Didactic Solutions for Improving Student Participation: A Design-based Research Project in Social Work Statistics Education

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***Abstract*—This design-based research project addresses the aim of developing student-centered interventions to increase the proportion of students who successfully complete a mandatory statistics seminar in a Social Work Bachelor's program (participation or with grade). Initial research phases involved a quantitative survey, an expert workshop, and focus groups, which made clear that students approach the seminar with anxiety and consider its practical relevance to be low. Based on these findings, four initial didactic materials—including Lern- und Studienfähigkeitstest (LSF) text, video on practical relevance, data set for evaluation, and Artificial Intelligence (AI) prompts were implemented over four semesters and evaluated by students using Mentimeter. Based on the initial results and the continuing low success rate, the prompts were subsequently replaced by a podcast and the course was supplemented by an optional individual session (to support participation/exam preparation) at the end of the course. These updated interventions were also evaluated to ensure a positive impact. Overall, the interventions have increased initial participation, satisfaction, and perceived relevance. While these formative evaluations indicate a positive trend in student engagement, final data on successful course completion rates are pending and will be analyzed in future cycles to avoid over-claiming outcomes. The study contributes to the understanding of how tailored didactic interventions can reduce statistics anxiety in social work education.**

***Keywords*—design-based research, Bachelor students in Social Work (BSW) students, statistics anxiety, nontraditional students, evidence-based interventions, statistics education**

I. Introduction

Many academic programs include mandatory statistics courses to ensure students acquire the foundational knowledge necessary for making evidence-based decisions in their future roles within industry, science, and medical fields. These courses are perceived as "manageable" by students in some disciplines (e.g., mathematics, psychology) [1–3], even if they are not aligned with their primary interests. Students of social work often begin their studies driven by an interest in vulnerable populations and frequently hold idealistic and altruistic goals [4], as well as career aspirations aimed at improving the lives of disadvantaged individuals [5, 6]. However, motivation and interest in mandatory statistics courses within the curriculum tend to be relatively below average among this student group [7–9]. Therefore, research on how to improve the perceived feasibility and success rates of statistics courses for Bachelor students in Social Work (BSW) has been ongoing for over 20 years [7, 10].

Within this research, it has been shown that BSW students particularly experience anxiety [11], lack motivation to consistently engage with the content throughout the semester [12], and often find the relevance of statistics for their future professional practice unclear [13]. However, although these barriers are well-documented, there remains a significant gap in the literature about how to deal with these challenges through iterative, real-time testing of solutions. While existing studies focus primarily on identifying barriers, there's a lack of evidence-based research that bridges the gap between theoretical analysis and practical didactical interventions in the classroom.

To address this gap, the present Design-Based Research (DBR) project aims to develop student-centered didactic solutions to increase successful participation, defined as completing the seminar with a passing grade. To achieve this, the study pursues three specific research objectives:

(1) To identify local barriers and motivational factors specific to BSW students;
(2) To design and iteratively test concrete didactic interventions;
(3) To evaluate the impact of these interventions on student engagement and perceived relevance.

The investigation and optimization of BSW statistics seminars are especially important, given that the existing shortage of qualified professionals in social work fields (e.g., healthcare, inpatient and outpatient elderly care) is expected to worsen further due to demographic changes [14]. It is unacceptable to lose potential workforce participants due to ineffective educational conditions. Moreover, evidence-based practice is increasingly critical for improving the quality of care, reducing unnecessary costs, and ensuring that care remains aligned with the latest scientific findings [15].

II. Literature Review

In reviewing empirical studies on the successful completion of university statistics courses, several key influencing factors emerge, which can be systematically categorized into (A) anxiety and attitudes, (B) motivation, and (C) perceived practical relevance. Building on these categories, empirical findings also highlight a range of didactic strategies (D) that can serve as targeted forms of support.

Regarding (A) anxiety and attitudes, studies indicate that a neutral to positive attitude is beneficial for successfully

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completing university-level statistics courses [16], and there is a strong correlation between test anxiety and academic performance [17]. In this context, it is irrelevant whether students aim to achieve a passing grade or an exam score [18],

Discipline-specific studies on social work students, indicates that social work students often do not hold positive attitudes or emotions toward university statistics seminars, instead reporting high levels of anxiety [9, 11, 19–22] and negative perceptions [23–25]. One possible reason could be that BSW students more frequently include non-traditional students [26], who tend to report higher levels of anxiety [20].

