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Effectiveness of Competency-based Training in Improving the Scientific Writing Skills of Students in Higher Education

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Abstract

Scientific writing skill is one of many competencies that must be possessed by postgraduate students to complete their studies. In fact, many students faced difficulties in expressing their thoughts in academic writing to meet the standards of scientific papers. This study aims to examine the effectiveness of competency-based training in improving the scientific writing skills of students in higher education. The study used a mixed methods approach involving 43 Master's students as research subjects. Data were collected through qualitative techniques (observation, interviews, and document analysis) and quantitative techniques (pretest, posttest, and questionnaire). Data analysis was conducted descriptively in quantitative and qualitative approaches by comparing the results of writing skills before and after the training. The results showed that the Competency-Based Training model successfully improved the ability of students in the Master of Educational Administration Study Program in writing academic papers, especially scientific journal articles, either in terms of writing systematics, use of methods, or academic style. These findings indicate that competency-based training can be an effective strategy in equipping master's Program students to improve academic writing skills. Therefore, it is recommended that such training be implemented continuously and integrated into higher education programs.

Keywords: Competency-based Training, Graduate Students, Scientific Papers, Writing Skills.

Introduction

The ability to write scientific papers is one of the academic skills that students must possess (1, 2). This study specifically focuses on master's students, who are required to produce scientific theses and journal articles as a condition for completing their graduate programs. Students need to possess comprehensive scientific writing skill because they are required to write scientific papers in order to pass the courses. In the process of completing their studies, students must also publish the results of their research in the form of scientific papers (3–5). Writing scientific papers such as scientific journals and theses is a mandatory curriculum in Master's programs at universities. Therefore, master's students need to comprehend this skill so that they will be able to create innovation within their original creativity and to ease them in achieving the learning outcome of any courses they take (6, 7). Scientific writing skills of Students offer various benefits for themselves, both in academic development and in terms of personal development (8, 9). In the process of writing scientific papers, students are trained to think critically, logically, and systematically in solving problems (10, 11). Furthermore, students are trained to hone their analytical thinking skills and synthesize relevant information sources relevant with any problems they experienced (12, 13). This is particularly relevant for master's students, many of whom work as educational leaders such as school principals, supervisors, or education policy-makers. For these master's students, scientific writing skills are not merely an academic requirement but a strategic tool to analyze complex educational problems ranging from teacher professionalism and curriculum implementation to student achievement and learning evaluation and to formulate evidence based solutions. Thus, within the context of master's

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education, scientific writing skill not only contributes to academic achievement but also strives to shape scientific attitudes, academic honesty, and professional readiness to face real world challenges in the field of education and at higher levels of study (14, 15). This study is grounded in two interrelated theoretical frameworks,

(a) social cognitive theory posits that learning occurs through the interaction of personal factors, behavior, and environmental influences (16). In the context of scientific writing, students' self-efficacy beliefs their confidence in their ability to produce academic texts play a crucial role in determining their writing performance and persistence,

(b) experiential learning theory emphasizes that knowledge is created through the transformation of experience, where learners progress through concrete experience, reflective observation, abstract conceptualization, and active experimentation (17).

Competency Based Training (CBT) aligns with this theory by providing structured, hands on writing practice, immediate feedback, and iterative learning cycles. Together, these theories explain why CBT can enhance students' scientific writing skills: self efficacy motivates engagement, while experiential learning cycles ensure deep, transferable skill acquisition.

Scientific writing is defined as a systematic, logical, and evidence-based product of critical thinking, literature review, or empirical research, presented in accordance with scientific principles and coherent writing rules to express, analyze, and solve a problem (18–20). The scientific method includes data collection, information processing, and drawing conclusions that can be academically accounted for. Scientific paper, as a result of scientific writing, can be a means for students to communicate research results that contribute significantly to the development of science and problem solving in society.

Some previous studies about university students' scientific writing skill, especially in writing scientific papers, showed less than satisfactory results. Most students lack the knowledge and skills to write scientific journal articles due to a lack of familiarity, low scientific-based academic literacy, limited information, and low motivation for self-development. These results correlated with previous which found that some students lack the skills to write scientific papers due to fundamental reasons such as limited access to information, tight schedules, motivation, and a low literacy culture (21, 22). As a result, students experience difficulties in expressing ideas and developing their ideas into scientific writing (23).

