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Exploring mathematics history: Desargues' contributions and perspectives of teacher candidates

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Abstract
This research explores the contributions of Girard Desargues, a pivotal but often overlooked mathematician in geometry. The study aims to provide insights, inspire interest, and evaluate the understanding of prospective mathematics teachers regarding Desargues' contributions, particularly his work on projective geometry. Employing a qualitative approach, the research integrates a literature review and a case study. Literature data were sourced from academic journals and books, while the case study involved interviews with students from five mathematics education classes. Open-ended interviews assessed students' familiarity with Desargues and their ability to comprehend and apply his theorem. Data were analyzed through meta-analysis and thematic analysis. The findings categorize student responses into three levels: Medium of Desargues and Desargues Theorem, Intermediate Knowledge of Desargues and Desargues Theorem, and Low of Desargues and Desargues Theorem. The results underscore varying levels of awareness among future mathematics educators and suggest that integrating historical mathematical insights into education may support a deeper understanding of concepts.

Keywords: girard desargues; projective geometry; mathematical history; teacher candidates

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I. Introduction

Girard Desargues, a mathematician born in Lyon, France, on February 21, 1591, is a significant yet often overlooked figure in the history of mathematics (Anglade & Briend, 2017; Briend, 2021). His professional career extended beyond mathematics; in 1645, he worked as an architect and contributed to innovative designs such as spiral staircases and water pumps utilizing revolutionary technology (Andersen, 1991). Despite his contributions, there is limited information about Desargues' life. His family background, primarily as a lawyer or judge in Lyon, offers little insight into his intellectual pursuits (Cache, 2011). However, his most notable achievement was the establishment of projective geometry, which earned him recognition as a true inventor in the 17th century

(Menger, 1936).

Mathematics is pivotal in human progress, with geometry being one of its foundational pillars (Fardian et al., 2024; Scristia, Dasari & Herman, 2023). Geometry underpins understanding abstract shapes and spatial relationships, making it indispensable in theoretical and applied sciences (Putri, Yerizon, Arnelis & Suherman, 2024). As pioneered by Desargues, projective geometry extends this discipline by exploring properties invariant under projection, forming the basis for modern computational imaging and architectural design (Swinden, 1950).

Despite its importance, awareness of Desargues and his contributions remains limited, particularly among mathematics students. Research indicates that many students view the history of mathematics as tedious and irrelevant, contributing to their lack of knowledge about influential mathematicians like Desargues (Cortese, 2016; Putri et al., 2025). This disconnect underscores the need to integrate historical context into mathematics education, fostering appreciation and deeper understanding of the subject. Girard Desargues was chosen as the subject of this study because, despite his foundational contributions to projective geometry, he remains underrepresented in mathematics education. His selection was intended to investigate whether such a historically significant figure is recognized and understood by future mathematics teachers.

Currently, literature and studies discussing Desargues are scarce, often limited to his theorem on projective geometry (Andersen, 1991). Such gaps in academic discourse necessitate further exploration of Desargues' work and its pedagogical implications. This study aims to bridge this gap by examining the awareness and understanding of mathematics teacher candidates regarding Desargues and his contributions to projective geometry. Through a qualitative approach, combining literature review and case studies, this research seeks to provide insights into how the legacy of this "forgotten mathematician" can be preserved and leveraged in mathematics education (Fardian et al., 2024; Lei & Vourdas, 2018).

The introductory section mainly contains (1) research problems, (2) a summary of theoretical studies related to the problem under study, (3) insights and problem-solving plans, and (4) formulation of research objectives).

II. Research Method

This research employs a qualitative approach, utilizing literature review and case study methods (Putri et al., 2024b). The literature review involves systematically collecting, analyzing, and managing library data, including reading and recording information from relevant sources (Fardian et al., 2025). This method serves as the foundation for understanding the theoretical framework and context of the research topic. On the other hand, the case study method is an intensive and detailed scientific investigation of a specific program, activity, or event. It is conducted at various levels, including individuals, groups, organizations, or institutions, to obtain in-depth information about particular phenomena.