In terms of (B) motivation, it has been shown that motivation contributes to the successful completion of a course [27] and is likewise associated with test anxiety [17]. Thus, it is possible that anxiety may be higher in credit courses, which could negatively affect motivation. Additional studies on BSW students demonstrate, first, motivation to learn statistics is generally low [7, 12], and second, students are difficult to motivate [28], partly because they dislike working with data [23]. One study found that BSW students with care responsibilities are equally motivated as students without such commitments, but they have less time to study [29], which can adversely impact their performance in cognitively demanding subjects like statistics.

Additionally, recognizing (C) perceived practical relevance helps students maintain their engagement throughout the semester [30, 31] and positively impacts course completion rates. Several empirical studies have demonstrated that students often do not see the importance of statistics for their future careers [10, 13, 32], and there is a positive relationship between perceived practical relevance and motivation [7, 20, 32, 33]. Therefore, explicitly highlighting the practical benefits of statistics courses can help sustain student motivation [34].

At this point, it is valuable to incorporate a constructivist perspective on the learning process. Constructivism describes learning as an active, interpretative, and sometimes nonlinear process in which students construct knowledge through interaction with their physical and social environment. Cognitive conflicts are considered central drivers for developing new knowledge schemas, which can be fostered by well-designed teaching arrangements [35]. The contextualization of knowledge plays a crucial role in consolidating these schemas; when learning occurs in meaningful contexts, it is easier to transfer knowledge to other life and professional situations [36].

The social constructivist approach additionally emphasizes the importance of social learning: exchanging ideas and collaborating with peers promotes the learning process by enabling perspective-taking and activating prior knowledge. Critical discussions of different viewpoints can help address and resolve cognitive conflicts [37].

The empirical evidence on (D) didactic strategies that address these factors influencing the successful completion of university statistics courses shows that when BSW students experience fear and lack motivation to engage continuously with statistical content throughout the semester [12], it can be effective to communicate to them that these skills will be developed during the course [33]—expectations that they do not need to meet beforehand. Additional resources such as audio and video materials [38], and active engagement activities—like working with datasets and answering related questions—also help improve attitudes and satisfaction [39]. Moreover, a study has shown that individual meetings with instructors can support BSW students in completing statistics seminars successfully [40].

Beyond personal support, studies indicate that using real-world data [34, 41] and questionnaire-based research can help students find meaning in statistics [10] and reduce prejudices [42]. During seminars, discussions on ethical implications and diversity issues can also effectively engage BSW students [41].

Given the complex challenges faced by BSW students in their statistics seminars, student-centered didactic interventions aimed at improving attitudes, increasing motivation, reducing anxiety, and explicitly emphasizing the practical relevance of the content appear most promising. For implementing such improvements, the Scholarship of Teaching and Learning (SoTL) approach is suitable, as it goes beyond simple evaluation [40, 43]. “Teaching as Design”, a methodological framework within SoTL, employs didactic discussions and student research to continuously optimize the teaching-learning environment—actively involving students and their needs throughout the process [44].

III. Materials and Methods

The following chapter describes the materials and methods employed to promote participation in mandatory statistics seminars, encompassing various empirical approaches to problem analysis as well as the practical development of didactic interventions. The approach is based on the scientific methodology of Design-Based Research (DBR) as outlined by McKenney and Reeves [45], which constitutes an iterative research process in which interventions are designed, implemented, evaluated, and continuously refined in close conjunction with theory and practice.

Fig. 1 illustrates the DBR process, starting with the ‘Analysis & Exploration’ phase (pre-survey, expert workshop, and focus groups), followed by the ‘Design & Construction’ phase in which four specific interventions were developed, and concluding with the ‘Evaluation & Reflection’ phase where these interventions were refined based on participant feedback.

At the outset of the project in the 2024 summer semester, a pre-survey was conducted to systematically analyze the reasons for non-participation among Bachelor students at Alice Salomon University of Applied Sciences Berlin. The standardized questionnaire, grounded in relevant literature [46–49], suggested an extensive range of potential factors influencing reasons for non-participation. The aim of this survey was to gain a comprehensive understanding of the various challenges and barriers students face regarding their participation and potential dropout, forming the basis for targeted interventions. The pre-survey was disseminated through QR codes integrated into the seminars, collected via the online questionnaire tool SoSci Survey, and analyzed using SPSS.

