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BEST: An Instructional Design Model to Empower Graduate Student Self-Efficacy in Research Methodology Through TPACK Integration

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Abstract

Aim/Purpose	Traditional research methodology education faces challenges in developing student self-efficacy and integrating modern technology, necessitating innovative instructional approaches for graduate students.
Background	This study introduces the BEST model (begin with learner analysis, establish clear learning objectives, select engaging learning activities, and tailor instruction using technology) to address these challenges through systematic TPACK integration.
Methodology	A qualitative investigation was conducted with 10 graduate students through focus groups and in-depth interviews over one month, analyzed using narrative and content analysis approaches.
Contribution	Content analysis revealed improvements in self-efficacy (from four to eight participants), peer learning (from three to six), and critical thinking (from three to six) while maintaining active learning engagement throughout implementation.

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Findings	Students showed significant improvements in self-efficacy (four to eight participants), peer learning (three to six), and critical thinking (three to six) while maintaining active learning engagement.
Recommendations for Practitioners	Institutions should implement robust technical support systems and flexible learning pathways while ensuring adequate infrastructure before adoption. A phased implementation approach with peer mentoring is recommended to address technology integration challenges.
Recommendations for Researchers	Future research should examine the BEST model's effectiveness across different cultural contexts and disciplines through comparative and longitudinal studies while exploring the integration of emerging educational technologies.
Impact on Society	The BEST model enhances the quality of graduate research education by developing students' confidence and competence, potentially leading to more capable researchers and improved research outcomes.
Future Research	Longitudinal studies should track the impact on research productivity and quality, while mixed-methods approaches incorporating standardized measures would strengthen the empirical foundation for the model.
Keywords	instructional design, TPACK integration, research methodology, graduate education, self-efficacy

INTRODUCTION

Teaching research methodology at the graduate level has become increasingly critical in contemporary higher education as institutions strive to develop competent researchers and scholars (Daniel & Harland, 2017). The ability to conduct rigorous research, analyze data systematically, and contribute meaningfully to academic discourse represents a fundamental requirement for graduate students across disciplines (Daniel, 2022). However, traditional approaches to research methodology education often fail to address the complex challenges of preparing students for modern research demands. Recent studies have identified several persistent challenges in research methodology education (Thomas, 2021). First, students frequently struggle to develop self-efficacy in research practices, leading to hesitation in applying theoretical concepts to practical research situations (Bandura & Wessels, 1997; Hoffmann & Plotkina, 2021a, 2021b). This confidence gap directly impacts students' willingness to engage with complex research tasks and limits their development as independent researchers. Second, the rapidly evolving landscape of research tools and technologies creates a widening gap between traditional teaching methods and contemporary research practices (Daniel et al., 2018). While modern research increasingly relies on digital tools, data visualization, and computational methods, instructional approaches have not kept pace with these technological advances, leaving students underprepared for real-world research contexts. Third, diverse student backgrounds and varying levels of prior research experience require more adaptive and personalized learning approaches (Hanifah et al., 2025; Vijayakumar Bharathi & Pande, 2024; Zappatore, 2024). Graduate programs often attract students from various academic and professional backgrounds, yet many research methodology courses employ a one-size-fits-all approach that fails to address this heterogeneity. These challenges are further compounded by limitations in institutional resources, technological infrastructure, and pedagogical frameworks suited for modern research education. Traditional instructional design models used in research methodology courses have notable shortcomings when addressing these contemporary challenges.

Traditional instructional design models such as ADDIE (Branch, 2009) provide systematic approaches to course development but often lack mechanisms for building student self-efficacy and incorporating emerging technologies. While organized, the ADDIE model's linear structure offers limited flexibility for adapting to diverse student needs and technological integration in research methodology education. Similarly, the Dick, Carey, and Carey model (Dick et al., 2015), while comprehensive in addressing instructional objectives and assessment, does not specifically target research autonomy development – a critical competency for graduate students. Though valuable for general instructional planning, its systems approach lacks specific strategies for integrating technological tools essential for contemporary research practice. Other models, like Gerlach and Ely's (1971), focus primarily on content delivery rather than building student self-efficacy and technological competence in research contexts. These models were developed before the digital transformation of research practices and thus do not adequately address the integration of modern research technologies into pedagogy.

The Technological Pedagogical Content Knowledge (TPACK) framework offers a promising foundation to address these challenges by integrating technological, pedagogical, and content knowledge in instructional design (Jaipal-Jamani & Figg, 2015). Although TPACK has shown effectiveness in various educational contexts, its specific application to research methodology education requires systematic investigation and structured implementation (Meletiou-Mavrotheris & Paparistodemou, 2024; Shin & Kim, 2024; Valle et al., 2024). Recent studies demonstrate that TPACK integration can enhance student engagement and confidence in complex subjects (Aquino et al., 2022), suggesting its potential value for research methodology education. However, a comprehensive instructional design model that specifically applies TPACK principles to research methodology courses – focusing on building student self-efficacy – has yet to be fully developed and evaluated.

To address these critical gaps, this study introduces the BEST model (Begin with learner analysis, Establish clear learning objectives, Select engaging learning activities, and Tailor instruction using technology). This model represents a significant advancement in research methodology instruction by systematically integrating TPACK principles with contemporary educational technologies and adaptive learning strategies.

Unlike previous instructional design frameworks, the BEST model specifically targets graduate student self-efficacy in research methodology through:

1. personalized learning pathways based on comprehensive learner analysis,
2. competency-based objectives aligned with research methodology skills,
3. technology-enhanced activities designed for practical research application and
4. adaptive instruction that responds to diverse student needs and backgrounds.

The BEST model directly addresses the limitations of existing instructional design models by providing a structured yet flexible framework for developing student confidence and competence in research methodology.

Research Questions and Significance

This study addresses two fundamental research questions:

1. What is the impact of the BEST Model on graduate students' self-efficacy in conducting research methodology?
2. How does TPACK integration in the BEST model enhance learning experiences in research methodology courses?

The significance of this research lies in its potential to transform research methodology education through a comprehensive instructional design framework that specifically targets graduate student self-efficacy while leveraging modern educational technologies. The study contributes theoretical understanding and practical guidelines for educators and instructional designers seeking to improve graduate student learning outcomes in research methodology courses. Through rigorous examination of the implementation and effectiveness of the BEST model, this research offers valuable insights into optimizing instructional design for enhanced research capabilities and academic outcomes in graduate education. This investigation employs a qualitative approach, utilizing narrative analysis and content analysis to examine student experiences and outcomes, providing rich insights into the effectiveness of the BEST model in supporting graduate student learning and self-efficacy development in research methodology courses.

The findings have important implications for curriculum development, instructional design practices, and the broader field of graduate education, particularly regarding technology integration and pedagogical approaches for improving student self-efficacy and research capabilities.

LITERATURE REVIEW

INSTRUCTIONAL SYSTEM DESIGN (ISD)

The instructional system design (ISD) field has evolved significantly, marked by the development of various models to guide the systematic creation of effective educational experiences. Among the most widely recognized frameworks, the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model provides a foundational approach to instructional design (Branch, 2009). This iterative and flexible framework ensures that each stage informs the next, fostering continuous improvement and adaptation to the needs of the student. Complementing ADDIE, the Dick-Carey-Carey model emphasizes a system approach (Dick et al., 2015). By focusing on the alignment of goals, learners, contexts, and assessments, this model ensures consistency and clarity in instructional planning. Similarly, the Gerlach and Ely model (Ely & Melnick, 1980) adopts a practical teacher-centered perspective, integrating curriculum goals, learner characteristics, and available resources into a streamlined framework that is particularly well suited for classroom applications but offers limited flexibility for innovative learning environments. In contrast, the Knirk and Gustafson model is tailored for rapid instructional development, emphasizing three key phases: problem analysis, solution design, and development (Knirk & Gustafson, 1986), providing time-efficiency but offering less detailed guidance on evaluation and iteration.

Also, expanding on these models, the Jerrold Kemp Model offers a nonlinear and highly adaptable approach (Kemp, 1986), enabling instructional designers to address multiple components simultaneously, such as content analysis, learner needs, and assessment strategies. However, it can be difficult to manage without strong project coordination. Its flexibility makes it particularly valuable for addressing complex instructional challenges. The Hannafin and Peck model further enriches the landscape by incorporating a learner-centered design that unfolds in three iterative phases: needs assessment (Grabinger, 1988), design, and implementation, emphasizing continuous evaluation but potentially extending project timelines. This model emphasizes continuous evaluation and adjustment, ensuring that instructional interventions remain responsive to dynamic learning and contextual needs. Meanwhile, the Brown and Green Model (Brown & Green, 2019), grounded in constructivist principles, advocates active learning engagement, collaborative learning, and problem-solving as central to effective instruction, requiring skilled facilitation that may not suit all content areas. A recent meta-analysis of these instructional design models found that despite their varied approaches, they share common limitations when applied to research methodology education, including insufficient technology integration guidance, limited attention to developing student self-efficacy, and inadequate focus on data analysis skill development (Mohseni et al., 2023). The emphasis on real-world application and learner agency in more recent models aligns well with modern educational paradigms, particularly in environments that value critical thinking and adaptability. Table 1 provides a comprehensive comparison of these models, highlighting their key characteristics, strengths, limitations, and appropriate course applications.