The data collection process involved meta-analysis from various academic journals (Fardian et al., 2024; Putri et al., 2024a) and websites relevant to the mathematician Girard Desargues and his contributions to projective geometry. Additionally, case studies were conducted through interviews with students from five classes in the mathematics education program. Participants were selected using purposive sampling based on specific criteria, including active enrollment in the mathematics education program, being in the third semester, and willingness to participate in the interview. Eight students were chosen to ensure diversity in academic background and exposure to geometry-related courses. These participants were asked questions to assess their knowledge of Desargues and his mathematical discoveries.

The primary objective of this research is to evaluate students' understanding of the significance of Girard Desargues and his contributions to projective geometry. To achieve this, open-ended interviews were the primary research instrument (Putri et al., 2024a). These interviews provided accurate and detailed responses from participants regarding their knowledge of Desargues. The data analysis process involved breaking down responses into smaller units, categorizing them based on themes, and drawing conclusions that could be presented in a structured manner. The analysis began with the author posing questions related to the main topic, which were subsequently explored in depth through participants' responses.

III. Results and Discussion

Biography and Discoveries of Desargues

Girard Desargues, a mathematician renowned for his contributions to geometry, was born in Lyon, France, on February 21, 1591 (Anglade & Briend, 2017; Sturm & Zengler, 2011). His family served the French Empire, with professions predominantly in law and judiciary in Lyon (Cortese, 2016). Beyond mathematics, Desargues also demonstrated his ingenuity as an architect by designing spiral staircases and water pumps that utilized revolutionary technology (Andersen, 1991).

Desargues is best known for his groundbreaking work in projective geometry, a branch of geometry that studies properties invariant under projection. This discipline forms the foundation for modern computational graphics and 3D imaging technologies. Projective geometry examines relationships such as collinearity and concurrency, which are preserved regardless of perspective (Desargues, 2011). The relevance of this field is evident in practical applications, including generating realistic 3D images on computer screens (Keshet & Eidelman, 2017).

Desargues joined the Marin Mersenne Mathematical Society during his time in Paris, whose members included Etienne Pascal, Blaise Pascal, and René Descartes (Andersen, 1991). Due to limited collaborations, Desargues self-published most of his works, with some later disseminated by Abraham Bosse, an engraver and perspective teacher (Gîrban, 2023). These efforts played a crucial role in preserving his legacy. One of Desargues' most celebrated achievements is his theorem in projective geometry, known as Desargues' theorem. The theorem states: In a projective space, two triangles are in axial perspective if and only if they are in concentric perspective. Mathematically, this can be expressed as:

AB ⋂ ab, AC ⋂ ac, and BC ⋂ bc are collinear if and only if Aa, Bb, and Cc are concurrent.

Evidence and Proof of Desargues' Theorem. To prove the above theorem, refer to Figure 1.

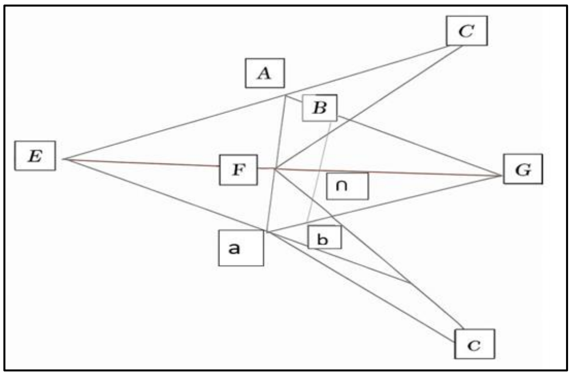

Figure 1. Proof of Desargues' Theorem

1). Lines AB and ab intersect because they lie in the plane spanned by points $A, B, a,$ and b.

