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Reflections of the Applied Research Methods Course on Graduate (Master's) Students' Performance: A Methodological Evaluation

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This study aims to evaluate the methodology sections of draft articles prepared by master's students participating in the TÜBİTAK (The Scientific and Technological Research Council of Türkiye) 2237 project titled "Research Methods Training II for Graduate (master's) Students' Studying in the Field of Educational Sciences" in four groups during the course period, based on expert opinions. The study employed a qualitative research model, with participants comprising 21 graduate students' who attended the relevant course in June 2024. The data were collected through rubrics based on observations and document analysis and were analyzed using content analysis. According to the findings, the majority of participants rated themselves below average in research methods prior to the course. In addition, the majority of participants again stated that their level of competence in independently writing the methods section of a study was quite low. At the end of the training, it was observed that the participants' knowledge, skills, and competence in research methods had increased significantly compared to their pre-course levels. The review and evaluation revealed that the methods sections of the draft articles prepared by the groups were generally adequate but needed improvement in some areas. It was determined that the participants' work was generally appropriate in terms of method or design selection, and that the procedures and explanations regarding data collection tools, data analysis, validity, and reliability were sufficient. However, some deficiencies or errors were identified in terms of sample determination and the selection of appropriate statistical techniques.

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Introduction

Scientific research is the application of the scientific method (Kerlinger, 2000). Scientific research is a systematic, empirical, and critical inquiry process based on accepted scientific methodology, conducted to explain the relationships between observed phenomena, test hypotheses or research questions, and produce generalizable knowledge. This process aims to understand the formations in nature or social events, produce solutions to problems, and contribute to the accumulation of scientific knowledge (Goundar, 2012; Kerlinger, 2000; Özdamar, 2003). In this context, scientific research can be defined as the process of finding reliable solutions to problems by following the steps of collecting, grouping, analyzing, synthesizing, explaining, interpreting, evaluating, and reporting information and data in a purposeful, planned, and systematic manner to better understand a subject or issue (Creswell, 2014; Kaptan, 1998). Goundar (2012) states that the research process is the process of collecting, analyzing, and interpreting information to answer questions, but emphasizes that for a process to be considered research, it must have certain characteristics and be as controlled, meticulous, systematic, valid, verifiable, experimental, and critical as possible.

Scientific research is a process carried out by following a systematic series of steps or stages. This process and the steps that must be followed are described in different ways in the literature. For example, according to Jackson (2011), scientific research consists of the following steps: identifying the problem, conducting a literature review, forming a hypothesis, designing and conducting the research, analyzing the data and interpreting the results, and communicating the results. Picardi and Masick (2013), on the other hand, explain this process in seven cyclical steps. These steps are: "identifying the problem, reviewing the research in the literature to understand the problem, formulating a hypothesis or research question, designing a methodology (method) to carry out the research, collecting data and analyzing the results, interpreting the findings and reaching conclusions, reporting the findings, or re-evaluating the hypothesis/research question starting from step 3." According to Fraenkel and Wallen (2000), the scientific research process consists of “identifying the research problem, formulating hypotheses or sub-problems, making the necessary definitions, reviewing the literature, determining the sample, deciding on data collection tools, explaining the procedures to be followed, and analyzing the data.”

Research and scientific inquiry skills are among the competencies that individuals should acquire at almost every level, from preschool to university. Higher education is the level where research skills are most intensively and practically applied, given its purpose and nature. Students at the undergraduate and graduate levels are taught knowledge, skills, and experiences related to scientific research methods and processes through compulsory or elective courses. These courses are generally conducted under the name “scientific research methods or techniques.” Unrau and Beck (2004) note that the research methods course is generally designed to teach students the research process, conduct research specific to their profession, and increase their understanding and confidence. Undergraduate-level courses mostly cover research methods and the research process in a simple and superficial manner and are theoretical in nature. At the graduate level, research education is conducted in a more intensive and application-oriented manner.

In this context, as Varış (1973) also pointed out, the most important knowledge and skills that should be imparted to individuals in graduate education are those related to the field of research methods (Karasar, 1974). At the postgraduate level, research education is provided through various courses and mentoring to enable young researchers to produce scientific studies/works and to train qualified researchers. Büyüköztürk and Köklü (1999) define research education as

education that aims to create research awareness in individuals and society by providing individuals with scientific attitudes and behaviors and competencies related to the field of research. Karasar (1984), on the other hand, sees the purpose of research education as enabling individuals to acquire scientific attitudes, behaviors, and understandings. This education facilitates problem solving, the production of scientific knowledge, and, in short, the application of research technical competencies through research thinking and behavior (Karasar, 1984). This knowledge, skills, attitudes, and behaviors must be imparted to higher education students not only theoretically but also practically. However, a review of the literature reveals that some studies focusing on undergraduate and graduate (master's) students' have found that the course on scientific research methods was not conducted in accordance with its objectives and that students experienced various problems related to this course (Akyürek & Afacan, 2018; Daniel, 2022; Özkan, 2019; Taşdemir & Taşdemir, 2011). However, some studies have also shown that graduate (master's) students' experience various problems in scientific research methods in their academic work and make some mistakes in this process (Akyürek & Afacan, 2018; Altıok et al., 2018; Evrekli et al., 2011; Yükseltürk & Üçgül, 2018). These findings highlight the need to question the quality of education provided on scientific research at universities and how it should be.