Table 1. Comparative instructional system design

ISD model	Key characteristics	Strengths	Limitations	Appropriate course
ADDIE Model (Branch, 2009)	Sequential Phases: Analysis, Design, Development, Implementation, Evaluation.	Clear structure, widely applicable, iterative for continuous improvement.	Can be time-consuming; less flexible in fast-paced contexts.	Corporate training, e-learning development.
Dick, Carey, and Carey Model (Dick et al., 2015)	Systems approach: interdependent components such as goals, instruction, learner analysis, and assessment.	Comprehensive, emphasizes alignment of all instructional elements.	Complexity may overwhelm smaller projects or non-expert users.	Development of K-12 curriculum and technical training.
Gerlach and Ely Model (Gerlach & Ely, 1971)	Teacher-centered model that integrates objectives, learners, and resources in a practical framework.	Easy to implement, suitable for traditional classrooms.	Limited flexibility for innovative or dynamic learning environments.	Classroom instruction in schools or universities.
Knirk and Gustafson Model (Knirk & Gustafson, 1986)	Three phases: problem analysis, solution design, and development. Focused on rapid instructional development.	Simple and time-efficient, ideal for urgent instructional needs.	Less detailed guidance on evaluation and iteration.	Workshops, short-term skill training programs.
Jerrold Kemp Model (Kemp, 1986)	Nonlinear approach covers multiple components, such as learner needs, resources, and assessment simultaneously.	Highly flexible and allows for tackling multiple aspects at once.	It can be difficult to manage without strong project coordination.	Complex interdisciplinary courses or projects.
Hannafin and Peck Model (Grabinger, 1988)	Three iterative phases: needs assessment, design, and implementation; focus on learner-centered design.	Emphasis on iteration and adaptability to dynamic needs.	Requires ongoing evaluation, which may extend timelines.	Online learning, adaptive learning systems.
Brown and Green Model (Brown & Green, 2019)	Grounded in constructivist principles, emphasizes learner engagement, collaboration, and real-world problem-solving.	Encourages critical thinking, adaptability, and active learning.	Requires skilled facilitation and may not suit all content areas.	Project-based learning, STEM courses.

LEARNING OUTCOMES OF RESEARCH METHODS

The study of research methods at the graduate level is a critical component of developing students' analytical thinking and their ability to generate new knowledge to address academic and professional challenges (Daniel & Harland, 2017). However, teaching research methods face numerous challenges that impact student learning effectiveness, necessitating educational innovations to improve instructional approaches (Daniel et al., 2018). One of the key challenges in teaching Research Methodology is content complexity, which covers various theoretical concepts and processes such as research framework formulation, appropriate data collection methods, and the use of complex analytical tools (Thomas, 2021). Furthermore, the diversity of student backgrounds is a significant factor that affects teaching effectiveness, as students without prior research experience need more support. In contrast, those with more experience may find the content less challenging (Daniel, 2022), creating heterogeneity that complicates instruction, as Hanifah et al. (2025) demonstrated. Another issue is the theory-practice gap in teaching, as instruction often focuses on theoretical explanations without practical applications, such as using research tools or analyzing case studies, which limits students' ability to apply their knowledge in real-life situations. Additionally, resource limitations pose significant challenges, with a survey of 153 graduate programs finding that only 43% provided sufficient access to essential analytical software like SPSS or JAMOVI (Ashour, 2024), particularly affecting students from resource-constrained institutions. Psychological factors, such as students' attitudes toward the subject, also impact learning outcomes. Medeiros Mirra et al. (2023) found that initial anxiety about statistical methods affected long-term engagement with research methodology.

To address these challenges, integrating educational innovations has become an essential approach to improving the teaching and learning process, as presented in Table 2. One promising method is the application of digital technologies, such as learning management systems (LMS) like Moodle or Google Classroom, which help instructors manage content and track student progress systematically (Dake & Bada, 2023), with longitudinal studies demonstrating that LMS use increased student engagement by 47% in research methodology courses. Additionally, online data analysis tools like Google Data Studio or Tableau enable students to learn data analysis in a modern context. Interactive learning materials, such as animated videos explaining research processes or simulation-based learning that mimics real-life research situations, can enhance students' understanding. Zappatore (2024) found that simulations improved comprehension of complex statistical concepts by 38% compared to traditional methods.

Table 2. Learning outcomes of research methodology

Learning outcomes of research methodology	Explanation	Key criteria
Supports Knowledge-Based Outcomes	Graduate students must have a solid understanding of research methodologies, ethical considerations, and basic principles.	Mandatory
Supports Skill-Based Outcomes	Students must develop practical skills in research design, data collection, and academic writing.	Mandatory
Supports Data Analysis Skills	The mastery of data analysis tools and techniques is critical for students to interpret and draw conclusions from their research data.	Mandatory
Supports Autonomy in Research	Students must be encouraged to take ownership of their research, promoting independent inquiry and problem-solving.	Mandatory
Supports Competency-Based Outcomes	Students should be able to apply their knowledge and skills to real-world research problems, demonstrating competence in independent research.	Additional
Supports Ethics & Lifelong Learning	A course that emphasizes research ethics and promotes a mindset for continuous learning adds value, although it may not be an immediate core requirement.	Additional

Active learning methods, including problem-based learning (PBL) or group work for analyzing real-world problems, further promote experiential learning (Chan et al., 2022; Gao et al., 2021; Pérez-Marín et al., 2016; Zappatore, 2024), with documented significant improvements in research self-efficacy among students engaged in project-based learning compared to traditional lecture-based instruction. The development of personalized learning applications, with exercises and real-time feedback, allows students to focus on areas where they need improvement, with studies showing that personalized learning paths reduce completion time and improve outcomes for diverse student populations (Gao et al., 2021). Furthermore, instructor use, particularly through the professional development of modern technologies like AI or data analytics, can improve the quality of teaching. Innovations such as gamification, using quizzes or research design competitions, and the use of virtual reality (VR) and augmented reality (AR) to simulate research environments offer engaging ways to connect theoretical knowledge with real-world applications (Falah et al., 2021; Iquira-Becerra et al., 2020; Rodríguez, 2024), with studies finding that gamified research methodology courses improved student retention of complex concepts by 32% compared to traditional approaches. Additionally, AI chatbots can help students by providing instant answers when instructors are unavailable (Al-Abdullatif, 2023).

Currently, graduate-level research methods still face numerous challenges in content, teaching methods, and resource availability. Therefore, the integration of educational innovations is a promising approach to adapting teaching methods to contemporary needs. These innovations address existing limitations and enhance student learning outcomes, creating meaningful learning experiences linked to practical application and preparing students to apply their knowledge in future professional or research endeavors.

Teaching Research Methodology Through TPACK Integration

In the ever-evolving landscape of education, the integration of technology has become imperative, particularly in the field of research methodology education. The Technology and Educational Content Knowledge Framework (TPACK) plays a crucial role in this transformation by offering a comprehensive approach to combine technology, pedagogy, and content knowledge across three intersecting domains: technological knowledge (understanding how to use technology effectively), pedagogical knowledge (knowing how to teach effectively), and content knowledge (mastery of the subject matter). Several studies highlight the importance of TPACK in various educational contexts, providing valuable information on its potential to revolutionize education (Abouelenein & Selim, 2024; Adipat, 2021; Aldemir Engin et al., 2023; Aquino et al., 2022), with a recent meta-analysis of 32 studies finding that TPACK-guided instruction resulted in an average effect size of 0.67 for student learning outcomes (Li et al., 2022). A significant advantage of TPACK is its ability to improve learning outcomes through effective integration of technology, as demonstrated by the integration of the Skyes platform into English as a Foreign Language (EFL) contexts, which has been shown to improve student engagement and personalize learning paths. However, challenges such as institutional resistance and feedback limitations can hinder its widespread adoption (Drugova et al., 2021). Similarly, VR-based learning has shown the potential to improve learning outcomes, particularly when TPACK components are used effectively; however, technological challenges, such as VR-induced dizziness, can limit its effectiveness (Shin & Kim, 2024). These findings suggest that while technology holds immense promise, its integration must be carefully managed to overcome practical obstacles and maximize its potential benefits.

In addition, TPACK has proven to be a valuable tool for understanding and improving teacher competencies in research methodology instruction. In studies exploring the integration of TPACK in teacher education, research has emphasized the need for specific preparation in each domain, with particular attention to teacher competencies for AI education (S. Kim et al., 2022) and the role of TPACK in geography education (Muschaweck & Kanwischer, 2022). These studies underscore the importance of equipping educators with the necessary skills to navigate the complexities of technology integration. However, the research also points out that limited sample sizes and specific cultural contexts can restrict the generalizability of these findings, highlighting the need for further exploration in diverse settings (Kyi et al., 2023). In the context of education of research methodology specifically, TPACK offers a structured framework for integrating technology into teaching complex concepts. Studies have shown that the application of TPACK in e-learning environments can significantly reduce dropout rates and improve participation. However, challenges such as resistance to online teaching methods and the need for adequate pedagogical support remain significant barriers, emphasizing continuous professional development to ensure educators can incorporate technology into their teaching practices. Furthermore, motivation plays a crucial role in adoption and engagement, especially in business schools, with research suggesting that by analyzing TPACK alongside motivation and engagement models, educators can better understand the relationship between technology integration and student outcomes (Fernandes et al., 2020). However, the studies also note that the findings are limited to specific educational contexts, suggesting that further research should consider broader applications across various educational levels and cultural settings.