Concurrently, the authors conducted an expert workshop (see Fig. 1) to incorporate an interdisciplinary perspective by involving specialists from different fields. The knowledge exchange with experienced, learning-oriented experts provided high-quality input, which was integrated into the development of the interventions. This process also broadened both the authors' and the students' perspectives. The workshop was documented through protocol notes, and the results were systematically analyzed via structured protocol evaluation.

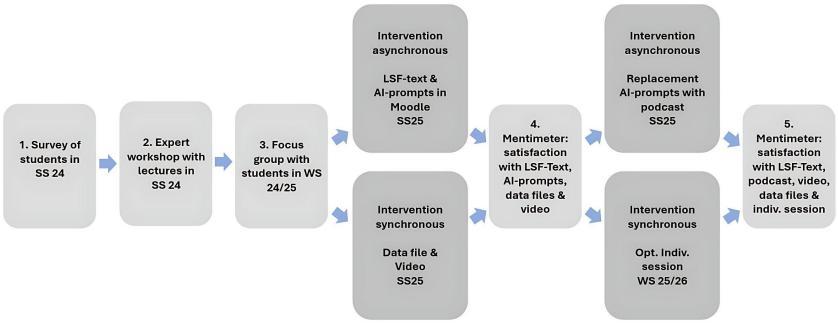

Fig. 1. Flowchart of the process.

Since the findings from both the pre-survey and the expert workshop showed only limited overlap, and given the low participation rate in the pre-survey, the two authors conducted two focus groups with eight students each, recruited from current statistics seminars in the 2024/25 winter semester. These focus groups aimed to deepen the understanding of the problem awareness and the challenges identified, providing a broader empirical basis for the 'Analysis & Exploration' phase. The goal was to analyze the issue of student non-participation in a moderated group discussion, leveraging peer exchange to gain differentiated insights into needs, experiences, and underlying dynamics. A semi-structured discussion guide was developed, focusing on high dropout rates and non-participation, while also encouraging participants to formulate support strategies from a student perspective. The discussions were fully recorded and transcribed using the Whisper software (version 12.18.3) on Mac. Afterward, the transcripts were edited by the two authors, standardizing markers for pauses, filler words, and overlaps. The qualitative content analysis by Mayring [50], supported by QCAmap visualization, was used to analyze the transcripts. Categories were inductively developed, coded, and visually summarized through the QCAmap web application.

All study components involving participants (pre-survey, focus groups, and Mentimeter evaluations) were conducted in accordance with the ethical guidelines of the Alice Salomon University of Applied Sciences Berlin. Participants were fully informed and provided their written voluntary consent. Data collection was fully anonymized, and all recordings were deleted immediately after transcription to ensure privacy and compliance with GDPR regulations.

Due to the iterative and context-sensitive nature of this DBR project, the sample sizes in the initial phases (e.g., $n = 7$ in the pre-survey and $n = 22/25$ in the Mentimeter evaluations) were limited to the specific student cohorts in the seminar. While these numbers are relatively small for traditional quantitative analysis, they are consistent with the principles of Design-Based Research, which prioritizes ecological validity, local impact, and transferability over broad statistical generalizability. To compensate for the limited sample size of the pre-survey, the project employed a multi-perspective triangulation approach, ensuring that the initial findings were cross-validated through expert workshops and qualitative focus groups before moving into the design phase.

Based on the empirical findings from these various data collection methods, four didactic interventions were developed during the 'Design & Construction' phase (see Fig. 1) to foster students' attitudes and motivation, enhance perceived practical relevance, and reduce anxiety.

Intervention 1 (asynchronous): The course descriptions in the booking system (Lern- und Studienfähigkeitstest (LSF) text) were revised to include an empathetic tone and transparent presentation of requirements and objectives, aiming to directly address students' fears and negative attitudes toward the topic.

Intervention 2 (asynchronous): Pre-formulated AI prompts were integrated, based on relevant statistical literature, to facilitate content review and provide simplified explanations of complex teaching materials. This approach aimed to enhance motivation and help reduce content-related anxieties.

Intervention 3 (synchronous): This involved adapting the seminar contents to include a real dataset that students could work with to increase motivation and identification with the subject matter. A practical video was also incorporated, followed by a discussion to highlight the real-world relevance and practical application.

Intervention 4 (synchronous): This offered students individual sessions to support their participation and exam performance, aiming to reduce dropout fears and motivate students to successfully complete the course.

In the 'Evaluation & Reflection' phase, these interventions were integrated into the seminar flow through iterative cycles, after which student feedback was collected and used to further refine or replace them.