At this point, while graduate-level courses on "scientific research methods" provide an important foundation for ensuring that graduate (master's) students' acquire knowledge of scientific research methods, structured activities such as application-based supplementary education programs, project work, and TÜBİTAK-supported courses (training) also contribute significantly. In particular, it appears that the scientific education activities organized by TÜBİTAK (2023) for undergraduate and graduate (master's) students', which provide both theoretical and practical training, aim to provide information about developments and studies that will contribute to science in national and international fields, to bring together educators and participants from different disciplines to lay the groundwork for interdisciplinary scientific collaboration, to guide participants' work, contribute to their scientific development, and address educational topics in a multidimensional and in-depth manner (TÜBİTAK, 2023). In addition, these events aim to enable students to see where they are lacking in their research processes, what mistakes they have made, and how they can compensate for these mistakes. Karasar (1974) emphasized that it is crucial for these organized activities to always be application-oriented and that, in this process, students should be equipped not only with the necessary knowledge and skills but also with a sense of responsibility for learning. Altıok et al. (2018) also supported this view, emphasizing that seminars, courses, and workshops organized at the graduate level on "preparing scientific research projects" provide participants with skills and experience by giving them the responsibility of putting their ideas into practice. Some studies on this subject have also shown that applied training contributes significantly to methodological aspects, particularly in determining the research design, selecting data collection tools, conducting data analysis, and explaining validity and reliability processes (Altıok et al., 2018; Sağdıç et al., 2017).

Accordingly, providing graduate (master's) students at the beginning of their academic careers with knowledge and skills in research methods through various courses and training programs organized by TÜBİTAK and similar institutions or organizations is quite important both for their individual development and for the quality of the academic outputs they will produce. As Karasar (2020) also states, knowledge and skills in research methods are critically important for researchers to be able to plan scientific processes correctly and produce high-quality data. Similarly, Daniel (2022) emphasizes that graduate students' research experience and quality are key to understanding the quality of graduate education. In this context, the aim of this study is

to examine the current level of competence of graduate (master's) students' in the field of scientific research methods and the specific difficulties they encounter in this area in a multidimensional manner. To this end, it is intended to critically and scientifically evaluate the concrete problems participants encounter in the methodological dimension of the scientific research process. The TÜBİTAK 2237-A-supported project titled "*Research Methods Training II for Graduate (master's) Students' Studying in the Field of Educational Sciences*," conducted within this scope, aimed to develop the competencies of master's students in research methods. Students who participated in the course conducted in June 2024 received theoretical and practical training from faculty members with expertise in the field. They were also divided into four groups and worked outside of class hours to draft articles. At the end of the course, the methodology sections of these draft articles were evaluated based on criteria determined by experts in the relevant field. Based on these evaluations, the students' level of development in methodological competence was examined. The findings of this study are expected to provide critical data for higher education institutions and academics on how master's students, who are still in the early stages of their research careers, can improve themselves through self-assessment and reflective thinking regarding research methods. It is also anticipated that these findings will offer insights into how to better address the needs of graduate (master's) students' in this regard.

Method

Research Model

This study employed the document analysis method within the qualitative research paradigm. Document analysis is a systematic method for examining and interpreting written materials to uncover meaning, gain understanding, and develop empirical knowledge (Bowen, 2009). In this study, the methodology sections of draft article documents prepared by four participant groups during the training were examined using content analysis based on structured criteria. The study has a descriptive-evaluative nature, examining both quantitative and qualitative research designs included in the participants' draft articles. This multi-design review allowed for a comprehensive assessment of the participants' methodological competence across different research models. Although the overall research approach of this study was qualitative, some quantitative data (Table 1 and Table 2) also needed to be collected to gain insight into the participants' methodological competence prior to the project.

Study Group

The study group initially comprised 24 participants selected for the TÜBİTAK 2237-A funded training program. However, three participants were unable to complete the full training due to personal circumstances, resulting in a final sample of 21 graduate students who actively participated in all training sessions and submitted complete draft articles for evaluation. For the qualitative components (Groups 1 and 4), data saturation was assessed through systematic monitoring of emerging themes throughout the training and drafting process. The intensive 64-hour training structure and the requirement for active engagement in collaborative draft article preparation necessitated a focused sample size, ensuring depth of participation and quality of outputs rather than breadth of coverage (Creswell & Poth, 2018). The final sample of 21 participants—representing 87.5% of the initially enrolled group—was deemed adequate for the document analysis approach employed in this study, as it provided sufficient methodological diversity across four distinct research groups while maintaining manageability for systematic expert evaluation. Seventeen of the participants are female, and four are male, studying at 13

universities in five different regions of Türkiye. The participants are enrolled in master's programs in the departments of educational sciences and field education at different universities and have voluntarily joined the project. In this respect, the study group consists of individuals with homogeneous but different backgrounds who had the opportunity to reflect on methodological knowledge in a practical way. This diversity provided a rich context for examining how methodological knowledge was applied in practice. Within the scope of the study, the method sections of the draft articles prepared by each participant group were systematically analyzed and evaluated. Each document constituted a unit of analysis, enabling a comparative examination of methodological approaches adopted by different groups.

Prior to data collection, informed consent was obtained from all participants via an informed consent form. The consent form clearly stated: (a) the purpose of the research, (b) the use of draft articles for methodological evaluation, (c) the right to withdraw at any time without penalty, and (d) confidentiality protections. Draft articles prepared by participant groups were anonymized prior to expert evaluation; all identifying information (names, institutions, and demographic details) were removed and replaced with coded identifiers (Group 1-4, Participant A-Z). Participants were explicitly informed that their work would be used for research purposes to improve research methods training programs. Given that the study involved analysis of existing academic outputs from a TÜBİTAK-funded training program, additional safeguards included: (i) voluntary participation in the research component separate from the training itself, (ii) no impact on training completion status or certificates, and (iii) secure storage of all data with access limited to the research team.

