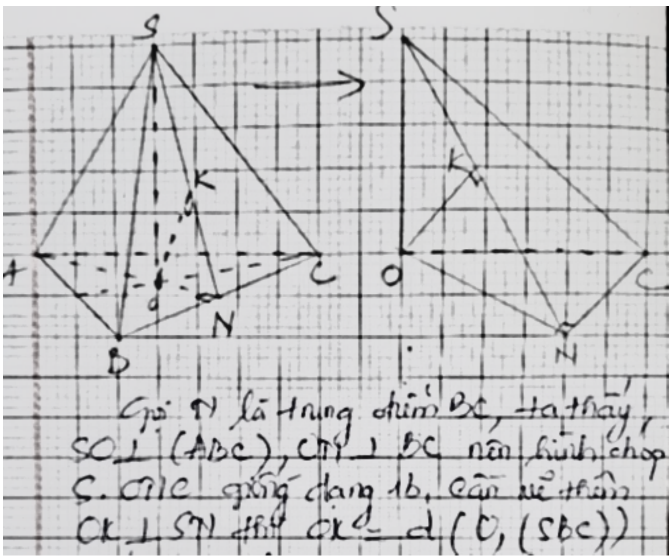
Figure 22
Model of problem P4



Note. Prepared by the authors (2025).

After evaluating the work of students in the EG, we found that 100% of students in this group completed step 1 (Correctly identifying the location of key elements of the problem). On that basis, 100% of students correctly determined the distance from the point *O* to the plane (*SBC*). This clearly shows the importance and effectiveness of the scaffolding method.

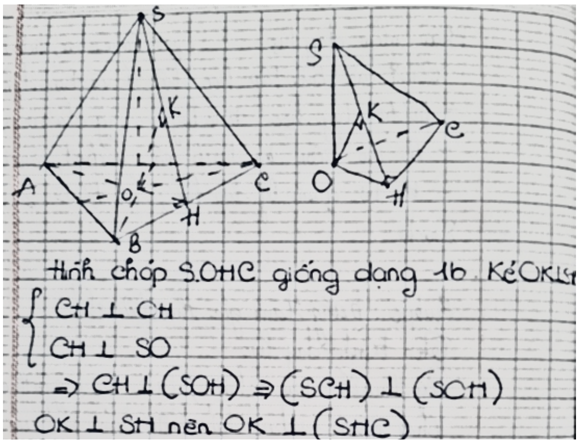
Figure 23
Students in the EG explain how to determine the distance.



Note. Prepared by the authors (2025).

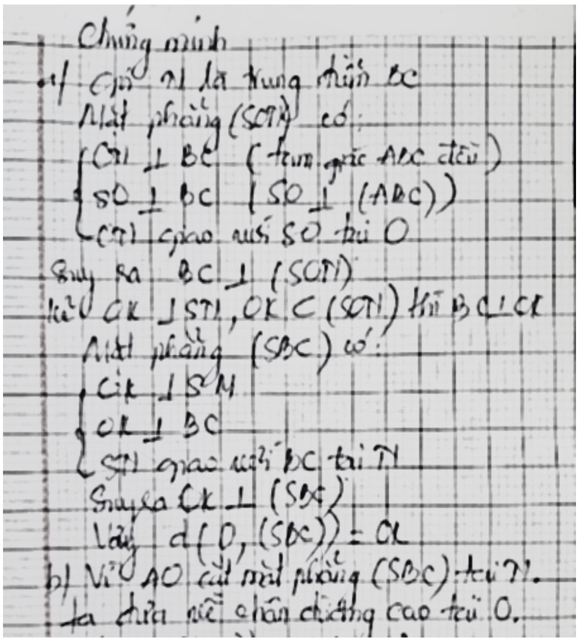
10.22633/rpge.v29iesp3.20687

Figure 24
Students in the EG present a poor solution.



Note. Prepared by the authors (2025).

Figure 25
Alunos do GE apresentam uma boa solução



Note. Prepared by the authors (2025).

The control group followed the traditional method:

Find the plane containing point *O* so that the plane is perpendicular to the plane (*SBC*). *N* is the midpoint of *BC*. The plane to be found is the plane (*SON*). Find the intersection of the two planes (*SBC*) and (*SON*).