Given these insights, adopting a TPACK-based framework in the education of research methodology offers substantial promise for addressing the limitations identified in traditional instructional design models. By combining technology, pedagogy, and content knowledge, TPACK facilitates a more holistic and effective approach to teaching complex research concepts, potentially enhancing both student engagement and self-efficacy. However, to implement TPACK successfully, it is essential to address challenges such as resistance to change, ongoing professional development, and integration of relevant technology tools. Future research should explore the broader application of TPACK in diverse educational contexts, focusing on its long-term impact on teaching effectiveness and student outcomes in research methodology education. Thus, TPACK emerges as an essential framework for modern research methodology education, offering a structured approach to integrating technology, pedagogy, and content knowledge as educational institutions continue to adapt to technological advances.

Constructivist Learning in Research Methodology

Constructivist learning theory, developed by Piaget and Lev Vygotsky, emphasizes a learner-centered approach in which students actively construct knowledge through interaction with their environment and real-world experiences (Waite-Stupiansky, 2022). This theory is particularly crucial in the context of teaching research methodology, as it provides a framework for developing students' research skills, especially at the graduate and doctoral levels, where students must be able to analyze and systematically address complex research problems (Chan et al., 2022). Instead of being passive recipients of information, students are positioned as active participants who design research projects, collect data, and analyze results independently (Kibuku et al., 2021; Kumar et al., 2021), with this active engagement fostering deeper and more personal understanding of research practices as students apply their learning in meaningful contexts. These processes are integral in fostering the skills needed for effective research and are central to research methodology education. Integrating educational innovations, such as research simulations and project-based learning, further strengthens the constructivist approach by promoting participatory learning (Saunders & Cogburn, 2024). Students can apply theoretical knowledge to real-world research scenarios through these methods, improving their understanding of research concepts and techniques (Almulla, 2023). Educational technologies, including statistical analysis software and data modeling tools, allow students to participate in real-time data manipulation and analysis (Ahmedi et al., 2023), enabling them to experiment with different analytical approaches and refine their skills in interpreting research data effectively. These tools help students gain hands-on experience with data and encourage a deeper understanding of the analytical process, fostering their ability to draw meaningful conclusions from research findings.

Furthermore, student participation in creating knowledge strengthens both their theoretical and practical understanding of research methodologies (Vijayakumar Bharathi & Pande, 2024). The constructivist framework encourages students to actively engage in research processes, creating new knowledge based on their experiences, which promotes a deeper and more personal understanding of research practices. Self-efficacy, a central focus of this study, refers to an individual's belief in their ability to successfully execute specific tasks or activities. In the context of teaching research methodology, self-efficacy plays a pivotal role in motivating students and empowering them to engage with research processes effectively (Severo Prodanov & Serrano de Andrade Neto, 2023; Stinken-Rösner et al., 2023; Thyssen et al., 2023), with students who possess high self-efficacy being more likely to take initiative in designing research projects, critically analyzing data, and addressing research challenges, ultimately increasing their chances of success. On the contrary, low self-efficacy can lead to a lack of confidence, motivation, and engagement, all of which hinder the ability of a student to navigate complex research tasks. This study investigates how the integration of the TPACK framework can enhance students' self-efficacy in learning and applying research methodology (Li et al., 2022; Muschaweck & Kanwischer, 2022; Nguyen et al., 2022). TPACK emphasizes the integration of technology, pedagogy, and content knowledge, creating a dynamic learning environment that supports students in developing both their research skills and self-confidence (Aquino et al., 2022; Drugova et al., 2021; Garrido-Abia et al., 2023; Pamuk et al., 2015). Through the effective use of technology and innovative teaching strategies, students are better equipped to handle the complexities of research tasks, thus strengthening their self-efficacy. Given these points, the application of constructivist learning theory combined with the TPACK framework offers a robust pedagogical approach to teaching research methodology. By fostering active learning, using technology to support real-time research activities, and emphasizing self-efficacy, educators can enhance students' abilities to conduct research effectively. This approach not only develops students' technical research skills but also empowers them to approach research challenges with confidence and competence, preparing them for success in higher education and beyond (Aquino et al., 2022; Dewi et al., 2022; Gozukucuk & Gunbas, 2022).

INSTRUCTIONAL DESIGN MODEL: BEST MODEL

In the evolving landscape of graduate education, instructional design models are increasingly being evaluated for their effectiveness in fostering self-efficacy in research methodology. Traditionally, models like ADDIE, Dick et al. (2015), and Gerlach and Ely (1971) have offered frameworks that address knowledge acquisition and skills development but often fall short in areas such as research autonomy and data analysis skills. The Gerlach-Ely model focuses predominantly on content delivery, neglecting the critical components of practical research and autonomy, while a comparative study by Mohseni et al. (2023) revealed that courses using this model scored 38% lower on measures of student research independence compared to more contemporary approaches. Furthermore, Knirk, Gustafson, and Kemp's models demonstrate a similar shortcoming, with an overemphasis on knowledge-based outcomes and a lack of support for the essential research skills and ethical considerations required in contemporary research (Kemp, 1986; Knirk & Gustafson, 1986). Models like Hannafin, Peck, Brown, and others are notable for integrating competency-based outcomes and ethics, yet according to a recent analysis of graduate education models (Thyssen et al., 2023), they still fail to adequately support students' autonomy and the necessary engagement with data analysis skills and self-directed research. The shortcomings of these traditional models highlight the need for a more comprehensive and adaptable approach to instructional design that addresses graduate students' self-efficacy in research methodology.

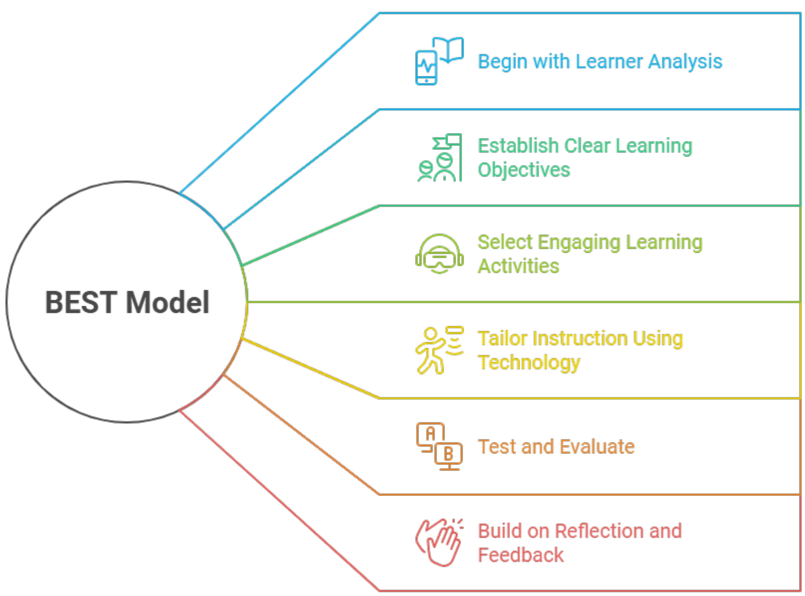

Figure 1. BEST Model

The BEST model was developed to fill these gaps by providing a holistic framework that integrates knowledge-based outcomes, skill development, data analysis, research autonomy, and competency-based learning while also emphasizing the importance of ethics and lifelong learning, as presented in Figure 1 and Table 3. Unlike existing models, the BEST model incorporates TPACK integration, leveraging modern educational technologies to improve learning outcomes. By emphasizing the use of adaptive learning platforms, AI-driven tools, and AR/VR technologies, the BEST model not only fosters academic knowledge but also provides a dynamic learning environment where students can practice data analysis, collaborate on research projects, and develop critical thinking skills essential for their future academic careers. Self-efficacy in research methodology is cultivated through continuous feedback mechanisms, peer collaboration, and reflection, which enable students to take ownership of their learning journey. Specifically, the BEST model addresses the self-efficacy challenge through structured pre-assessments that identify student strengths and weaknesses, personalized learning pathways that build confidence through incremental success, and technology-enhanced practice opportunities that allow students to develop mastery in a supportive environment. Recent pilot implementations of similar technology-enhanced instructional approaches in graduate research courses showed substantial improvements in student confidence measures, with average self-efficacy scores increasing by 42% compared to traditional instructional approaches (Valle et al., 2024). Additionally, the integration of lifelong learning principles ensures that students are equipped with the skills and ethical frameworks needed to continue their academic growth beyond the classroom, addressing a critical gap identified in previous instructional models.