The evaluation was conducted after each semester using Mentimeter, as this tool proved to be accessible and motivating for students [51]. All interventions were presented concurrently on a shared Mentimeter slide, allowing for simultaneous evaluation and direct comparison, enhancing efficiency. The participating students rated the interventions on a five-point Likert scale from 1 (did not like at all) to 5 (liked very much). The use of smartphones facilitated easy participation, and real-time discussion of the results fostered greater engagement within the seminars. The use of descriptive means in this context is justified as a

formative evaluation tool within the DBR framework. These values are treated as exploratory indicators to guide the iterative design process, rather than as summative statistical proof. This approach aligns with the project's focus on local impact and ecological validity over broad statistical generalizability.

IV. Result and Discussion

The following section presents the empirical results and the discussions derived from them in the present DBR project, which developed, evaluated, and continuously optimized didactic interventions through iterative loops.

A. Survey of Students

The pre-survey (n = 7) provided initial indications of potential barriers to regular participation in mandatory seminars: in particular, high course and exam requirements and fear of failing were cited as the main obstacles. The descriptive means indicated a tendency toward high agreement with statements such as "The course content seems too difficult" (mean 4.2) and "I am afraid of failing the course" (mean 4.0) with high agreement. In addition, the lack of support from teachers (mean 2.0) and fellow students (mean 2.0) was identified as considerably barriers. These findings form the basis for the development of targeted interventions designed to promote engagement with the course content and strengthen feelings of self-efficacy. However, due to the small number of participants, these results are not intended for statistical inference but should be interpreted as preliminary, qualitative insights that were further validated in the next intervention cycles.

B. Expert Workshop

Several didactic framework conditions for the design of statistics seminars can be identified from the results of the expert workshop. First, it is emphasized that interactive and engaging learning formats in which students can collect, evaluate, and interpret data themselves are central. Second, the use of visual representations is highlighted as conducive to interest in statistical content. Third, it is evident that integrating university-relevant topics (e.g., student life satisfaction or requirements for active participation in seminars) into the teaching content can increase motivation for active participation. In addition, the integration of AI-based assistance systems is described as a way to convey complex content more clearly and create a supportive, anxiety-reducing learning atmosphere.

The results of the workshop expanded the intervention development to include interdisciplinary knowledge, and the subject-specific perspectives underscore the importance of learning-oriented, interactive teaching. This once again highlights the importance of taking different objectives into account in the interventions in order to ensure that the statistics seminars are as effective and motivating as possible.

With these results, the authors were encouraged to also incorporate technology-assisted support in their interventions to help students better understand complex content.

In conjunction with the findings from the pre-survey, the reasons and challenges for attending and completing statistics seminars, as well as potential interventions, can so far only be described in an initial, still undifferentiated form.

C. Focus Group

The qualitatively analyzed focus group results provide a nuanced picture of the problem situation. After transcribing, the transcripts of both focus groups were uploaded as Word files into QCAmap [52]. Since both focus groups were conducted using the same semi-structured guide, the inductive categories were derived from the entire transcribed material [50].

Whole words and semantically related words (phrases) were chosen as units of analysis. During the reduction process, all emotions, attitudes, and statements regarding practical relevance were initially coded. In this step, 172 words/phrases were coded. To distill the material to its essential points, negative emotions (e.g., fear and irritation), negative attitudes (e.g., math aversion and disinterest, dislike), and statements about practical relevance were combined into a total of eleven categories.

Three categories of attitudes were identified: positive attitudes before the seminar, negative attitudes before the seminar, and negative attitudes during the seminar. Similarly, three categories of emotions emerged from the material: positive emotions before the seminar, negative emotions before the seminar, and negative emotions during the seminar. Additionally, there was a category that summarized positive statements (positive emotions and attitudes) made during the seminar, as these were rather unspecific (see Table 1: positive emotions/attitudes during the seminar.

Statements regarding practical relevance were condensed into four categories: teaching methods for conveying practical relevance, perception of practical relevance, non-perception of practical relevance, and recognition of relevance for master's studies.

After the second author developed the categories, a joint workshop was held with the first author to review the categories against the original material (member check). Both agreed that the category system (see Table 1) appropriately reflected the statements.