From *O* draw *OK* perpendicular to the intersection at *K*. So *d(O,(SBC)) = OK.*

Because *AO* intersects the plane (*SBC*) at *N*, so $\frac{d(A,(SBC))}{d(O,(SBC))} = \frac{AN}{ON} = \frac{3}{1}$

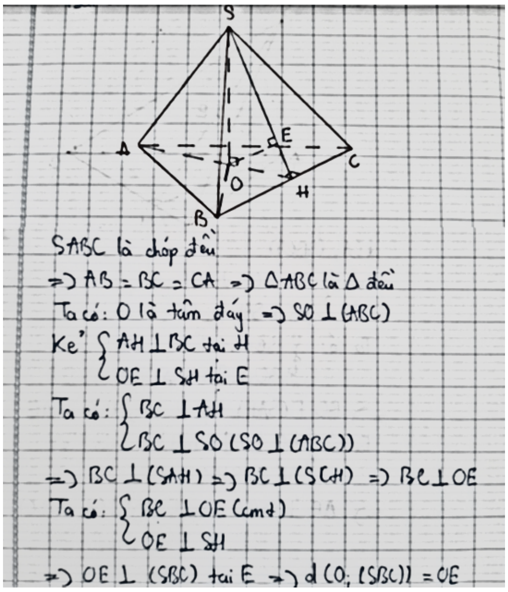
Because *AO* intersects the plane (*SBC*) at N, so $\dfrac{d(A,(SBC))}{d(O,(SBC))}=\dfrac{AN}{ON}=\dfrac{3}{1}$

Therefore *d(A,(SBC))=3.d(O,(SBC))=3.OK*

Through the test evaluation results of the CG, we found that students with scores in the range (0;4) were students who drew the problem model incorrectly (Figure 27 and 28), which led to incorrect determination of the distance from the point *O* to the plane (*SBC*). In addition, students with scores in the range (4;7) did not perform well in presenting the solution logically (Figure 29).

Figure 26

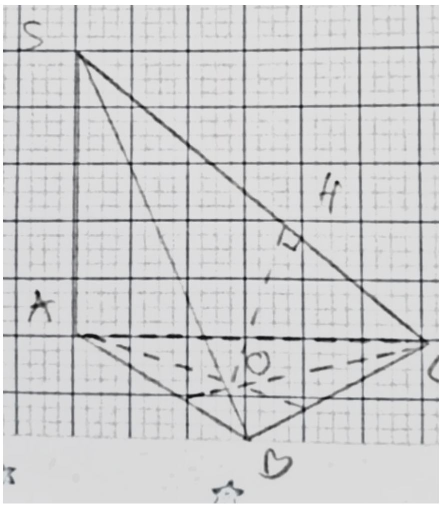
Students of the CG performed well



Note. Prepared by the authors (2025).

Figure 27

Poor results from students of the CG

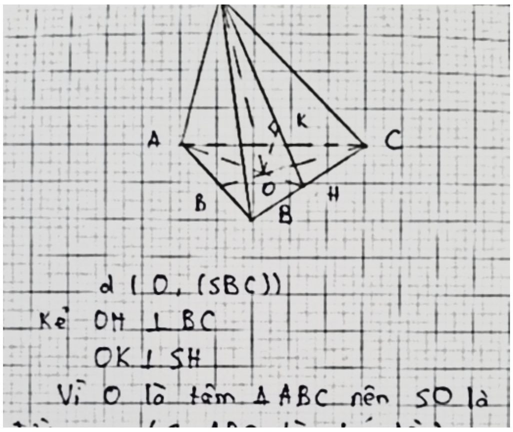


Note. Prepared by the authors (2025).