2). Suppose $AB \cap ab = G$

Points A and B lie on the plane containing triangle $\triangle ABC$, and points a and b lie on the plane containing triangle $\triangle abc$. Therefore, Glies are at the intersection of the planes (denoted as line l), and hence G lies at line h.

3). Lines AC and ac intersect because they lie in the plane spanned by points $A, C, a,$ and c.

4). Suppose $AC \cap ac = E$

Points A and C lie on the plane containing triangle $\triangle ABC$, and points a and c lie on the plane containing triangle $\triangle abc$. Therefore, E lies is at the intersection of the planes (line l).

5). Lines BC and BC intersect because they lie in the plane spanned by points $B, C, b,$ and c.

6). Suppose $BC \cap bc = F$
Points B and C lie on the plane containing triangle $\triangle ABC$, and points b and $c$lie on the plane containing triangle $\triangle abc$. Therefore, F lies at the intersection of the planes (line l).

7). From steps (2), (4), and (6), it follows that points G, E, and F (the intersections $AB \cap ab, AC \cap ac, BC \cap bc$) are collinear.

8). Using the dual statement, it is guaranteed that if $Aa, Bb, and\ Cc$ are concurrent, then $AB \cap ab, AC \cap ac, and\ BC \cap bc$ are collinear.

Student Categories

The following section presents the variations in responses from eight participants across five classes with varying knowledge and abilities.

Student 1

Researcher : Do you know Desargues?
AZP : No, I do not know Desargues.
Researcher : Do you know projective geometry?
AZP : No, I do not.
Researcher : Can you solve this theorem?
AZP : I do not know the name, but I connected the triangle's points, and all lines met at one point. That helped me conclude that they were in perspective.

Student 1's answer is shown in Figure 2.

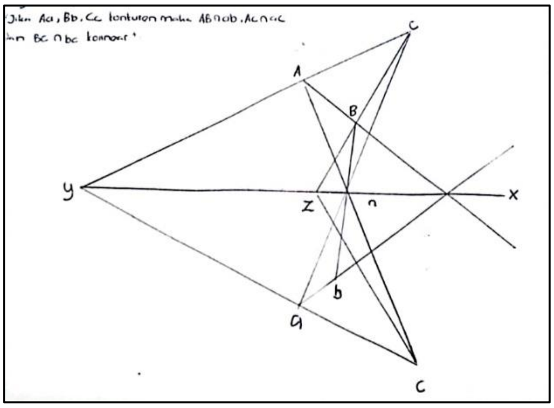

Figure 2. Representation of AZP's answer to the basic theorem of argues

Student 2

Researcher : Do you know Desargues?
UA : No, I do not know Desargues.
Researcher : Do you know or have you heard of projective geometry?
UA : No, I do not know and have never heard of projective geometry.
Researcher : How do you solve this theorem? In a projective space, two triangles are axial perspectives if and only if they are concentric perspectives.
UA : I do not know how to solve it because I have not learned about it yet.

Based on the interview results, it can be concluded that UA does not know who Desargues is, is unfamiliar with projective geometry, and cannot solve the given theorem. UA demonstrated limited engagement with the problem due to unfamiliarity with the concept and vocabulary, affecting their ability to reason through the task.

Student 3

Researcher : Do you know Desargues?
APP : Yes, I think Desargues was a mathematician from France.
Researcher : Do you know or have you heard of projective geometry?
APP : Yes, I have heard of projective geometry.
Researcher : How do you solve this theorem? In a projective space, two triangles are axial perspectives if and only if they are concentric perspectives.

Student 3's answer is shown in Figure 3.