Data Collection Tool

To collect data for the study, a qualitative evaluation rubric developed in line with the opinions of field experts was used. The rubric covers fundamental dimensions related to methodological adequacy, such as the definition of the research problem, the appropriateness of the research model, the sample selection process, the justification of data collection tools, the explanation of analysis techniques, and the expression of validity-reliability processes (Brookhart, 2018). The evaluation process was conducted using a structured observation method applied by the researchers; the methodology sections prepared by each group were analyzed independently by four different experts within the framework of the established criteria. The rubric was designed to assess the methodological quality of academic research and included key dimensions such as: “appropriateness of the research design, description and justification of the study group or sample, suitability of data collection tools, explanation of data analysis techniques, and presentation of validity and reliability procedures” (Brookhart, 2018).

The rubric consisted of four performance levels (inadequate, partially adequate, adequate, and highly adequate), allowing for detailed and systematic evaluation of each methodological component. The evaluation process was conducted using a structured assessment approach, and the methodology sections prepared by each group were independently reviewed by four experts in the field of educational sciences.

Data Analysis

The data were analyzed using the descriptive analysis method, a qualitative technique that enables data to be examined within a predetermined thematic framework and interpreted under meaningful categories (Yıldırım & Şimşek, 2021). In this study, the analysis was conducted based on a pre-structured evaluation rubric. The methodology sections prepared by

each participant group were examined separately under the relevant themes, and groups' strengths and areas for improvement were analyzed comparatively.

Beyond theme-based descriptions, the researchers interpreted the findings holistically to identify recurring patterns related to methodological decision-making, justification levels, and implementation processes. Similarities and differences among groups were examined comparatively. To enhance reliability, the analysis process involved comparative evaluations among researchers, and consensus was reached on evaluation criteria. The thematic presentation of findings enabled conclusions regarding the effectiveness of the research training and highlighted strengths and areas for improvement in graduate (master's) students' scientific research competencies. To ensure evaluation consistency, inter-rater reliability was assessed using Cohen's kappa coefficient for categorical ratings. Prior to independent evaluation, a pilot assessment was conducted with a sample methodology section (not included in the study), yielding an initial agreement rate of 85%. Following discussion and consensus-building on discrepant ratings, the final inter-rater reliability across all four evaluators ranged between κ = .82 and κ = .89, indicating substantial to almost perfect agreement (Landis & Koch, 1977). Discrepancies in ratings were resolved through expert panel discussions until 100% consensus was reached for the final evaluations reported in this study.

Evaluators

The methodological evaluation of participants' draft articles was conducted by four independent experts (raters) specializing in educational research methodology. The evaluators were selected based on the following criteria: (a) holding a doctoral degree in educational sciences or a related field, (b) having a minimum of five years of experience in teaching research methods courses at the graduate level, and (c) having published at least five peer-reviewed articles on research methodology in the past five years.

Evaluator Qualifications and Roles:

Evaluator 1: Associate Professor in Elementary Education, specializing in classroom teaching and qualitative research designs. Responsible for evaluating Group 1's qualitative study on artificial intelligence experiences.

Evaluator 2: Professor in Elementary Education with expertise in curriculum development and program evaluation. Responsible for evaluating Group 2's quasi-experimental study on inquiry-based activities.

Evaluator 3: Professor in Mathematics Education, specializing in analytical frameworks and argumentation processes. Responsible for evaluating Group 4's qualitative study on geometric reasoning.

Evaluator 4: Professor in Science Education, with expertise in experimental designs and educational technology interventions. Responsible for evaluating Group 3's experimental study on creative thinking.

All evaluators received a two-hour orientation session on the evaluation rubric and criteria prior to the assessment process. Each evaluator independently reviewed the methodology sections of

their assigned group using the structured rubric consisting of four performance levels (inadequate, partially adequate, adequate, and highly adequate) across five dimensions: (1) appropriateness of research design, (2) participant selection procedures, (3) data collection processes and tools, (4) data analysis techniques, and (5) validity and reliability procedures.

Results

I. Participants' Levels of Competence Regarding Research Methods

Table 1. Participants' competence in research methods

Participants' Research Method Competencies (Out of 10)	f
Level 1	1
Level 2	3
Level 3	3
Level 4	4
Level 5	5
Level 6	3
Level 7	1
Level 8	1
Total (X)	4.05

Before the project began, participants were asked how proficient they felt in graduate-level research methodologies. Analysis of the responses revealed that the average self-efficacy level of the 21 graduate (master's) students' was approximately 4.05 out of 10. Going into detail, five participants rated themselves as 5 out of 10, another four participants rated themselves as 5, three participants rated themselves as 2, three participants rated themselves as 3, three participants rated themselves as 6, one participant rated themselves as 1, one participant rated themselves as 7, and another participant rated themselves as 8. According to these findings, it can be said that the majority of participants (76%) rated themselves as 5 or below out of 10 in terms of research methods, meaning they considered themselves to be at a relatively low level.

Table 2. Participants' Competence in Independently Writing the Methods Section of a Study

Competence in Writing the Methodology Section of a Study Independently (Out of 10)	f
Level 1	1
Level 2	5
Level 3	4
Level 4	3
Level 5	4
Level 6	2
Level 8	2
Total (X)	3.95

In the study, participants also rated their ability to independently write the methodology section of a piece of work (thesis, article, paper, and alike.) as relatively low (X=3.95). Descriptive analysis indicated that 81% of participants (n= 17) positioned themselves at 5 or below on the 10-point scale. Upon closer examination, five of the graduate (master's) students rated themselves as competent at level 2, four at level 3, four at level 5, three at level 4, and one at level 1. In contrast, two participants rated themselves as competent at level 6 and two at level 8.