10.22633/rpge.v29iesp3.20687

Figure 28

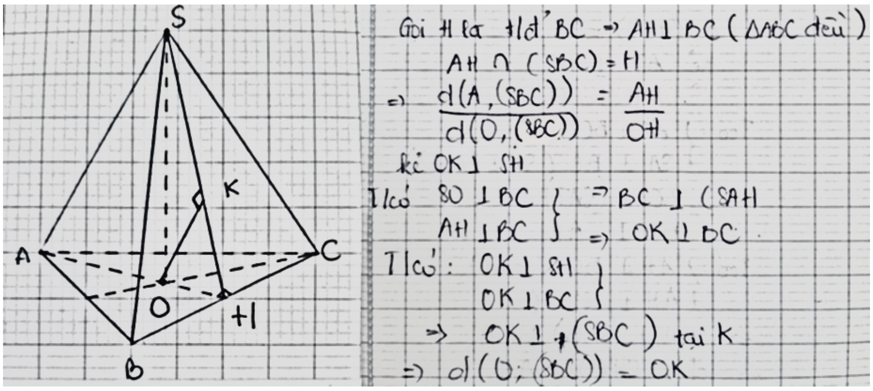
Poor results from students of the CG



Note. Prepared by the authors (2025).

Figure 29

Poor reasoning ability from students of the CG



Note. Prepared by the authors (2025).

Our pedagogical intention when giving the P4 problem in the form of a regular triangular pyramid is to ensure fairness and avoid falling into a thinking rut. The model of the P4 problem is an equilateral triangular pyramid designed as a new model problem that has never been taught directly to either group. The goal is to assess students' ability to transfer knowledge instead of repeating the learned model. Specifically, for the traditional method, students encounter a problem with a regular triangular pyramid, so the height of the pyramid is no longer *SA* but *SO*. This makes students quite confused and bewildered in finding the plane containing *O* perpendicular to (*SBC*) if they are not specifically instructed on how to find it and there is no familiar image they have ever encountered. This leads to them refusing to do even the first task, leading to the second task being even more vague and difficult to determine. In contrast, students in the experimental group were able to activate familiar strategies through thinking similar to their actual development zone. Thanks to their ability to recognize similar geometric structures, they were able to

10.22633/rpge.v29iesp3.20687

construct solutions even when faced with unfamiliar problems, clearly demonstrating the feasibility of the scaffolding strategy.

CONCLUSION AND RECOMMENDATION

The results of the study showed that the application of scaffolding strategies based on Vygotsky's Zone of Proximal Development theory had a significant positive impact on both students' learning motivation and problem-solving performance in the topic "distance from a point to a plane". Teaching based on scaffolding to the actual development zone (ADZ) supported students in solving problems by guiding them through the stages of modeling the problem; Perform analogical reasoning based on the ADZ; Verify and present the solution.

Students moved from a state of not knowing how to do it to autonomous thinking through the teacher's guided support. Specifically, teachers can organize activities using physical models (zinc), locating key elements (points, planes, perpendicular lines) for students to explore on their own. The results showed that students in the experimental group not only showed higher confidence and interest but also developed systematic and flexible problem-solving thinking.

The statistically significant difference between the two groups further reinforced the effectiveness of this teaching model. In teaching spatial geometry, teachers should integrate the scaffolding strategy based on the zone of proximal development as a form to help students reduce cognitive load and develop structural thinking. Teacher training programs should equip students with knowledge on designing learning paths and constructing core problems that are appropriate to the learners' ADZ. In addition, integrating the expectation–value framework into regular assessment will help monitor and promote students' cognitive and emotional development more effectively.

However, this study was conducted on a sample of 300 students in the 11th grade, focusing on the topic of distance from a point to a plane in spatial geometry. Therefore, the results cannot be generalized to all grades, other geometry topics or different learning environments. Further studies can be extended to the topic of distance between two intersecting lines to test the reliability and applicability of the method on a larger scale.

.