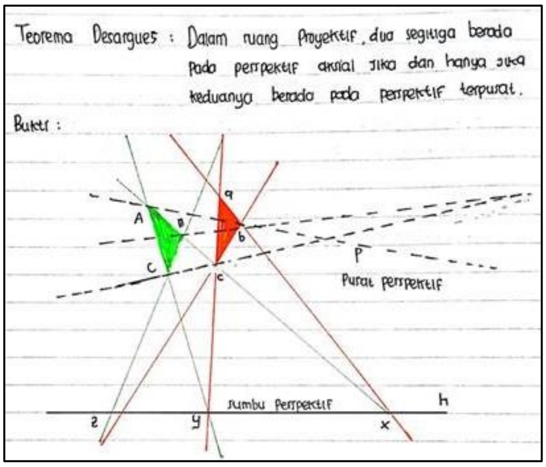

Figure 3. APP's representation of answers to Desargues' Theorem

Based on the interview results, APP knew Desargues but could not solve the given theorem because she could not correctly show that x,y, and z are collinear. Although APP recognized Desargues as a historical figure and recalled hearing about projective geometry, she could not correctly apply the theorem, indicating a gap between historical awareness and procedural understanding.

Student 4

Researcher : Do you know Desargues?

LM : No, I do not know Desargues.

Researcher : Do you know or have you heard of projective geometry?

LM : No, I also do not know about projective geometry.

Researcher : How do you solve this theorem? In a projective space, two triangles are axial perspectives if and only if they are concentric perspectives.

LM : I do not know how to solve it because there are many terms that I do not know.

Based on the interview results, LM did not know Desargues and geometry and could not solve the theorem given. LM showed confusion with the problem's terminology and lacked historical and conceptual familiarity, hindering any attempt to solve the problem.

Student 5

Researcher : Do you know Desargues?

SZ : No, I do not know Desargues.

Researcher : Do you know or have you heard of projective geometry?

SZ : No, I have never heard of projective geometry.

Researcher : How do you solve this theorem? In a projective space, two triangles are axial perspectives if and only if they are concentric perspectives.

SZ : I do not know how to solve it

SZ is unfamiliar with Desargues and projective geometry and cannot solve the theorem. SZ could not identify an entry point into the problem due to complete unfamiliarity with the mathematical and historical context.

Student 6

Researcher : Do you know Desargues?

HSFR : Yes, I have heard of Desargues.

Researcher : Do you know or have you heard of projective geometry?

HSFR : Yes, I have heard of projective geometry.

Researcher : How do you solve this theorem? In a projective space, two triangles are axial perspectives if and only if they are concentric perspectives.

The student's answer is shown in Figure 4.

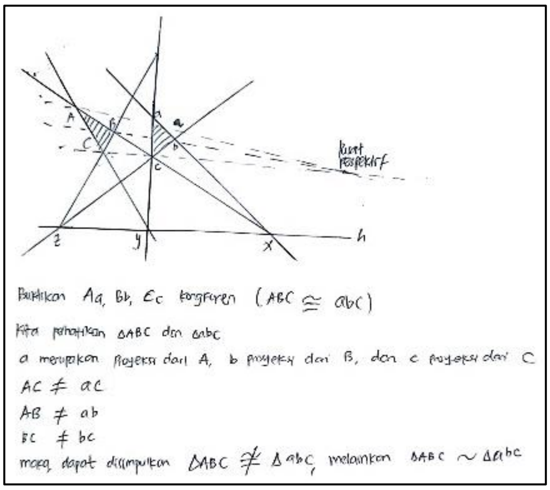

Figure 4. HSFR's representation of answers to Desargues' Theorem

Based on the interview results, HSFR is familiar with Desargues and projective geometry but could not provide a correct proof for the theorem. Despite hearing of Desargues and projective geometry, HSFR struggled to recall the necessary reasoning steps and could not construct a correct proof.

Student 7

Researcher : Do you know Desargues?

PH : No, I have never heard of Desargues.

Researcher : Do you know or have you heard of projective geometry?

PH : No, I have never heard of projective geometry.

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Researcher : How do you solve this theorem? In a projective space, two triangles are axial perspectives if and only if they are concentric perspectives.
PH : I do not know how to solve it.

Based on the interview, PH did not know Desargues or projective geometry and could not solve the given theorem. PH lacked the historical and conceptual background, which led to an inability to engage with or attempt the problem.