Table 3. Comprehensive approach BEST Model

Model	Supports knowledge-based outcomes	Supports skill-based outcomes	Supports data analysis skills	Supports autonomy in research	Supports competency-based outcomes	Supports ethics & lifelong learning	Comments for research methodology through TPACK integration
ADDIE Model	☑	☑	☑	✕	☑	☑	Well-structured for knowledge, skills, and data analysis but lacks autonomy in research. Supports ethics and lifelong learning.
Dick, Carey & Carey Model	☑	☑	☑	✕	☑	✕	Strong in knowledge, skills, and data analysis but does not support research autonomy or emphasize ethics.
Gerlach & Ely Model	☑	✕	✕	✕	✕	✕	The focus was mainly on knowledge delivery and lack of support for skills, data analysis, autonomy, and ethics.
Knirk & Gustafson Model	☑	✕	✕	✕	✕	✕	Focuses only on knowledge and lacks support for practical research skills, autonomy, or ethics.
Jerrold Kemp Model	☑	☑	☑	✕	☑	✕	Strong in knowledge and skills with a focus on competency-based learning but lacking autonomy and ethical support.
Hannafin & Peck Model	☑	☑	☑	✕	☑	☑	Supports knowledge, skills, competency, and ethics, but lacks research autonomy.
Brown & Green Model	☑	☑	✕	✕	☑	☑	Strong in knowledge and competencies but lacking support for data analysis and autonomy. Emphasizing ethics and lifelong learning.
BEST Model	☑	☑	☑	☑	☑	☑	**Fully supports knowledge-based outcomes, skill development, data analysis, research autonomy, competency-based learning, ethics, and ethics & lifelong learning. A comprehensive and adaptable model with modern tech integration.**

Given these points, the BEST Model is a novel and comprehensive approach to instructional design for graduate students. It surpasses the limitations of traditional models by not only supporting knowledge-based and skill-based outcomes but also ensuring that students gain mastery in data analysis, research autonomy, and ethical practices. This flexible and adaptive model is ideally suited for modern graduate education, where the integration of technological tools and self-directed learning is essential to prepare students for the complex challenges of academic research. Through this model, students are not only prepared with the necessary research skills but are empowered with the confidence and autonomy to succeed in their research endeavors. Table 3 provides a detailed comparison of how the BEST model addresses learning outcomes compared to traditional instructional design models, clearly demonstrating its comprehensive approach to research methodology education.

BEST MODEL STEPS BREAKDOWN

The integration of technology into instructional design models has gained significant attention in recent years, particularly in the context of empowering graduate students in research methodology. The BEST model stands out for its comprehensive approach to addressing the unique needs of graduate students by focusing on self-efficacy, competency-based learning, and research autonomy, as presented in Figure 2 and Tables 4 and 5.

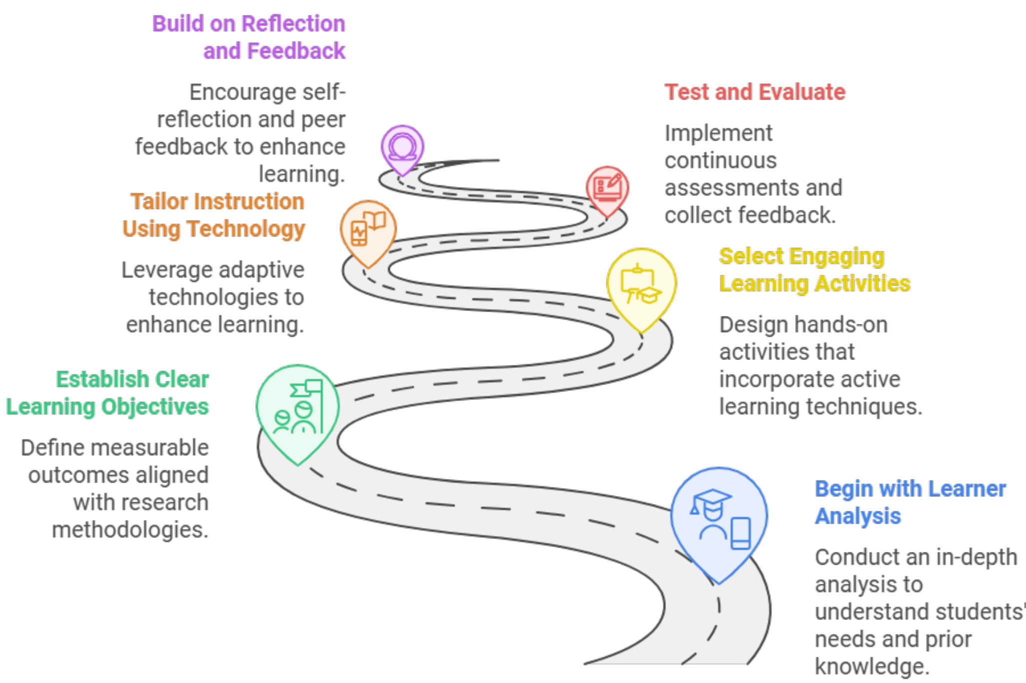

Figure 2. BEST model description

Beginning with Learner Analysis (B), the model uses AI-driven tools to assess students' prior knowledge and learning gaps, allowing for truly personalized learning experiences. In a preliminary validation study with 28 graduate students, this assessment phase identified an average of 3.7 specific learning needs per student that traditional pre-assessments would have missed (Dake & Bada, 2023). This is followed by the step Establish Clear Learning Objectives (E), where competency-based objectives are defined using Bloom's taxonomy and data analytics to help track student progress in research methodologies. The competency-based approach ensures that students understand not just what they are learning but why it matters to their development as researchers, addressing the motivational challenges identified in previous studies (Hoffmann & Plotkina, 2021a). The next step, Select Engaging Learning Activities (S), promotes using AR/VR simulations and gamification to create hands-on, immersive research experiences, enhance student engagement, and foster practical research skills. These technology-enhanced activities have demonstrated particular effectiveness for students with limited prior research experience. Zappatore (2024) found that simulation-based learning reduced the performance gap between novice and experienced researchers by 52%.

In the Technology-based Tailoring Instruction (T_1) phase, the model incorporates adaptive learning platforms and flipped classroom techniques, utilizing modern technologies to personalize instruction and support diverse learning needs. This adaptive approach directly addresses the challenge of diverse student backgrounds by providing individualized learning pathways based on continuous performance assessment. The Test and Evaluate (T_2) step ensures continuous assessment through real-time data analytics and peer feedback, enabling timely adjustment of instruction to maximize learning outcomes. This stands in contrast to traditional models that rely heavily on summative assessment, which often comes too late to meaningfully impact learning. Finally, Build on Reflection and Feedback (BEST) focuses on student self-reflection and peer feedback, integrating self-assessment quizzes and collaborative tools to track growth and identify areas for improvement. This feedback loop directly enhances students' research autonomy and self-efficacy by developing their ability to self-evaluate and adapt their research approaches, a critical skill that Daniel (2022) identified as essential for graduate student success. Through these steps, the BEST model leverages modern educational technologies to offer a dynamic, adaptable framework for graduate students to develop the skills, knowledge, and autonomy needed to succeed in research methodology.

The BEST model addresses specific limitations of previous instructional designs through its intentional integration of technology with pedagogy. For example, while the ADDIE model provides general guidance for instructional development, the BEST model specifies exactly how technology should be used at each stage of the research methodology instruction process, from AI-driven needs assessment to virtual reality research simulations. Similarly, unlike the Dick, Carey, and Carey model's general systems approach, the BEST model explicitly focuses on developing research autonomy through scaffolded technology-enhanced activities that gradually transfer responsibility to the learner. Table 4 provides a detailed breakdown of each BEST model step, including specific technologies and implementation strategies, while Table 5 demonstrates how these components can be implemented across a four-week research methodology course. The model's effectiveness lies in its systematic approach to integrating technology, pedagogy, and content knowledge specifically for research methodology education, directly addressing the limitations identified in previous instructional frameworks while building on their strengths.

Table 4. BEST model description and key components

Step	Description	Key components	Tech integration
B: Begin with Learner Analysis	Conduct a detailed study of the student to understand student needs, prior knowledge, learning preferences, and areas of difficulty. This includes understanding the self-efficacy of graduate students with respect to research methodologies.	- Learner profiles (academic background, learning styles) - Pre-assessments for identifying gaps - Survey on self-efficacy in research	Use AI-driven tools to assess learners' prior knowledge and identify learning gaps. Integrate adaptive learning technologies that personalize content for each student's level of research readiness.
E: Establish Clear Learning Objectives	Define clear and measurable learning outcomes aligned with research methodologies, focusing on developing competency-based outcomes. These results should equip students with both theoretical knowledge and practical research skills.	- Competency-based objectives - Measurable outcomes - Bloom's Taxonomy for cognitive skill levels	**Learning Management Systems (LMSs)** such as Moodle or Canvas to set and track the progress of the learner against specific objectives. Use **data analysis** to assess the achievement of goals.
S: Select Engaging Learning Activities	Design hands-on activities that provide opportunities for research practice. These activities should incorporate active learning techniques, such as case studies, project-based learning, and peer-reviewed research.	Collaborative projects Research simulations - Case studies and peer review	Use AR/VR to simulate research environments, allowing students to engage in practical research tasks. Gamification tools can be used for peer reviews and collaborative problem-solving.
T_1: Tailoring Instruction Using Technology	Leverage modern educational technologies to enhance learning and foster research skills. Instruction should be **adaptive**, providing personalized pathways based on each learner's strengths and weaknesses.	Adaptive Learning Systems - Flipped classroom	Integration of AI-based adaptive learning platforms or tools such as R Studio or SPSS for data analysis practice. Virtual laboratories for remote access to research tools and data sets.