10.22633/rpge.v29iesp3.20687

REFERENCES

Ames, C. (1992). *Classrooms: Goals, structures, and student motivation. Journal of Educational Psychology, 84*(3), 261–271. https://doi.org/10.1037/0022-0663.84.3.261

Anghileri, J. (2006). Scaffolding practices that enhance mathematics learning. *Journal of Mathematics Teacher Education, 9*(1), 33–52. https://doi.org/10.1007/s10857-006-9005-9

Benden, D. K., & Lauermann, F. (2023). Relative importance of students' expectancy–value beliefs as predictors of academic success in gateway math courses. *Annals of the New York Academy of Sciences, 1521*(1), 132–139. https://doi.org/10.1111/nyas.14961

Bomia, L., Beluzo, L., Demeester, D., Elander, K., Johnson, M., & Sheldon, B. (1997). *The impact of teaching strategies on intrinsic motivation*. ERIC Clearinghouse on Elementary and Early Childhood Education. https://files.eric.ed.gov/fulltext/ED418925.pdf

Darboe, K. (2000). *An empirical study of the social correlates of job satisfaction among plant science graduates of a Midwestern university: A test of Victor H. Vroom's (1964) expectancy theory.* Bell & Howell Information and Learning Company.

Duong, H. T., Ha, H. Q. T., Bui, P. U., & Nguyen, Q. K. (2018). Solving a mathematical problem in different ways: A case of calculating the distance from a point to a plane. *Can Tho University Journal of Science, 54*(8), 54. https://doi.org/10.22144/ctu.jen.2018.038

Eccles, J. S. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motives* (pp. 75–146). Freeman.

Eccles, J. S. (2006). A motivational perspective on school achievement. In R. J. Sternberg & R. F. Subotnik (Eds.), *Optimizing student success in schools with the other three Rs: Reasoning, Resilience, and Responsibility* (pp. 199–224). Information Age Publishing.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology, 53*(1), 109–132. https://doi.org/10.1146/annurev.psych.53.100901.135153

Eccles, J. S., & Wigfield, A. (2020). From expectancy-value theory to situated expectancy-value theory: A developmental, social cognitive, and sociocultural perspective on motivation. *Contemporary Educational Psychology, 61*, 101859. https://doi.org/10.1016/j.cedpsych.2020.101859

Eccles, J. S., & Wigfield, A. (2024). The development, testing, and refinement of Eccles, Wigfield, and colleagues' situated expectancy-value model of achievement performance and choice. *Educational Psychology Review, 36*(2). https://doi.org/10.1007/s10648-024-09888-9

10.22633/rpge.v29iesp3.20687

Fielding-Wells, J., O'Brien, M., & Makar, K. (2017). Using expectancy-value theory to explore aspects of motivation and engagement in inquiry-based learning in primary mathematics. *Mathematics Education Research Journal, 29*(2), 237–254. https://doi.org/10.1007/s13394-017-0201-y

Hart, P. (2023). Perceived happiness and general health: An IRT investigation. *Research in Psychology and Behavioral Sciences, 11*(2), 49–55. https://doi.org/10.12691/rpbs-11-2-3

Holton, D., & Clarke, D. (2006). Scaffolding and metacognition. *International Journal of Mathematical Education in Science and Technology, 37*(2), 127–143. https://doi.org/10.1080/00207390500285818

Hulleman, C. S., & Harackiewicz, J. M. (2009). Promoting interest and performance in high school science classes. *Science, 326*(5958), 1410–1412. https://doi.org/10.1126/science.1177067

Lee, Y., & Song, H. (2022). Motivation for MOOC learning persistence: An expectancy–value theory perspective. *Frontiers in Psychology, 13*. https://doi.org/10.3389/fpsyg.2022.958945

Manaf, L. I., Wutsqa, D. U., & Radite, R. (2024). Effectiveness of scaffolding technique in scientific learning model on students' mathematics critical thinking skills and self-regulated learning. *AL-ISHLAH: Jurnal Pendidikan, 16*(4). https://doi.org/10.35445/alishlah.v16i4.5862

Mayerhofer, M., Lüftenegger, M., & Eichmair, M. (2024). The development of mathematics expectancy–value profiles during the secondary–tertiary transition into STEM fields. *International Journal of STEM Education, 11(*31). https://doi.org/10.1186/s40594-024-00491-6

McLeod, S. (2025). *Lev Vygotsky's sociocultural theory of cognitive development.* Simply Psychology. https://www.simplypsychology.org/vygotsky.html

Ministry of Education and Training. (2018). *General Education Program: Comprehensive Program* (Circular No. 32/2018/TT-BGDDT).