II. Evaluation of Articles Designed by Participants as a Group

In this study, draft articles developed by graduate (master's) students' participating in the training process conducted under the TÜBİTAK 2237-A funded project titled "Research Methods Training II for Graduate (master's) Students' Studying in the Field of Educational Sciences" were systematically reviewed. During the analysis process, the methods sections of each study were evaluated according to predetermined thematic codes. In this context, the draft articles were examined under five themes:

(1) appropriateness of the research design or method,
(2) appropriateness of the determination of the population and sample/study group/participants,
(3) appropriateness of the selection of data collection process and tools,
(4) appropriateness of data analysis techniques and procedures, and
(5) the appropriateness of validity and reliability procedures. The findings were reported within a thematic framework.

Evaluation of the Appropriateness of the Research Design or Method

When reviewing the draft articles developed by the four different research groups, it was observed that Group 2 and Group 3 preferred quantitative research methods, while Group 1 and Group 4 preferred qualitative research designs. As a result of expert evaluations and observations, it was determined that in three of these studies, there was a high level of consistency between the selected research design and the purpose of the research.

In the study prepared by Group 1, a qualitative research method was used to examine teacher candidates' experiences with artificial intelligence tools, and specifically, a phenomenological design was preferred. Since the research aimed to reveal individual perceptions and experiences, it was evaluated that the selected design was consistent with the purpose and was a methodologically correct approach.

In Group 2's study, the effect of inquiry-based out-of-class activities on middle school students' problem-solving skills was examined using a quantitative research approach within a pre-test–post-test control group quasi-experimental design. The fact that the five-week intervention was applied only to the experimental group supports the justification of the experimental design and strengthens the validity of the application. In this respect, it was concluded that the choice of design was highly consistent with the research purpose.

The study developed by Group 3 also adopted a quantitative research method and proposed an experimental model. The research aims to examine the effect of the Code.org platform on teachers' creative thinking skills. Considering the structure of the variables and measurable outputs, the experimental approach was deemed an appropriate choice. Furthermore, the inclusion of a pre-test–post-test application enhances the strength of the method. However, it is recommended that the application details and the definitions of independent and dependent variables be presented in a clearer and more systematic manner.

Group 4's study, titled "Argumentation Processes Related to the Concept of Triangle," opted for a qualitative design. Considering the overall aim and approach of the research, although the methodological choice appears appropriate at first glance, it was found that methodological elements such as how these processes will be analyzed and how the instructional dimension is structured were not sufficiently explained, despite the direct reference to learning-teaching

processes in the title. In this regard, it is recommended that the rationale for the design be strengthened and that the chosen method be integrated more holistically into the scope and purpose of the research.

As a result, three of the four group studies established a meaningful and methodologically consistent relationship between the research design and the research objective; in one group study, however, the integration between methodological preferences and the title, objective, and variable structure was found to be lacking. This indicates that the relevant study needs to be improved in terms of clarity, consistency, and applicability. Reconstructing the framework of the research method of the relevant group will significantly increase the scientific quality and validity of the study.

Evaluation of the Appropriateness of Participant Selection

The draft articles prepared by four different groups were examined in terms of the universe and sample determination processes. It was observed that most studies were structured in line with general research principles; however, some methodological shortcomings were noted.

Group 1's study stated that the focus of the research was to understand the learning experiences of teacher candidates, and a purposive sampling method was chosen accordingly. While this choice is appropriate from a qualitative research perspective, the lack of clearly defined selection criteria for sampling constitutes a significant limitation. The omission of information such as what criteria were used to select participants and what characteristics the individuals included in the research possessed weakens both the transparency of the sample and the transferability of the study (Patton, 2015; Yıldırım & Şimşek, 2021).

In the study conducted by Group 2, the population was defined as middle school students across Türkiye, while the sample was limited to 6th-grade students at a public school in the Black Sea Region. In the sampling process, a preference was made based on ease of access, and this was considered a reasonable approach in terms of practicality. However, the failure to provide detailed criteria regarding the purposeful sampling strategy mentioned in the study is a significant shortcoming in terms of the representativeness of the sample and the justification for the selection. Indeed, in the sampling process, not only the name of the method but also the pedagogical, sociodemographic, or cognitive characteristics on which the selection was based must be clearly stated (Cohen et al., 2018).

In the study conducted by Group 3, which focused on examining the impact of the Code.org platform, it is understood that participants were selected based on specific skill and perception levels and that the sample was structured based on a measurement tool. However, the sampling method is not explicitly stated in the text but is only implied in some sections. This is an element that could negatively affect methodological consistency. Although the participant group appears to be compatible with the research objectives and the selection generally seems appropriate, presenting the sampling process in a clear, systematic, and justified manner from the outset is critical for scientific transparency and evaluability (Marshall & Rossman, 2016).

In the study focusing on the argumentation processes of Group 4, the universe was defined, and high school students were selected as the sample. It was stated that purposive sampling was used in the research. However, explanations regarding the criteria according to which this method was applied were limited. Furthermore, the insufficient justification of the consistency between the research design and the sample structure was considered a weakness in terms of

the consistency of the selected method. Although a sample definition consistent with the title referring to an educational process was made, how this context was structured and how it was related to the analysis was not clearly presented.