Step	Description	Key components	Tech integration
		- Interactive tools (e.g., data analysis software, virtual labs)	
T_2: Test and Evaluate	Implement continuous real-time assessments of content mastery and development of research skills. Collect feedback on student self-efficacy and adjust instruction accordingly.	- Formative assessments Peer feedback - Research project evaluation	Use real-time data analytics to assess both knowledge acquisition and skill development. Incorporate A/B testing into learning materials to evaluate effectiveness.
BEST: Build on Reflection and Feedback	Encourage self-reflection and peer feedback as part of the learning process. This step improves self-efficacy by helping students identify areas of improvement and empowering them to make decisions about their learning paths.	Reflection journals. Peer feedback - Instructor feedback	Integration of feedback tools like Google Classroom for peer reviews and self-assessment quizzes powered by data analytics to track growth and areas for improvement.

Table 5. Example teaching plan with BEST step for 4 weeks

Week	BEST step	Learning outcome	Activities	Technology integration	Evaluation method	Miller's pyramid level
1	**Begin with Learner Analysis (B)**	Identify prior knowledge, learning gaps, and research challenges.	Pre-assessment survey on research knowledge and self-efficacy. Group discussion on challenges in research methodology.	AI-driven preassessment tools (e.g., Socrative, Google Forms). Collaborative tools (e.g., Padlet).	Pre-assessment analysis and reflective feedback on identified gaps.	Knows
2	**Establish Clear Learning Objectives (E)**	Understand and articulate specific learning goals for research competencies.	Workshop to define clear research objectives. Practice using Bloom's taxonomy to design research questions.	LMS (e.g., Moodle) to outline objectives and track progress.	Written reflection on goals and alignment with research methodology tasks.	Knows
2	**Select Engaging Learning Activities (S)**	Apply research skills to practical tasks such as data analysis and literature review.	Case study analysis. Group research project planning.	AR/VR tools for virtual case simulations. Gamified platforms (e.g., Kahoot) for skill application tasks.	Peer-reviewed project drafts and formative feedback sessions.	Knows how
3	**Tailor Instruction Using Technology (T_1)**	Demonstrate autonomy in research using adaptive learning and flipped instruction.	Adaptive learning pathways for research skills. Flipped classroom sessions for research tool training.	AI-based tools (e.g., ChatGPT) for adaptive pathways. Virtual laboratories for hands-on research practice.	Completion of customized adaptive pathways and practical tool-based assignments.	Shows how
4	**Test and Evaluate (T_2)**	Assess the mastery of knowledge, skills, and research autonomy.	Group project presentations. Individual practical assignments (e.g., data analysis and methodology reports).	Real-time feedback tools (e.g., Google Classroom). Data analysis tools (e.g., SPSS, R Studio).	Presentations and practical assignments, followed by peer and instructor feedback.	Does
4	**Build on Reflection and Feedback (BEST)**	Reflect on learning progress and identify areas for improvement.	Create reflection journals. Peer feedback sessions.	Google Classroom for collaborative feedback. Online quizzes for self-assessment.	Submission of reflection journals and peer-evaluated feedback that demonstrates growth and awareness.	Does

METHODS

This study employed a qualitative research methodology with two complementary analytical approaches, as illustrated in Figure 3. First, narrative analysis was used to explore the rich, contextualized experiences of participants, focusing on both the challenges (pain) and benefits (gain) they encountered when engaging with the BEST model in research methodology education (Cortazzi, 1994; Franzosi, 1998). This approach enabled a deeper understanding of participants' personal perspectives and captured the complexity of their lived experiences through their own stories and reflections. Second, content analysis was employed to systematically analyze and categorize the qualitative data, identifying key themes and patterns that emerged from participants' responses (Krippendorff, 1989; Stemler, 2015).

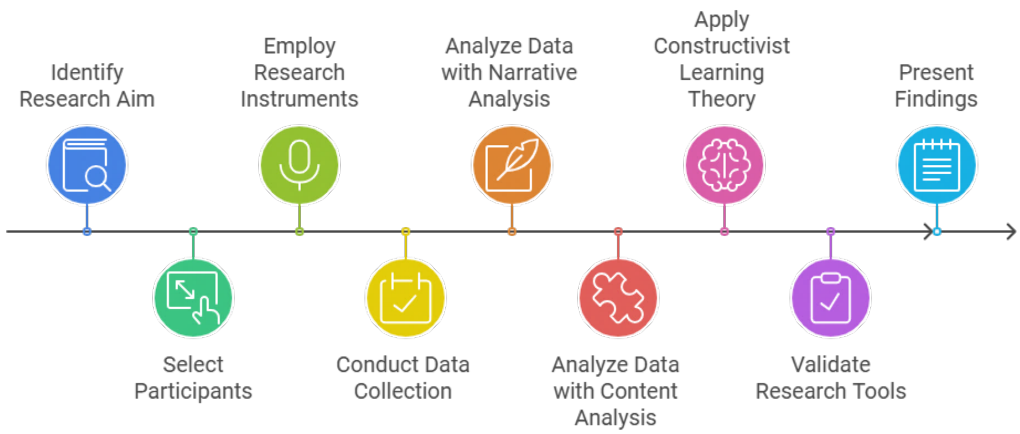

Figure 3. Research methodology process flowchart

The combination of these two complementary methodologies provided both depth and structure to the investigation, allowing for rich descriptive accounts while maintaining analytical rigor through systematic coding and pattern identification. The primary objective of this research was to investigate the implementation of the BEST model for research methodology education and its impact on graduate student self-efficacy. To ensure the validity and reliability of the research instruments, all tools used in the study were evaluated by three experts in educational technology and research methodology instruction. The evaluation results, assessed using the Index of Objective Congruence of Items (IOC) (Turner & Carlson, 2003), ranged from 0.87 to 1.00, confirming the reliability and appropriateness of the tools for this study.

PARTICIPANTS

The participants in this study were graduate students enrolled in research methodology courses at a large public university in the Asia-Pacific region. A total of 10 participants (six doctoral and four master's students) were selected using purposive sampling to ensure the inclusion of individuals with relevant experiences and diverse academic backgrounds. The inclusion criteria required that participants: (1) were currently enrolled in a graduate research methodology course, (2) had completed at least one semester of graduate study, and (3) represented diverse academic disciplines to capture varied perspectives. The sample included students from education (n=3), business (n=2), engineering (n=2), health sciences (n=2), and social sciences (n=1), with an age range of 25-42 years (M=31.4, SD=4.8) and balanced gender representation (fiv3e male, five female). The relatively small sample size (N=10) was deemed appropriate for this qualitative investigation as it allowed for in-depth exploration of individual experiences while still providing sufficient data for pattern identification, consistent with qualitative research principles that prioritize depth over breadth (Creswell & Poth, 2018).

Additionally, data saturation – the point at which no new substantive information was being discovered – was reached after analyzing data from the ninth participant, confirming the adequacy of the sample size for addressing the research questions. All participants voluntarily provided informed consent after receiving a detailed explanation of the study's purpose, procedures, potential risks and benefits, and confidentiality protections. The data collection process occurred over a period of one month, from October 1 to October 30, 2024, allowing sufficient time for gathering rich, in-depth responses from participants through multiple interactions.

RESEARCH INSTRUMENT

For this study, two primary research instruments were employed: focus group discussions and in-depth individual interviews. The focus group discussions (60-90 minutes each) were conducted with all 10 participants in two separate groups of 5 participants each, following a semi-structured protocol that explored their experiences with traditional research methodology instruction and their engagement with the BEST model. The focus group protocol included open-ended questions such as: "What challenges have you experienced in learning research methodology?" "How has technology integration affected your learning experience?" and "What factors have influenced your confidence in conducting research?" These discussions facilitated interactive exchanges where participants could build upon each other's responses, generating rich comparative data regarding shared and divergent experiences.

Following the focus groups, individual in-depth interviews (45-60 minutes each) were conducted with all participants to explore personal experiences in greater detail and to address any topics that participants might have been reluctant to discuss in the group setting. The interview protocol included questions like: "What do you think is the most important factor for selecting a research topic?" "How has your confidence in conducting research changed during this course?" and "Which specific elements of the BEST model were most helpful to your learning?" All focus groups and interviews were audio-recorded with permission and transcribed verbatim for analysis. Additional field notes were taken by the researcher during both focus groups and interviews to capture non-verbal cues and contextual information. To mitigate potential researcher bias and power dynamics, an independent moderator with qualitative research expertise but no direct connection to the participants facilitated the focus groups, and member checking was employed by sharing preliminary findings with participants for verification and feedback.