Student 8
Researcher : Do you know Desargues?
RSP : No, I do not know Desargues.
Researcher : Do you know or have you heard of projective geometry?
RSP : No, I do not know projective geometry.
Researcher : How do you solve this theorem? In a projective space, two triangles are axial perspectives if and only if they are concentric perspectives.
RSP : I cannot solve it.

Based on the interview results, RSP did not know Desargues and projective geometry and could not solve the theorem given. RSP showed no recognition of either Desargues or projective geometry and did not attempt to engage with the problem-solving process.

The table below summarizes students' knowledge of Desargues and their reasoning in solving the problem, reflecting their familiarity with the theorem and projective geometry.

Table 1. Summary of students' knowledge and reasoning about Desargues and his theorem

Student	Knows Desargues	Knows Projective Geometry	Solved Theorem	Explanation / Reasoning
AZP	No	No	Yes	Used visual and spatial reasoning
UA	No	No	No	Unfamiliar with terms and stuck
APP	Yes	Yes	No	Heard of theorem but lacked application
LM	No	No	No	Confused; no strategy
SZ	No	No	No	I did not understand the question
HSFR	Yes	Yes	No	Aware of Desargues but could not apply
PH	No	No	No	No engagement
RSP	No	No	No	Gave up immediately

Thematic analysis of the student responses revealed three distinct categories:

1. Medium Knowledge of Desargues and His Theorem: One student (12.5%) belonged to this category. Although the students were unfamiliar with Desargues, they were able to solve the given theorem, suggesting that understanding can still occur through conceptual reasoning, independent of historical awareness.
2. Intermediate Knowledge of Desargues and His Theorem: Two students (25%) had heard of Desargues and his discoveries but could not solve the theorem correctly.
3. Low Knowledge of Desargues and His Theorem: Five students (62.5%) lacked knowledge of Desargues and projective geometry and could not solve the theorem.

The research results described above can be considered findings associated with relevant theories from previous studies. In line with the research objectives, which aim to assess the extent of students' knowledge regarding the forgotten mathematician Desargues and his discoveries, the findings are categorized into three levels: Medium knowledge of Desargues and Desargues' theorem, Intermediate knowledge of Desargues and Desargues' theorem, and Low knowledge of Desargues and Desargues' theorem. Therefore, the researcher will discuss and compare these findings with previous studies' findings.

1. Medium Knowledge of Desargues and Desargues' Theorem

The researcher's findings on Medium Knowledge of Desargues and Desargues' theorem indicate that students who do not know Desargues or his discoveries can still solve the given Desargues theorem. This suggests that students, despite lacking historical knowledge of mathematicians, can apply problem-solving skills to mathematical problems derived from these discoveries.

This aligns with findings from Darsono (2019), who argued that integrating inquiry-based methods in history education can improve students' engagement and critical thinking skills, helping them connect abstract knowledge to practical applications. Similarly, Rulianto (2019) highlighted that history education serves not only to deepen students' understanding of past events but also as a tool to enhance their analytical and problem-solving abilities when applying historical concepts to current contexts.

These studies collectively suggest that while students may effectively solve mathematical problems without historical context, integrating historical perspectives can enrich their understanding and application of mathematical concepts.

2. Intermediate Knowledge of Desargues and Desargues' theorem

The researcher's findings on Intermediate Knowledge of Desargues and Desargues' theorem indicate that students who have heard of Desargues but cannot solve Desargues' theorem correctly fall into this category. In other words, these students possess partial knowledge of the history of mathematicians but lack a comprehensive understanding.

The relationship between students' understanding of mathematicians' history and their ability to solve problems based on their theories is a nuanced topic that intertwines educational psychology, pedagogy, and mathematics education (Rambe & Asmin, 2019). Previous research suggests that a historical perspective on mathematics can enhance students' problem-solving abilities by providing context and fostering a deeper understanding of mathematical concepts and their applications (Francisco & Maher, 2005; Putri et al., 2024c; Surya, Putri & Mukhtar, 2016).