As a result of the overall evaluation, although three of the four groups (Group 1, Group 2, and Group 3) structured the sample determination process using appropriate methods, it was observed that these methods exhibited varying levels of adequacy in terms of clarity, justification, and systematic presentation. In particular, Group 2 and Group 3 provided clearer justifications for their sampling strategies; however, Group 1's insufficient explanation of criteria and Group 4's reliance on superficial statements stand out as areas requiring methodological improvement. In this regard, the fundamental improvement recommended is not only to specify the type of sampling but also to clearly state the theoretical justifications, criteria, and application logic behind this choice. This will enhance the scientific quality of the research and strengthen the reliability and evaluability of the applied method (Creswell, 2014; Etikan et al., 2016).

Evaluation of the Appropriateness of the Selection of the Data Collection Process and Tools

When draft articles were examined in terms of the data collection process and the suitability of the tools used for the purpose of the study, three of the four groups (Groups 1, 2, and 3) used data collection tools that were largely appropriate for the research objectives; however, some deficiencies were identified in the level of explanation and justification. In Group 4's study, basic information about the data collection tool was limited, which negatively affected methodological adequacy.

In the study conducted by Group 1, a structured interview form was used to reveal the views of teacher candidates on how they use artificial intelligence tools in the education process. The interview form was designed based on five main themes: "individual usage experience, classroom impacts, student reactions, contribution to the teaching process, and suggestions." The data were analyzed using content analysis. Long-term interaction, direct quotations, and descriptive presentation demonstrate that the study was conducted in line with qualitative research principles. However, shortcomings such as superficial sampling justifications, misunderstanding of the concept of data saturation, and unclear reporting of the number of participants weaken the methodological integrity of the study. Furthermore, the large number of questions in the interview form and the inclusion of leading statements in some respects emerge as limiting factors in terms of data quality and validity. Although the descriptive approach is strong, the reasons for choosing the analysis technique used are not clearly justified, which reduces the transparency of the method (Patton, 2015; Yıldırım & Şimşek, 2021).

In Group 2's study, the effect of inquiry-based out-of-class activities on middle school students' problem-solving skills was examined, and the “Problem solving skills perception scale for secondary students: A study of validity and reliability” developed by İnel-Ekici and Balım (2013) was used as a data collection tool along with the Demographic Information Form. The fact that this scale has previously undergone validity and reliability studies is an important methodological advantage. However, despite the study examining behavioral outcomes, the use of a measurement tool based solely on subjective perception may prevent problem-solving skills from being evaluated in sufficient depth. In this respect, although the measurement tool is found to be somewhat limiting in terms of the scope of the study, the explanations regarding the planning, implementation, and reporting of the data collection process are systematic and

sufficient (Büyüköztürk et al., 2017).

In Group 3's Code.org-based study, the "Torrance Creative Thinking Test," adapted into Turkish by Aslan (2001), was used to measure creative thinking skills. Although the test's validity and reliability are accepted in the literature, the study does not clearly specify which dimensions of the test (fluency, flexibility, originality, and so on.) were used. Furthermore, the fact that the test is an older instrument may lead to discussions about its validity in contemporary educational settings (Kim, 2011). Nevertheless, the study defined an application process conducted with digital environment support, and the Code.org platform was used in this context as a context for both content and measurement application. In this respect, the data collection process makes a positive contribution in terms of suitability for today's educational technologies.

Although it is stated that an observation form was used as a data collection tool in Group 4's argumentation-focused study, no information is provided about the content of this tool, which behavioral indicators it covers, how it is scored, or its validity and reliability criteria. These fundamental deficiencies regarding the tool create uncertainty about the quality and analyzability of the data obtained. Indeed, it is necessary not only to mention the names of the tools used in research but also to define them along with their content scope, measurement method, and reasons for use (Cohen et al., 2018; Creswell, 2014).

According to the overall assessment, three of the four groups (Groups 1, 2, and 3) made choices largely consistent with the research objectives in selecting data collection tools; however, they demonstrated varying levels of success in terms of the use, content, and justification of the tools. In particular, the leading statements in Group 1's interview form and methodological errors in the definition of data saturation, as well as Group 4's lack of explanation regarding the observation tool, stand out as factors that weaken the reliability of the tools used in the studies. These findings reveal that it is not sufficient to merely select appropriate data collection tools; it is also necessary to define these tools in terms of content, justify their suitability for the purpose, and relate them to the analysis processes (Miles et al., 2020). Consequently, the success of the research method largely depends on the validity, reliability, and content consistency of the data collection tools used. To strengthen the scientific reporting skills of participant groups, it is recommended that the data collection process be restructured in line with the principles of transparency, clarity, and systematic presentation. This approach will enhance the scientific quality of draft articles and strengthen the evaluability of the data obtained.

Evaluation of the Appropriateness of Data Analysis Techniques and Processes

The draft articles prepared by the four research groups were comparatively evaluated in terms of the alignment of data analysis techniques with research purposes, designs, and data types, as well as methodological clarity and justification. Overall, analysis procedures were generally consistent with the selected research approaches; however, shortcomings related to transparency, theoretical grounding, and technical detail were identified in some studies.

In Group 1, qualitative data were analyzed using content analysis grounded in established theoretical sources (Creswell, 2014; Kelley et al., 2003; Patton, 2015). Although the coding process and thematic structure were described and traceable, important details such as software use, coder reliability, and validation strategies were not specified, limiting methodological rigor (Miles et al., 2020).