Table 1. Overview of categories (N = 172)

#	Name	Prototypical example	n
1	Positive attitudes before the seminar	Also hope	6
2	Negative attitudes before the seminar	No desire for statistics before	25
3	Negative attitudes during the seminar	I don't feel like it here	32
4	Positive emotions before the seminar	I actually enjoy this kind of thing	7
5	Negative emotions before the seminar	Fear and overwhelm	16
6	Negative emotions during the seminar (and stress)	Carried-over fear from the past	14
7	Positive emotions/attitudes during the seminar	It actually was kind of fun	19
8	Teaching methods for conveying practical relevance	Short review, references to practice	18
9	Practical relevance is recognized	Already important for club work	11
10	Practical relevance is not recognized	In work, [statistics] is of no use at all	20
11	Relevance is seen for master's studies	I do not plan to pursue a master's degree either	4

The three most frequent categories were negative attitudes during the seminar (n = 32), negative attitudes before the seminar (n = 25), and the perception that practical relevance is not recognized (n = 20). The most frequently expressed emotion before and during the seminar was "fear" (the word "fear" was found 28 times in the transcripts).

It is noticeable that markedly fewer positive than negative attitudes (6 vs. 25) and emotions (7 vs. 16) are mentioned. This indicates that students often begin the seminar with a negative attitude or emotional disposition and are probably not receptive to the topics at all. Although didactic methods aimed at conveying practical relevance were indeed perceived (n = 18), there were still many statements indicating that the practical relevance of statistics is not recognized (n = 20). This could also be caused by the fact that many students, due to their emotions and attitudes, are not receptive to the content.

D. Mentimeter 1

Based on the findings, four didactic interventions were developed within the framework of the study that potentially have a positive impact on seminar participation. In the 2025 summer semester, the interventions involving the LSF text, the AI prompts, the real dataset, and the video were evaluated by the students (n = 22) at the end of the semester using Mentimeter surveys on a 5-point scale (1 "did not like it at all" to 5 "liked it very much").

The results (see Table 2, column Mean I) suggest that the LSF text (mean 4.4) and the real dataset (mean 4.2) were perceived as particularly helpful by the participating students This appears to align with the qualitative findings, as students had previously identified 'fear and overwhelm' (Category 5) as well as a 'lack of desire for statistics' (Category 2) as significant barriers. The fact that the real dataset was rated so highly (mean 4.2) supports the idea that BSW students need to see how statistics apply to their actual field to stay engaged. This aligns with the theory that learning is more effective when it happens in a meaningful context. However, it is important to note that these evaluations reflect the individual perceptions of students; therefore, no direct conclusions can be drawn at this stage regarding measurable increases in learning success or actual changes in seminar completion rates.

By working with data that relates to their future professional roles, students can better bridge the gap between abstract formulas and practical use, which helps reduce the common feeling that statistics is irrelevant to social work (Category 10).

The interventions "video" (mean 3.6) and "AI prompts" (mean 3.3) were rated less positively but still above the midpoint of the scale. With adjustments to the interventions implemented in the following semester, some of the missing mean values in Table 2 are accounted for, as these interventions were no longer evaluated after the modifications.

The feedback suggests that students may place great importance on the information provided prior to the semester in order to gain a clear understanding of the seminar content and to potentially reduce their anxieties in advance. A high relevance of context to promote learning processes is further supported by positive descriptive feedback regarding in the positive reception of the real data as a didactic tool for conveying complex instructional content. Contrary to empirical findings [53,] the authors' initial assumption that AI-based support offers would be received positively by students, these are rated as less supportive. However, it should be noted that the use of AI tools may still involve uncertainties and might require prior intervention to develop the necessary competencies for handling these tools.

Table 2. Mean values of the intervention evaluation

Type	Intervention evaluation		
	Intervention	Mean I (n = 22)	Mean II (n = 25)
as	Course descriptions (LSF Text)	4.4	4.2
as	KI-Prompts	3.3	-
s	Datafile	4.2	4.2
s	Video	3.6	3.5
as	Podcast	-	3.8
s	Individual session	-	4.0

Based on feedback regarding the individual interventions, further development of the measures is planned for the 2025/26 Winter semester. The intervention rated most highly—the LSF text, the real dataset, and the video—will be re-evaluated in a subsequent cycle, while the AI prompts will be replaced by a podcast. Additionally, individual sessions to support students with their exam preparation will be integrated into the seminar structure.

E. Mentimeter 2

The second evaluation of the interventions by the students is conducted using the same survey design as the first. All interventions are rated by students on a 5-point scale.