Understanding the historical development of mathematical theories enriches students' learning experiences. For example, when students learn about mathematicians such as Girard Desargues, who contributed significantly to projective geometry, they can better appreciate the evolution of mathematical ideas and their practical implications. This historical context motivates students to engage more deeply with the material, as they see mathematics not just as abstract concepts but as a dynamic field shaped by human thought and discovery.

Although our findings did not show a direct correlation between historical awareness and problem-solving accuracy, previous research has indicated that awareness of mathematical history may contribute to the development of reasoning skills and conceptual engagement (Francisco & Maher, 2005; Rambe & Asmin, 2019). For instance, Rambe and Asmin (2019) emphasized that metacognitive skills, such as reflecting on one's thinking processes, play a crucial role in mathematical problem-solving. They argue that understanding mathematics's historical and theoretical foundations enhances students' ability to think critically and strategically when solving mathematical challenges. Similarly, Francisco & Maher (2005) found that collaborative learning, which includes discussions about the historical development of mathematical ideas, fosters flexible problem comprehension and adaptive problem-solving strategies.

Integrating historical perspectives in mathematics education helps students connect mathematical concepts to real-world applications. Surya et al., (2016) discussed the contextual learning model, highlighting the importance of relating mathematical problems to students' everyday experiences. This approach is further enriched by understanding the historical significance of the concepts being taught, enhancing students' problem-solving abilities, and fostering an appreciation for mathematics' role in society.

Additionally, students' mathematical literacy, defined as their ability to formulate, solve, and interpret mathematical problems, is significantly influenced by their understanding of mathematical history (Nurutami, Riyadi & Subanti, 2018). This literacy allows students to draw connections between mathematical ideas and apply them effectively in diverse contexts, a skill crucial for modern education.

3. Low Knowledge of Desargues and Desargues' theorem

The researcher's findings on Low Knowledge of Desargues and Desargues' theorem indicate that students in this category do not know Desargues or his discoveries and cannot solve Desargues' theorem. In other words, these students lack knowledge of the history of mathematicians and show little interest in learning about it.

Asmara (2019), in her study "Learning History Becomes Meaningful with an Intellectual Approach," highlighted that many students perceive history lessons as boring, uninteresting, and unimportant. This perception can result from a lack of connection between historical topics and students' daily lives and the absence of engaging teaching strategies that make history relatable and meaningful. This lack of interest may stem from how history is traditionally presented in classrooms, focusing on memorization rather than exploration or inquiry-based learning. Research has shown that when students are encouraged to explore history through critical questions and problem-solving, they are more likely to find it engaging and relevant (Fardian & Dasari, 2023). Such an approach can be applied to teaching the history of mathematicians by encouraging students to understand how past discoveries influence current mathematical practices.

In addition, providing students with opportunities to see the practical applications of historical mathematical concepts could enhance their engagement. For example, showing how Desargues' contributions to projective geometry are used in modern technology, such as computer graphics and architecture, can bridge the gap between abstract historical concepts and their real-world significance.

Integrating historical context into mathematics education requires innovative approaches that connect the achievements of mathematicians to contemporary problems. By doing so, educators can foster curiosity and a deeper appreciation for mathematics, motivating students to value the discipline's historical and practical aspects.

IV. Conclusion

While the results did not directly correlate historical knowledge and problem-solving ability, the study highlights the importance of understanding how historical context can enhance conceptual engagement and support future educators' teaching approaches. The findings suggest that while historical awareness alone does not directly improve problem-solving outcomes, it may contribute to a more comprehensive understanding of mathematical concepts, as previous research supports.

This study categorizes participants into varying levels of historical awareness. It illustrates that while historical knowledge is not a prerequisite for solving the given problems, it could still play a role in fostering a more enriched learning environment. While not directly influencing problem-solving success in this study, integrating historical context suggests areas for future exploration on how history may enhance students' conceptual understanding and curiosity about mathematics.

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