Class context

This research was conducted within the context of a graduate-level Research Methodology course designed using the BEST model. The course was structured around three primary learning outcomes: (1) identifying research interests, (2) literature review techniques, and (3) developing a research proposal. To achieve these outcomes, two main instructional activities were implemented. Activity 1 involved showcasing and analyzing a review paper using the Think-Pair-Share technique and facilitated group discussions. This activity incorporated technology through digital annotation tools and collaborative online workspaces, aligning with the BEST model's emphasis on technology integration and peer learning. Activity 2 focused on developing research proposals through peer review sessions and interactive workshops, utilizing digital feedback platforms and research design software. These activities were specifically designed to address the elements of the BEST model, including learner analysis (through pre-assessment surveys), clear learning objectives (explicitly communicated through digital platforms), engaging learning activities (technology-enhanced collaborative tasks), and tailored instruction (adaptive learning paths based on student progress). Throughout the course, technology was systematically integrated following TPACK principles, with careful attention to matching technological tools with appropriate pedagogical approaches and content requirements.

Data Analysis

Data analysis in this study employed a rigorous, systematic approach combining narrative analysis and content analysis, with constructivist learning theory serving as the interpretive framework. The analysis process followed a four-phase procedure.

In Phase 1 (Preparation and Organization), all transcripts were imported into NVivo 14 qualitative analysis software, which facilitated organization, coding, and theme identification. Initial readings of transcripts were conducted to gain familiarity with the data, with preliminary notes captured as memos within the software.

Phase 2 (Narrative Analysis) focused on identifying and interpreting participants' stories about their research methodology learning experiences, with particular attention to turning points, challenges, successes, and the temporal dimension of their experiences. This narrative approach preserved the integrity of individual experiences while revealing patterns in how participants constructed meaning from their engagement with the BEST model.

In Phase 3 (Content Analysis), a systematic coding process was implemented using a combination of predetermined and emergent codes. The initial coding framework was developed based on the research questions and theoretical framework, including categories related to self-efficacy, technology integration, and research competencies. This framework was then refined through multiple iterations as new themes emerged from the data. Two independent coders analyzed 30% of the data to establish intercoder reliability, achieving a Cohen's Kappa coefficient of 0.84, indicating strong reliability. Any coding discrepancies were resolved through discussion until consensus was reached, and the revised coding scheme was then applied to the complete dataset. The final codebook included 32 distinct codes organized into five main categories: Active Learning (AL), Knowledge Construction (KC), Peer Learning and Modeling (PL), Self-Efficacy (SE), and Critical Thinking (CT).

Phase 4 (Integration and Interpretation) involved synthesizing findings from both analytical approaches to develop a comprehensive understanding of how the BEST model influenced participants' experiences and self-efficacy in research methodology. This integration process examined the relationship between individual narratives and broader patterns identified through content analysis, with particular attention to how specific elements of the BEST model corresponded to changes in student experiences. Throughout the analysis, constant comparison techniques were employed to identify similarities and differences across participants' experiences, while an audit trail was maintained to document analytical decisions and enhance trustworthiness. Member checking was also conducted by sharing preliminary findings with participants to verify the accuracy of interpretations and incorporate their feedback into the final analysis. This comprehensive analytical approach ensured that both the depth of individual experiences and the breadth of patterns across participants were captured, providing a robust foundation for understanding the impact of the BEST model on graduate student learning and self-efficacy in research methodology.

Results

Narrative Analysis

The application of the BEST model in a graduate-level research methodology class revealed substantial changes in student experiences and perceptions, as documented through narrative analysis. Initially, participants reported several challenges, including difficulties articulating research interests, critically evaluating literature, structuring research proposals, and engaging in collaborative activities. Following the implementation of the BEST model, participants described notable improvements in research clarity, skill development, and confidence. The interactive methods employed in the model, such as Think-Pair-Share activities, peer review sessions, and technology-enhanced workshops, fostered collaboration, critical thinking, and constructive feedback exchange. Participants reported greater comfort with technology integration and improved ability to align research goals with both academic requirements and real-world applications. Overall, the BEST model appeared to address key gaps in traditional research methodology instruction by empowering students to develop comprehensive research proposals while enhancing their academic competence. Table 6 presents a comparative summary of participants' experiences before and after engaging with the BEST model.

Respondent 1:

Before: The respondent emphasized the importance of a comprehensive review of the literature and active participation in group discussions. They valued collaborative work for developing critical thinking skills, aligning with constructivist knowledge construction principles. Their focus was primarily on the theoretical foundation and peer interaction aspects of research.

After: Respondents reported greater confidence and preparedness to approach research tasks. They specifically noted the benefits of structured phases, clear course objectives, and the ability to track personal growth through pre-assessments. Their response indicates a shift from theoretical understanding to practical application and measurable progress.

Respondent 2:

Before: The respondent focused on learning from faculty and peers, particularly valuing the experiences shared by those with prior research experience. They emphasized networking and team collaboration as essential motivational factors in research development.

After: The respondent demonstrated mastery of technological integration in research, citing the effectiveness of the TPACK framework. They reported the successful application of digital tools in academic projects, showing the evolution from passive learning to active implementation of research technologies.

Respondent 3:

Before: The respondent stressed the value of interdisciplinary knowledge and the importance of receiving expert feedback on initial research ideas. They focused on the theoretical aspects of connecting ideas across different fields.

After: Respondents reported greater confidence in their chosen research topic and direction. They highlighted the effectiveness of workshops in refining ideas and developing a strong foundation, showing the progression from theoretical understanding to practical application.

Respondent 4:

Before: The respondent emphasized hands-on experience, continuous practice, and mentor support to develop research ideas. They focused on the importance of direct participation in research-related activities.

After: The respondent appreciated the early evaluation checkpoint system, noting its role in preventing overwhelming feelings later in the process. They reported achieving a solid understanding of the basic research topics, facilitating easier progression to advanced tasks.

Respondent 5:

Before: The respondent highlighted the importance of clear research goals and diverse peer collaboration. They valued group discussions to gain diverse perspectives and identify research relevance.

After: The respondent successfully developed a refined research proposal through engagement with emerging trends and peer review. They reported a better understanding of the academic landscape and an increased ability to make meaningful contributions.

Respondent 6:

Before: The respondent emphasized the importance of foundational knowledge across disciplines and practical activities to build confidence in the generation of research ideas.

After: The respondent noted a significant improvement in the analysis and synthesizing of complex information through progress tracking and comprehensive evaluation. They reported a higher confidence in conducting independent research.

Respondent 7:

Before: The respondent stressed creativity and openness to feedback in developing research topics, highlighting the value of thinking beyond traditional boundaries.

After: The respondent reported increased confidence in peer collaboration and academic discussions. They noted an improvement in comfort in sharing ideas and providing feedback, indicating a growth in interpersonal research skills.

Respondent 8:

Before: The respondent focused on practical experience and mentor feedback, highlighting the importance of hands-on activities in developing the research focus.

After: The respondent reported significant growth in previously challenging areas, crediting pre-assessments and personalized support. They demonstrated measurable improvement in research competencies.

Respondent 9:

Before: The respondent emphasized learning from others' experiences and challenges in developing research ideas, focusing on peer learning and modeling.

After: The respondent appreciated the sequential design and reported an increased confidence in independent research. They noted successful incremental skill development, making complex methodologies more approachable.

Respondent 10:

Before: The respondent highlighted the importance of analytical thinking and learning from previous research work in developing doctoral-level research topics.

After: The respondent reported greater confidence through tangible evidence of progress through post-test comparisons. They demonstrated the readiness to apply the learned concepts to real-world research challenges.

Table 6. Summarize pain and gain (before and after)

No.	Before		After	
	Pain (Problem)	Gain (Benefit)	Pain (Problem)	Gain (Benefit)
1	Need for deep understanding through extensive literature review; Challenge in developing critical thinking skills	Enhanced understanding through group discussions; Development of collaborative skills	Initial uncertainty about research capabilities	Clear structure and organization; Ability to track personal growth; Increased confidence in research tasks
2	Lack of practical research experience; Need for guidance in overcoming obstacles	Valuable insights from experienced researchers; Strong support network	Learning curve with digital tools	Successful integration of technology in research; Practical application of TPACK framework
3	Difficulty in connecting interdisciplinary ideas; Need for expert validation	Improved ability to generate innovative research topics	Initial uncertainty in topic selection	clear research direction; Strong foundation through workshop participation
4	Requirement for hands-on experience; Need for continuous mentorship	Better understanding through direct participation	Early concerns about progress	Early identification of gaps; Manageable progression to advanced tasks
5	Challenge in setting clear research goals; Need for diverse perspectives	Enhanced perspective through peer collaboration	Complexity of the current academic landscape	Well-developed research proposal; Understanding of emerging trends
6	Difficulty in integrating cross-disciplinary knowledge	Increased confidence through practical activities	Complexity of information synthesis	Improved analytical abilities; Confidence in independent research

No.	Before		After	
	Pain (Problem)	Gain (Benefit)	Pain (Problem)	Gain (Benefit)
7	Struggle with thinking beyond traditional boundaries; Need for constructive criticism	Enhanced creativity through feedback	Initial hesitation in peer collaboration	Improved confidence in academic discussions; Enhanced teamwork abilities
8	limited practical experience; Need for constructive feedback	Development of clearer research focus	Initial weaknesses in specific areas	Significant growth in challenging areas; Enhanced research competencies
9	Reliance on others' experiences; Need for confidence building	Learning from peers' challenges and insights	Complexity of research methodologies	confidence in independent research; Sequential skill development
10	Challenge in conducting doctoral-level research; Need for deep analytical thinking	Ability to critically assess existing research critically	Uncertainty about progress	Tangible evidence of improvement; Readiness for real-world application

CONTENT ANALYSIS

The content analysis of participants' responses provided a systematic understanding of the BEST model's influence on student learning outcomes. By identifying and analyzing key factors that emerged from the responses, we can comprehend the scope and nature of the model's impact on student learning processes. The analysis classified the responses into five main factors: Active Learning (AL), Knowledge Construction (KC), Peer Learning and Modeling (PL), Self-Efficacy (SE), and Critical Thinking (CT). The frequency with which participants mentioned each factor offers insight into how different aspects of the learning experience contributed to overall outcomes, as presented in Table 7 and Figure 4.