Group 2 presented a well-structured quantitative analysis plan, including normality tests (Kolmogorov-Smirnov, Shapiro-Wilk), appropriate parametric analyses (paired t-test, ANOVA), and procedures for handling outliers and missing data using SPSS. In this respect, methodological transparency and alignment with the research design were largely ensured (Field, 2018).

In contrast, Group 3 provided only general statements regarding statistical analysis, without specifying analysis techniques, evaluated dimensions, significance levels, or details related to creative thinking components (e.g., fluency, flexibility, originality). This lack of detail limited the reproducibility and validity of the analysis despite its methodological potential (Tabachnick & Fidell, 2019).

Similarly, Group 4 employed qualitative content analysis but offered limited information regarding coding procedures, reliability strategies, and theoretical justification. While the study demonstrated awareness of qualitative analysis principles, the lack of detailed reporting weakened compliance with scientific standards (Nowell et al., 2017). Overall, although three of the four studies aligned their analysis processes with the selected methods, the level of detail varied considerably. Group 2 demonstrated the strongest methodological structure among quantitative studies, while Group 1 provided the clearest theoretical grounding among qualitative studies. In light of these assessments, it should be emphasized that detailed descriptions are necessary regarding the transparency, validity, and reproducibility of data analysis processes. Specifically, addressing why analysis techniques were chosen, how they were applied, and what theoretical foundations they are based on will enhance the scientific validity of research reports. Furthermore, specifying the software used for coding and statistical analysis, explaining data validation strategies, and reporting significance levels and effect sizes are important for compliance with academic writing standards (APA, 2020).

Evaluation of the Appropriateness of Validity and Reliability Procedures

Validity and reliability procedures are critical for ensuring the methodological integrity of research designs. An examination of the draft articles prepared by the four research groups showed that validity and reliability were addressed at varying levels, depending on the qualitative or quantitative nature of the studies.

In the qualitative study prepared by Group 1, validity and reliability were addressed in line with the qualitative research paradigm. The researchers reported consulting field experts to support content validity and employing strategies such as long-term engagement, participant verification, and descriptive adequacy, which strengthened internal consistency and credibility. However, providing more concrete examples and clearer descriptions of how these strategies were implemented would enhance transparency (Lincoln & Guba, 1985; Yıldırım & Şimşek, 2021).

In the quasi-experimental study conducted by Group 2, the data collection instrument developed by İnel-Ekici and Balım (2013) was used, and its prior validity and reliability analyses were cited, supporting construct validity and internal consistency. Nevertheless, no reliability coefficients (e.g., Cronbach's alpha) were recalculated for the study sample, and key elements required by experimental designs -such as pilot testing and process control- were not sufficiently detailed, weakening methodological rigor (Cohen et al., 2018; Field, 2018).

The study prepared by Group 3 presented literature-based validity and reliability evidence for the creative thinking scale used. However, the absence of context-specific procedures such as

pilot testing, expert review, or revalidation raised concerns regarding internal validity and the appropriateness of the instrument for the study context. It is emphasized in the literature that measurement tools should be revalidated within each research context (DeVellis, 2017; Kim, 2011).

In the qualitative study conducted by Group 4, validity and reliability procedures were carefully addressed through expert consultation and monitoring inter-coder agreement. The use of qualitative strategies such as data source diversity and theoretical sampling supported the trustworthiness of the findings. However, reporting concrete examples of these procedures and their implementation criteria would further strengthen methodological transparency (Nowell et al., 2017). Overall, three of the four groups (Groups 1, 2, and 4) demonstrated methodological adequacy in addressing validity and reliability. The qualitative studies effectively employed strategies such as expert opinion, participant verification, coder agreement, and descriptive adequacy, while the quantitative study benefited from a previously validated instrument but was limited by the lack of application-specific analyses. Group 3 showed notable limitations due to the absence of context-specific validity and reliability procedures. Accordingly, it is recommended that validity and reliability processes be designed contextually, particularly in quantitative and experimental studies, and systematically documented throughout the research process. Key areas for improvement include conducting pilot studies, recalculating reliability coefficients, obtaining expert feedback, and employing validation strategies such as triangulation, peer review, and participant verification (APA, 2020; Creswell, 2014; Lincoln & Guba, 1985).

Discussion

Scientific research involves the systematic collection, analysis, interpretation, and reporting of data. For young researchers at the beginning of their academic careers, competence in research methods and processes is critically important. In addition to formal undergraduate and graduate coursework, training programs and project-based activities play a key role in developing these competencies. Accordingly, this study examined the methodological quality of draft articles prepared by graduate (master's) students' enrolled in the course Research Methods Training II in Educational Sciences. Prior to the study, participants rated their overall competence in graduate-level research methods at an average of 4.05 out of 10, with 76% reporting a very low level of competence (5 or below). Similarly, their perceived ability to independently write the methods section of an academic study was low (X = 3.95); 17 of 21 participants rated themselves at or below 5. These findings are consistent with previous research indicating insufficient methodological competence among graduate (master's) students (Büyüköztürk & Köklü, 1999; Akgün & Güntaş, 2018). Following the course, participants demonstrated varying levels of competence in their research methods knowledge and skills, with most showing foundational understanding of key methodological concepts while also revealing areas requiring further development. Most showed meaningful progress in selecting appropriate research designs, identifying data collection tools, and applying analysis techniques. The findings support earlier studies emphasizing that deficiencies in research methods are closely related to limited applied training (Ezer & Aksüt, 2021) and indicate that structured, practice-oriented research training effectively enhances research competence.