Nagle, C. (2021). Using expectancy–value theory to understand motivation, persistence, and achievement in university-level foreign language learning. *Foreign Language Annals, 54*(4), 1238–1256. https://doi.org/10.1111/flan.12569

Nam, P. S., Thai, L. H., Lavicza, Z., Schmid, A., & Houghton, T. (2024). Augmented reality as a tool to support the connection between reality and mathematical knowledge. *International Journal for Technology in Mathematics Education, 31*(3), 135–142. https://doi.org/10.1564/tme_v31.3.04

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). McGraw-Hill.

10.22633/rpge.v29iesp3.20687

Phuc, N. M., & Tam, H. T. (2024). Enhancing measurement and calculation education in high school through 3D printing technology. *International Journal for Technology in Mathematics Education, 31*(3), 143–152. https://doi.org/10.1564/tme_v31.3.05

Polya, G. (1957). *How to solve it: A new aspect of mathematical method*. Princeton University Press.

Puntambekar, S., & Hubscher, R. (2005). Tools for scaffolding students in a complex learning environment. *Educational Psychologist, 40*(1), 1–15. https://doi.org/10.1207/s15326985ep4001_1

Sari, I. N., Mahanal, S., & Setiawan, D. (2024). Implementation of a problem-based learning model assisted with scaffolding. B*IO-INOVED: Jurnal Biologi-Inovasi Pendidikan, 6*(1), 35. https://doi.org/10.20527/bino.v6i1.17890

Sari, S. R., Wibowo, T., & Kurniasih, N. (2024). Use of scaffolding techniques in mathematical problem solving. *AURELIA: Jurnal Penelitian dan Pengabdian Masyarakat Indonesia, 3(*1), 768–775. https://doi.org/10.57235/aurelia.v3i1.1755

Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom. *Journal of Educational Psychology, 85*(4), 571–581. https://doi.org/10.1037/0022-0663.85.4.571

Tran, L. T., & Nguyen, T. S. (2021). Motivation and mathematics achievement: A Vietnamese case study. J*ournal on Mathematics Education, 12(*3), 449–468. https://doi.org/10.22342/jme.12.3.14274.449-468

Tran, N. D., Tran, D. H., Nguyen, T. A., Nguyen, C., Ngo, H. L., Pham, H. Q., & Pham, T. T. (2023). *Math 11.* Vietnam Education Publishing House.

Trimurtini, T., Waluya, S. B., Sukestiyarno, Y. L., Kharisudin, I., & Nugraheni, N. (2023). Scaffolding guidelines in geometry learning. *Progress in Language, Literature and Education Research, 3*, 20–37. https://doi.org/10.9734/bpi/pller/v3/8261a

Vo, X. M., & Le, N. N. H. (2023). On the problem of calculating the distance from a point to a plane. *Dong Thap University Journal of Science, 28*, 109–116. https://doi.org/10.52714/dthu.28.10.2017.519

Vygotsky, L. S. (1978). *Mind in society: Development of higher psychological processes.* Harvard University Press. https://doi.org/10.2307/j.ctvjf9vz4

Waruwu, B., & Zega, C. S. (2023). The effectiveness of scaffolding model on students' conceptual understanding. *Jurnal Review Pendidikan dan Pengajaran, 6*(3), 245–250. https://journal.universitaspahlawan.ac.id/index.php/jrpp/article/view/18866

10.22633/rpge.v29iesp3.20687

Wigfield, A., & Eccles, J. S. (2000). Expectancy–value theory of achievement motivation. *Contemporary Educational Psychology, 25*(1), 68–81. https://doi.org/10.1006/ceps.1999.1015

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry, 17*(2), 89–100. https://doi.org/10.1111/j.1469-7610.1976.tb00381.x

10.22633/rpge.v29iesp3.20687

CRediT Author Statement

Acknowledgements: No.
Funding: This research did not receive any financial support.
Conflicts of interest: There is no conflict of interest.
Ethical approval: The work respected ethics during the research.
Data and material availability: The data and materials used in the work are not publicly available for access.
Authors' contributions: 20% each author.

Processing and editing: Editora Ibero-Americana de Educação
Proofreading, formatting, standardization and translation

EDITORA IBERO-AMERICANA