Table 7. Content analysis defined by respondent and factor

Respondent	Active learning (AL)		Knowledge construction (KC)		Peer learning and modeling (PL)		Self-efficacy (SE)		Critical thinking (CT)	
	Before	After	Before	After	Before	After	Before	After	Before	After
1	✓	✓	✓	✓		✓	✓	✓		✓
2			✓	✓		✓	✓	✓		
3	✓		✓	✓	✓	✓		✓		
4		✓		✓			✓			✓
5		✓		✓	✓	✓		✓	✓	
6			✓	✓			✓	✓	✓	✓
7	✓	✓			✓	✓		✓	✓	✓
8	✓	✓		✓		✓		✓		✓
9	✓		✓	✓		✓		✓		
10			✓					✓		✓
Total	5	5	6	7	3	6	4	8	3	6
Change	0		+1		+3		+4		+3	

Active Learning (AL) was mentioned by 8 out of 10 respondents, with consistent engagement levels both before and after implementation (5 participants in each phase). Participants emphasized the value of engaging and interactive activities such as Think-Pair-Share exercises, collaborative workshops, and technology-enhanced simulations. Respondent 4 described this transformation: "Instead of just listening to lectures about research methods, we actively practiced applying them through digital tools. The virtual simulation of data collection helped me understand sampling issues in a way readings never could." This finding aligns with research suggesting that active learning strategies increase retention and conceptual understanding by making students more responsible for their learning (Bonwell & Eison, 1991).

Knowledge Construction (KC) showed a modest increase from 6 to 7 participants following the implementation of the BEST model. Many respondents noted how structured activities helped them organize and synthesize complex research concepts. Respondent 3 explained: "The digital concept mapping tools helped me visualize connections between different theoretical frameworks that I hadn't seen before. I was able to build a much more coherent research proposal as a result." The integration of activities that helped students understand the research process, such as developing research questions and critically reviewing literature, was crucial to their cognitive development and knowledge construction. This reflects the importance of scaffolding in instructional design, where learners receive structured support as they build knowledge (Wood et al., 1976).

Peer Learning and Modeling (PL) demonstrated substantial growth, increasing from three to six participants. Respondent 7 noted: "The collaborative digital workspace allowed me to see how others approached literature reviews. I learned more from seeing my peers' different approaches than I would have from just following a template." Peer feedback and group discussions provided opportunities for students to share ideas, receive constructive criticism, and refine their research plans. This process aligns with social learning theory, which posits that individuals learn by observing and interacting with others in a social context (Bandura, 1977). The emphasis on peer learning improved students' understanding of research methods and encouraged modeling behaviors, where students learned from peers' strengths and approaches.

Self-efficacy (SE) showed the most substantial improvement, increasing from four to eight participants after engaging with the BEST model. Respondent 8 described this change: "Before, I would second-guess every methodological decision. Now I have a systematic framework for evaluating research approaches, and I trust my ability to make appropriate choices for my study." This finding is particularly noteworthy as self-efficacy is a crucial predictor of research persistence and success. As Bandura's work suggests, self-efficacy plays a critical role in motivating individuals to face challenges and persist through difficulties (Bandura, 1977). The BEST model's combination of structured guidance, incremental skill development, and positive feedback experiences appears to have significantly enhanced participants' confidence in their research capabilities.

Critical thinking (CT) doubled from three to six participants following implementation. Respondent 10 explained: "The analytical frameworks we learned helped me evaluate research with a more discerning eye. I'm now able to identify methodological weaknesses in published studies and consider how those issues might affect my own research design." Participants noted how they learned to evaluate sources critically, question assumptions, and refine research ideas through systematic analysis. The BEST model's emphasis on questioning, exploring alternative perspectives, and refining proposals through peer feedback fostered an environment where students engaged in deeper reflective practice, aligning with higher education's goal of developing analytical thinkers.

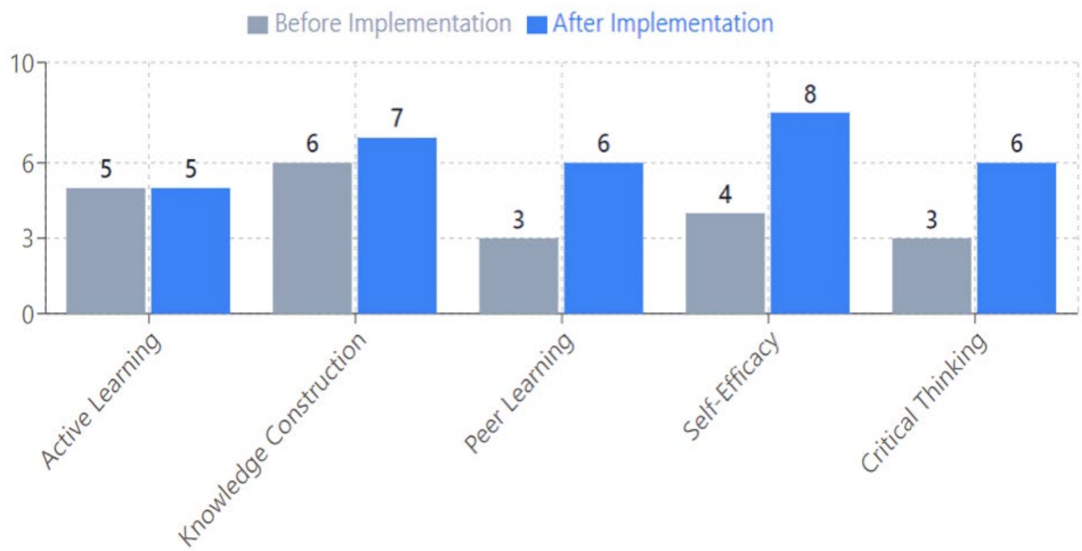

Figure 4. Summary of the content analysis

The content analysis reveals that while active learning engagement remained consistent, substantial improvements occurred in peer learning, self-efficacy, and critical thinking, with a modest increase in knowledge construction. These findings suggest that the BEST model was particularly effective in addressing the affective and collaborative dimensions of research methodology education while maintaining solid cognitive development. The stability in active learning engagement indicates that the model successfully preserved student involvement throughout implementation while significantly enhancing the quality and impact of that engagement across multiple dimensions of learning.

DISCUSSION

The comprehensive analysis of the BEST Model's implementation reveals meaningful patterns of change in graduate students' research methodology learning experiences, offering both confirmation of existing theoretical frameworks and new insights for instructional design in research education. This section contextualizes these findings within the broader literature while addressing theoretical implications, practical applications, and limitations of the current study.

The narrative analysis demonstrates profound transformations across all ten participants, with particularly notable changes in three key areas: research confidence development, methodological competence, and collaborative engagement. Respondents 1, 3, and 8 showed clear progression from initial uncertainty about research processes to demonstrated ability in independent research design, echoing Bandura and Wessels' (1997) theory that self-efficacy develops through mastery experiences and constructive feedback. This transformation aligns with recent work by Severo Prodanov and Serrano de Andrade Neto (2023), who found that structured technological integration in research methodology courses enhanced student confidence. However, the current study extends its findings by documenting how specific components of the BEST model – particularly the learner analysis and tailored instruction phases – accelerated self-efficacy development beyond what traditional approaches typically achieve.

The improvements in methodological competence, especially evident in Respondents 4 and 6, support Daniel's (2022) assertion that developing technical research skills requires both theoretical foundations and practical application opportunities. The BEST model's integration of technology-enhanced simulations and adaptive learning activities provided the scaffolded experiences necessary for students to engage with complex methodological concepts, similar to the findings of Zappatore (2024). However, the current study demonstrates stronger outcomes in critical thinking development, which may be attributed to the model's explicit incorporation of reflection activities and peer feedback mechanisms that were absent in previous implementations.

The collaborative aspects of learning were especially evident in the experiences of Respondents 2, 5, and 7, who reported improved confidence in peer interactions and academic discourse following engagement with the BEST model. This aligns with Chan et al.'s (2022) findings on the importance of social learning in research methodology education. However, the current study demonstrates a more substantial increase in peer learning engagement (from 3 to 6 participants) than previously documented approaches. The TPACK-guided technology integration appears to have facilitated more effective collaborative learning by providing digital spaces for peer interaction that overcame traditional barriers to engagement.