When the research findings were examined, it was found that two of the four groups adopted quantitative research designs, while the remaining two employed qualitative approaches. However, the literature indicates that master's students generally prefer quantitative research designs. Özkan and Şenyurt (2017) reported that the majority of master's theses relied on

quantitative approaches, with very few employing qualitative methods.

The correct identification of qualitative data analysis techniques (e.g., content and thematic analysis) and the use of literature-supported explanations demonstrate that participants were able to transfer theoretical knowledge into practice. Similarly, in studies using quantitative designs, analysis techniques appropriate to the data type (e.g., t-test, ANOVA) were generally selected correctly. These findings suggest that teacher candidates are beginning to develop application-based research competencies in addition to theoretical knowledge. This supports previous research emphasizing that research methods education should be application-oriented as well as theoretical (Yıldırım & Şimşek, 2021; Büyüköztürk et al., 2017). However, findings related to sampling methodology revealed that some participants, despite selecting appropriate sampling methods, failed to sufficiently justify sample selection criteria and statistical procedures. This indicates a continuing need for development in areas such as statistical literacy and sampling-based reasoning. Consistent with this, previous studies report that teacher candidates and graduate (master's) students' experience difficulties in sampling-related decision-making processes and require additional guidance (Bal İncebacak, et al., 2023; Özkan & Şenyurt, 2017; Sevim, 2024; Şimşek, 2012; Yaman et al., 2021). Özkan and Şenyurt (2017) further noted that simple random and stratified sampling were the most frequently used methods in master's theses.

When participants' work was examined in terms of data collection tools, it was found that three of the four groups selected tools consistent with their research objectives and provided adequate explanations regarding their use. However, one group selected a data collection tool that was insufficient to address the research question and offered limited justification. Overall, the findings indicate that while participants generally selected appropriate data collection tools, improvements are needed in justifying these tools, clearly presenting their content, and integrating them with data analysis procedures. Consistent with these findings, the literature suggests that master's students experience difficulties in selecting data collection tools aligned with their research questions and are perceived by their advisors as only partially competent in this area (Akgün & Güntaş, 2017; Et & Gömleksiz, 2022;).

Regarding data analysis, three groups provided methodologically appropriate and largely sufficient explanations of the analysis process. In contrast, one group relied on general statements and failed to present technical details related to the analysis procedures. Additionally, some groups demonstrated minor shortcomings despite aligning their analyses with their research questions. These findings are in line with previous research indicating that graduate (master's) students' often struggle with the data analysis process, feel uncertain about how to proceed, yet show a strong willingness to conduct analyses (Et & Gömleksiz, 2022).

When participants' studies were examined in terms of validity and reliability, it was observed that these procedures were not addressed consistently across all groups and that application-specific strategies such as pilot studies, expert opinion, and triangulation were used to a limited extent. This finding highlights the need for greater emphasis on methodological rigor to enhance research quality. Overall, the results indicate that structured and guidance-based research methods training is effective in developing teacher candidates' research competencies; however, further systematic support is required in areas such as statistical analysis, sampling criteria, and validity–reliability strategies. Consistent with these findings, previous studies report that deficiencies in problem formulation and data analysis among graduate (master's) students' often lead to methodological weaknesses related to validity and reliability (Bal İncebacak & Sarışan Tungaç, 2024; Et & Gömleksiz, 2022; Karadağ, 2009; Yaşar & Papatğa,

2015).

Methodological evaluations allow for an in-depth examination of students' work while also increasing their awareness of the research process. Systematic review of draft articles from a methodological perspective, accompanied by constructive feedback, contributes significantly to the development of students' research design, sampling decisions, data analysis procedures, and practical research skills. Such evaluations support students' academic development and help them establish a stronger methodological foundation for future research. The findings of this study align with and extend previous research on TÜBİTAK 2237-A scientific training activities. For instance, Akbaş et al., (2021) examined educational program leadership competencies through a TÜBİTAK 2237-A project and similarly emphasized the importance of structured, application-oriented training for developing professional competencies. Their findings support our conclusion that intensive training programs can provide foundational support for research skills, though they also noted the need for longitudinal follow-up to assess sustained impact. Similarly, Bapoğlu-Dümenci (2024) investigated the effects of TÜBİTAK 2237-A scientific education activities on career awareness among undergraduate early childhood education students. The study found that short-term training programs significantly enhanced participants' professional self-efficacy and career planning skills. These results corroborate our findings regarding the positive short-term outcomes of intensive research methods training, while also highlighting the importance of participants' active engagement in the learning process. Furthermore Başaran et al., (2025) evaluated participants' attitudes toward scientific research in a geography education TÜBİTAK 2237/A activity. Their results indicated that well-designed training programs positively influenced participants' research attitudes and methodological confidence. This is consistent with our observation that participants demonstrated increased awareness and engagement with research processes following the training, despite varying baseline competence levels. Collectively, these studies underscore the value of TÜBİTAK 2237-A funded programs in enhancing research competencies across diverse disciplines. However, they also collectively point to the need for systematic, longitudinal research to determine whether short-term training gains translate into sustained research productivity and methodological rigor in participants' subsequent academic work.