The results show that the LSF test (mean 4.2) and the real dataset (mean 4.2) continue to receive the highest ratings (see Table 2, column Mean II). The individual session receives an average rating of 4.0, while the podcast is rated with a mean of 3.8. The video is evaluated with an average score of 3.5 in the second survey wave (see Table 2).

The stable evaluation of the LSF texts and the real dataset suggests that these interventions were perceived as helpful in alleviating anxiety within this specific cohort and can thereby positively influence successful participation in the statistics seminar. The strong contextual relevance provided by practice-oriented data appears to enhance student motivation, as it enables them to better connect the content with real-world applications and practical tasks in their future professional careers.

The high acceptance of individual sessions underscores the supportive needs of students when dealing with the complex seminar material (countering 'Negative emotions during the seminar', Category 6) and highlights the positive impact that guidance from instructors can have on seminar participation. The positive feedback for individual support (mean 4.0) highlights the role of social interaction in the learning process. These sessions allow for a more personalized approach to the 'negative emotions' (Category 6) reported by students. In line with social constructivist theory, such interactions help students navigate complex material in a supportive environment, which in turn helps mitigate the anxiety and stress often associated with mandatory statistics courses.

The slight decline in the evaluation of the video in the second assessment may indicate that it is outdated and no

longer sufficiently conveys practical relevance within the learning content. Updating the video, for example by replacing it with a more current format, could help restore its practical applicability, further supporting students who struggle to see the importance of statistics for their future careers (Category 10).

Overall, the findings indicate a positive trend, suggesting that a combination of LSF texts, real data, and personalized counseling can contribute to reducing anxiety and motivate students to successfully complete the seminar.

V. Conclusion

This design-based research project successfully developed and evaluated didactic interventions aimed at increasing student participation and successful course completion in the mandatory statistics seminar for the bachelor's program in Social Work at Alice Salomon University of Applied Sciences Berlin. The process involved multiple semesters of empirical data collection through pre-studies, which informed the conception of targeted interventions. Following their implementation, students evaluated the interventions regarding their effectiveness, with the results feeding into subsequent iterations.

The empirical investigation of the problem highlights the importance of exchange between instructors—who primarily emphasize technical or organizational aspects—and students, who cite emotional and motivational barriers such as a perceived lack of relevance, insufficient practical application, or anxiety.

The most significant findings confirm that negative attitudes, low motivation, perceived lack of practical relevance, and fears are among the most common reasons for non-participation. By considering these perspectives, four didactic interventions were implemented: the course description (LSF text) was revised to address anxieties and foster positive attitudes; real datasets and a practice-oriented video were integrated as teaching materials to strengthen the practical relevance; pre-formulated AI prompts were used to support complex content; and a podcast was introduced to further convey practical relevance. Additionally, offering individual sessions aimed to support students in preparing for their participation or exam performances.

Evaluations showed predominantly positive ratings, especially for the use of real datasets. This highlights the central role of practical relevance, aligning with key principles of constructivist learning theory: authentic contexts and application-oriented materials are beneficial for the learning process. While the revised LSF text proved effective as a support intervention to address uncertainties in advance, the finding also suggests a current reticence toward AI tools among students. Consequently, the AI prompts were replaced with a practice-oriented podcast, resulting in considerably higher acceptance.

Beyond the local context, this study articulates three core transferable design principles for statistics education in social sciences: (1) Emotional Scaffolding, by using empathetic and transparent communication (e.g., LSF texts) to address pre-existing anxieties; (2) Authentic Contextualization, through the integration of field-specific, real-world datasets; and (3) Low-Threshold Support Structures, by providing a safety net during stressful exam preparation. In terms of future prospects, further research is valuable to integrate competency development in dealing with artificial intelligence into the curriculum. Additional interventions could include extended and virtual reality applications to introduce gamification elements and potentially improve academic performance.

However, some limitations apply. The descriptive nature of the quantitative data collected via Mentimeter limits statistical depth, as detailed measures of dispersion were not collected to maintain real-time anonymity. Nevertheless, findings were validated through triangulation with qualitative data. Furthermore, the reliance on self-reported data provides formative feedback on satisfaction but cannot be equated with objective learning gains. Actual completion outcomes are still pending and will be the focus of the final project evaluation in late 2026.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Both authors designed the research together. A.B.-F. programmed the various questionnaires, while M.K. analyzed the data collected. Both authors conducted and evaluated one focus group each. M.K. wrote the article, and both authors approved the final version.

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