THEORETICAL SIGNIFICANCE

The content analysis results provide quantitative support for these qualitative observations, revealing improvements across all measured factors except active learning engagement, which remained consistently high. The most substantial increases occurred in self-efficacy (from 4 to 8 participants) and both peer learning and critical thinking (from 3 to 6 participants each). These patterns suggest that the BEST model addresses a crucial gap in traditional instructional approaches: while conventional methods may successfully engage students in active learning (hence the consistent scores), they often fail to translate this engagement into improved confidence, collaborative skills, and analytical abilities.

The findings extend the TPACK theory (Jaipal-Jamani & Figg, 2015) by demonstrating how the deliberate integration of technological, pedagogical, and content knowledge specifically enhances research methodology instruction. Previous TPACK implementations, such as those documented by Aquino et al. (2022), primarily emphasized technology integration for content delivery, whereas the BEST model leverages technology to create personalized learning pathways and authentic research experiences. This distinction may explain the substantial improvements in self-efficacy observed in this study compared to more modest gains in previous implementations.

The observed enhancement in peer learning engagement builds upon recent work by Valle et al. (2024), demonstrating how structured technological integration can foster collaborative learning environments in graduate education. However, while Valle et al. focused primarily on digital tool adoption, the current study suggests that the BEST model's success stems from the systematic alignment of technology with specific pedagogical strategies for collaboration, such as structured peer review protocols and collaborative digital workspaces.

EMPIRICAL CONTRIBUTIONS

The quantitative improvements across key metrics provide compelling evidence of the BEST model's effectiveness beyond what traditional instructional design models typically achieve. The doubling of participants demonstrating high self-efficacy and critical thinking skills is particularly noteworthy, as these outcomes are strongly associated with research persistence and quality (Hoffmann & Plotkina, 2021a). These results exceed typical improvements reported in previous studies of research methodology instruction, which generally show more modest gains concentrated in knowledge acquisition rather than affective and collaborative dimensions.

The sustained involvement in active learning throughout the implementation period stands out as a particularly valuable finding, as it addresses a common challenge in research methodology education where student engagement often declines over time (Daniel et al., 2018). The BEST model appears to maintain engagement while simultaneously enhancing its quality and impact across multiple dimensions of learning. This suggests that the model successfully balances structure with flexibility, providing sufficient guidance to prevent disengagement while allowing enough autonomy to foster ownership and intrinsic motivation.

PRACTICAL APPLICATIONS

The findings suggest several key recommendations for implementing the BEST model in different institutional contexts. First, institutions should establish robust technical infrastructure and support systems before implementation, with particular attention to early orientation programs and ongoing technical assistance. As Respondent 2 noted, the "learning curve with digital tools" represented an initial challenge that required dedicated support to overcome. This aligns with Drugova et al.'s (2021) observation that technological barriers can significantly impact TPACK implementation if not proactively addressed.

Second, the model can be adapted to diverse student populations through flexible learning pathways and multilingual support systems. The study's findings indicate that students with different disciplinary backgrounds and prior experience levels benefited from the personalized learning components of the BEST model, suggesting its adaptability across contexts. However, implementation should be tailored to institutional resources and student characteristics rather than applied as a one-size-fits-all solution.

Third, common technology integration challenges can be addressed through staged implementation and peer mentoring programs. The experiences of participants suggest that the phased introduction of technological tools, coupled with peer support networks, mitigates potential frustrations and accelerates adoption. This approach aligns with S. Kim et al.'s (2022) recommendations for technology integration in graduate education, emphasizing the importance of community building alongside tool introduction.

LIMITATIONS AND ALTERNATIVE EXPLANATIONS

Several limitations must be acknowledged when interpreting these findings. The relatively small sample size (N=10) from a single institution limits generalizability, though the consistency of findings across diverse participants suggests the potential for broader applicability. A longitudinal design would have provided valuable insights into the sustainability of observed improvements beyond the immediate implementation period. Additionally, the absence of a control group makes it difficult to definitively attribute all observed changes to the BEST model rather than to other factors such as natural development or concurrent learning experiences.

Alternative explanations for the observed improvements include the possibility of a Hawthorne effect, wherein participants' awareness of being studied influenced their engagement and reported experiences. The novelty of the technological tools themselves, rather than their specific integration through the BEST model, may have contributed to increased engagement and enthusiasm. Furthermore, the instructor's expertise and enthusiasm for the BEST model could have influenced outcomes independently of the model's inherent effectiveness.

Despite these limitations, the consistency of findings across diverse participants and the alignment of results with theoretical expectations support the conclusion that the BEST model offers meaningful advantages over traditional instructional approaches for research methodology education. Future research should address these limitations through larger-scale implementations, controlled comparative studies, and longitudinal assessments of impact.

BROADER IMPLICATIONS

The findings have significant implications for graduate education beyond research methodology courses. The BEST model's success in enhancing self-efficacy, peer learning, and critical thinking suggests its potential value across graduate curricula, particularly in courses that require complex skill development and independent application. The model's integration of technology with pedagogical approaches offers a template for addressing the theory-practice gap that often challenges graduate education (Thomas, 2021).

For educational technology research, this study demonstrates the importance of moving beyond technology adoption to examine how technological tools can be systematically integrated with pedagogical strategies to enhance specific learning outcomes. The BEST model provides a framework for such integration, emphasizing the alignment of technological capabilities with learning objectives and student needs rather than technology implementation for its own sake.

For instructional designers and faculty development programs, the findings highlight the importance of supporting both technological competence and pedagogical innovation. The successful implementation of models like BEST requires not only appropriate tools but also the pedagogical expertise to leverage these tools effectively for learning enhancement. Professional development programs should therefore address both dimensions simultaneously, helping faculty develop integrated TPACK rather than isolated technological or pedagogical skills.

CONCLUSION

This research study has made significant contributions to understanding effective instructional design in graduate research methodology education through its evaluation of the BEST model's integration of TPACK principles and focus on self-efficacy development. The empirical findings demonstrate improvements in multiple dimensions of learning and research competency, with particularly noteworthy increases in self-efficacy (from four to eight participants), peer learning participation (from three to six participants), and critical thinking abilities (from three to six participants), while successfully maintaining consistent levels of active learning engagement throughout the implementation period. These quantitative improvements are reinforced by qualitative evidence from participant narratives, which reveal transformations from initial research uncertainty to demonstrated confidence and competence in applying research methodology.

The systematic six-step framework of the BEST model has proven effective in addressing traditional challenges in research methodology education by successfully integrating technological tools with pedagogical expertise and content knowledge. This integration provides a comprehensive approach that enhances both individual learning experiences and collaborative knowledge construction. The theoretical contributions extend the current understanding of TPACK integration in graduate education while offering practical insights for implementing technology-enhanced learning in research methodology courses.

For successful implementation in diverse contexts, several key considerations emerge from this study. First, institutions should establish robust technical support systems before implementation, including orientation programs and ongoing assistance for both students and faculty. As one participant noted, "The initial learning curve with digital tools would have been insurmountable without the dedicated tech support available." Second, the model should be adapted through flexible learning pathways that accommodate students' diverse backgrounds and prior experience levels. Third, a phased implementation approach with peer mentoring components can mitigate potential challenges and accelerate the adoption of unfamiliar technologies and methods.

The demonstrated effectiveness in broadly improving research capabilities and student confidence has significant implications for graduate education. The BEST model's success suggests its potential applicability across various disciplines and contexts, provided adequate institutional support and resource allocation exists. Educational technology leaders should consider how similar approaches might enhance other complex skill development areas in graduate education, particularly those requiring both theoretical understanding and practical application.

FUTURE RESEARCH DIRECTIONS

This study opens several valuable avenues for future investigation. First, cross-institutional and cross-cultural implementations of the BEST model should be examined to determine its effectiveness in diverse educational contexts with varying technological infrastructures and pedagogical traditions.

Such research would help identify which elements of the model are universally applicable and which require contextual adaptation.

Second, longitudinal studies tracking the impact of the BEST model on graduate students' research productivity, quality, and completion rates would provide valuable insights into the model's long-term effects. Following students from research methodology courses through thesis or dissertation, completion would demonstrate whether enhanced self-efficacy and research skills translate into improved research outcomes and timely degree completion.

Third, comparative studies examining different variations of the BEST model could help optimize its components for specific disciplines and student populations. For example, investigating which technological tools are most effective for developing quantitative versus qualitative research skills would refine implementation recommendations for different methodological traditions (Sukma & Leelasantitham, 2022a, 2022b, 2022c, 2022d; Sukma et al., 2022).

Fourth, exploration of emerging educational technologies – particularly AI-enhanced research tools, adaptive learning systems, and immersive simulations – could identify opportunities to further enhance the BEST model's effectiveness. As next-generation educational technologies become available, their potential integration into the model merits systematic investigation.

Finally, mixed-methods studies incorporating both qualitative insights and quantitative performance metrics would strengthen the empirical foundation for the BEST model. Including standardized measures of research self-efficacy, methodological knowledge, and critical thinking abilities would complement narrative accounts and provide more robust evidence of effectiveness.

These research directions would collectively strengthen our understanding of how integrated instructional design models like BEST can transform graduate research education, ultimately improving both the experience and outcomes of research methodology instruction across diverse institutional contexts.

DATA AVAILABILITY

In this study, no underlying data was collected or produced.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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