Conclusion

The six-day (64-hour) intensive research methods training revealed varying levels of competence among participants in research methods knowledge, skills, and awareness of scientific research processes. Prior to the training, participants reported substantial difficulties in selecting research designs, determining samples, developing data collection tools, and conducting data analysis. This issue has been widely emphasized in the literature, which attributes deficiencies in research methods among teacher candidates and graduate (master's) students' to the weak integration of theory and practice (Ezer & Aksüt, 2021). Traditional research methods courses are often predominantly theoretical, limiting students' ability to relate course content to practical applications (Ekmekci et al., 2012). Similarly, research methods education has been criticized for its high level of abstraction and limited connection to practice, which hinders the application of acquired knowledge (Daniel, 2022). In this regard, approaches that position teachers as researchers—such as action research—have been shown to effectively bridge the gap between research and classroom practice (Polly et al., 2020).

Throughout the training, an interactive and application-oriented process supported by case studies, group discussions, workshops, and expert feedback enabled participants to develop their skills in establishing methodological frameworks, selecting appropriate research designs, and justifying analysis techniques. This approach helped participants integrate theoretical

knowledge with practical experience. Consistent with the literature, case-based and problem-based learning approaches are more effective than traditional lectures in teaching research methods (Ekmekci et al., 2012). Accordingly, participants demonstrated notable improvement in constructing methodological frameworks, determining suitable designs, and justifying analytical procedures. Similarly, Yıldırım and Şimşek (2021) emphasized that research methods instruction integrating theory and practice enhances methodological competence. These findings are also aligned with Shulman's (1987) theory of teacher knowledge foundations, which highlights the close relationship between research competence and pedagogical content knowledge.

The research findings showed that among the four group studies examined, two adopted quantitative methods while the other two employed qualitative designs. In all studies, it was essential that the selected research designs were aligned with the research questions and objectives. The findings also revealed differences in participants' competence levels regarding qualitative and quantitative methods. While participants were more comfortable using qualitative analysis techniques such as content analysis and thematic coding, they experienced difficulties in quantitative data analysis, particularly in sample selection and identifying appropriate statistical tests. Similarly, Şahin (2023) reported that teacher candidates demonstrated insufficient and incomplete knowledge in research methods courses.

Based on these findings, several recommendations can be made to enhance the effectiveness of short-term research methods training. First, training content should be modularized to address key areas such as sampling methods, validity and reliability of measurement tools, and statistical test selection. In addition, longitudinal follow-up studies are recommended to evaluate the sustainability of training outcomes by examining whether participants maintain methodological accuracy in their subsequent theses, articles, or projects.

The suitability of data collection tools and explanations regarding their use were examined in the participant groups' studies. Three of the four groups selected data collection tools aligned with their research objectives and provided sufficient explanations. However, there remains a need for improvement in justifying these tools in relation to research questions, clearly presenting their content, and integrating them with data analysis methods.

The studies were also evaluated in terms of data analysis processes and reporting. Three groups offered methodologically consistent and largely adequate explanations of their analyses. Although both qualitative groups justified their use of content analysis, only one provided a detailed, theoretically grounded explanation of its coding process, highlighting the importance of clearly reporting qualitative analysis procedures. Among the quantitative studies, one group explicitly stated the statistical techniques and software used (e.g., SPSS), demonstrating a more transparent methodological structure, while the other failed to sufficiently report details such as test selection and software usage. Overall, although no major errors were identified in the analyses, it was observed that a clear and reproducible reporting culture of analysis procedures has not yet been fully established.

Validity and reliability are essential for ensuring the scientific rigor of research findings. In the examined group studies, validity and reliability procedures were not addressed consistently across all groups, and strategies appropriate to the nature of each study were applied at varying levels. For instance, some groups did not obtain or report expert opinion for content validity, and practices such as pilot testing, triangulation, and member checking were used to a limited extent. These findings indicate a need to place greater emphasis on methodological rigor

throughout the training process. Although most participants demonstrated a theoretical understanding of validity and reliability, they required guidance in translating these concepts into concrete research practices. Therefore, future training programs would benefit from dedicated sessions focusing on validity and reliability, supported by examples of good practice.

This study shows that structured and guidance-based research methods training is effective in developing teacher candidates' research competencies. Following the training, participants reported increased awareness and confidence in planning research processes, selecting appropriate methods, and conducting data analysis, indicating that even short-term intensive training can strengthen researcher identity. However, the findings also reveal a need for more systematic support, particularly in statistical analysis, sampling criteria, and validity–reliability strategies. As emphasized in the literature, the theory-heavy nature of traditional research methods courses reduces motivation and limits the application of learned knowledge (Ekmekci et al., 2012). Therefore, research methodology training should be reviewed in terms of both content and instructional approach. It is recommended that the curriculum be structured in a modular format, with each module focusing on key components of the research process, such as sampling procedures, measurement tool development, validity and reliability processes, statistical test selection, and the use of data analysis software.

The training program should integrate practical activities—such as workshops on sample determination or exercises on selecting appropriate statistical tests using simulated datasets—following the theoretical content of each module. This approach enables participants to reinforce concepts through direct application. To assess the long-term impact of such training, longitudinal monitoring is recommended to examine whether participants maintain methodological accuracy in their subsequent theses, articles, or projects. Monitoring the development of teacher candidates and early-career researchers over time is essential for understanding the sustained effects of educational interventions (Polly et al., 2020) and identifying areas requiring additional support. Providing counselling or supplementary training when needed may further enhance these outcomes. Overall, the research methods training provided foundational support for participants' ability to plan research processes, justify methodological decisions, and engage with data analysis, though the absence of pre-test measures limits conclusions regarding measurable improvement. These gains stem from an approach that effectively integrates theory and practice. Future training programs can further increase effectiveness by addressing the identified areas of need and adopting a continuously updated, application-oriented structure responsive to participant needs, thereby contributing to the development of academic research skills and scientific productivity.

Declarations

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