To address these issues, it is crucial for universities' teachers to promote a scientific writing habit through adequate training and guidance to foster students' critical thinking skills and active participation in scientific writing (24). Unlike traditional lecture-based approaches that focus on passive knowledge transfer, Competency Based Training (CBT) is particularly effective in overcoming writing skill deficiencies because it emphasizes hands-on practice, mastery learning, and personalized feedback. CBT ensures that participants not only understand theoretical concepts but also demonstrate tangible writing competencies such as structuring arguments, citing sources correctly, and presenting data systematically before progressing to the next skill level. This approach directly addresses the root causes of students' difficulties, including lack of practice, low self-efficacy, and limited experience in producing scientific texts. Competency based training is a solution to address these issues. It is expected that competency-based training could be the best solution for improving students' knowledge and skills in writing scientific papers.

Competency based training is a training approach that emphasizes the achievement of real abilities (competencies) that participants must possess to carry out tasks or jobs effectively according to established standards (7, 25). In this type of training, the programs are focused on developing skills and knowledge that align with the competency requirements for compiling scientific papers. Students are guided to have core competencies through practice, feedback, and measurable performance evaluation so that the results can be directly applied in compiling scientific papers and professional development.

The aim of this study is to identify the extent to which a CBT model can help students master the skills of writing scientific papers, analyze the training process through a CBT approach, measure the development of students' abilities in terms of mastery of scientific knowledge, skills, and attitudes, and provide recommendations for

effective learning strategies for universities in equipping students with the ability to write scientific papers as one of the important academic competencies.

Methodology

Research Design

This study used a mixed-method research design. Mixed-method research design is a research design that combines quantitative and qualitative approaches to gain a more comprehensive understanding (26). The design approach used an explanatory sequential design, a combination of quantitative and qualitative research methods sequentially. In the first stage, the research was conducted using quantitative methods and in the second stage we used qualitative methods (27, 28). The quantitative stage has been conducted by collecting and analyzing numerical data gained from pre-test or post-test scores which were taken from learning and training evaluations. The qualitative stage was done by conducting interviews and observations to investigate the training, methods, and effectiveness of the model. This training was attended by 43 Master's Program students in the Master of Educational Administration Study Program at Universitas Tanjungpura, Pontianak, West Kalimantan, Indonesia (approximate GPS coordinates: 0.0606°S 109.344056°E).

Participants were selected using a purposive sampling technique, with the following inclusion criteria:

(a) third semester students who were actively preparing their thesis research proposals,

(b) students who had not yet published any scientific article in a journal, and

(c) students who voluntarily agreed to participate in the full training series.

Regarding participant demographics, the sample consisted of 28 female (65.1%) and 15 male (34.9%). In terms of occupational background, 31 participants (72.1%) worked as school teachers, 7 (16.3%) as education administrators or school principals, and 5 (11.6%) as education supervisors.

Research Stages and Instrument

This research was conducted in two integrated stages. The first stage began with quantitative data collection through needs analysis to measure training needs, pre- and post-tests for measuring skills, and training evaluation. The quantitative data were analyzed statistically to determine any improvement in writing skills. Then, the second qualitative stage was conducted through interviews, observations, and document analysis to deepen understanding of the quantitative results, particularly regarding students' experiences in participating in the training, the effectiveness of the method, and supporting and inhibiting factors. To obtain optimal results, the training effectiveness evaluation used the Kirkpatrick evaluation model approach from levels 1-4. In short, the research instruments of this research consist of tests, questionnaires, interviews, observations, and document studies. Table 1 below presents the research instruments and their corresponding competencies and indicators.

Table 1: Research Instrument

Competences and Indicator
Competence in Deciding Research Title
Title reflects the focus and scope of the research
Title is specific, clear, and communicative (not too wordy)
Title is attractive and in line with student's expertise
Competence in developing abstract of the article
The abstract covers background, aims, methods, results, and conclusion
Written briefly and informatively (150–250 words)
Using systematic, communicative, and effective language
Competence in writing introduction
Elaborating problem background logically
Presenting research gap or the urge of the research
Including literature review from relevant previous studies
Explaining research aims and questions
Competence in writing research method
Explaining approach, type, procedure and data analysis process

Stating the research instruments
Competence in presenting results and discussion
Results are presented clearly in table/ figure informatively
Data are interpreted clearly and logically
Discussion connects findings with theories or previous studies
Any critical analysis towards results and research implication
Competence in delivering conclusion
Conclusion is presented shortly from the main findings Kesimpulan
Written consistently, in line with aims and findings
Stating implication or recommendation (if needed)
Competence in writing bibliography
Writings contain relevant scientific references (journals, books)
Article templates were written consistently and systematically

Training evaluation was conducted by using the Kirkpatrick evaluation model. The Kirkpatrick evaluation model has four levels of evaluation: reaction evaluation, learning evaluation, behavior evaluation, and outcome evaluation. This model is used because it has been standardized and the evaluation steps are carried out systematically and comprehensively (29, 30). The training evaluation instrument adopted from the Kirkpatrick model is described in Table 2 below.

Table 2: Competency-based Training's Evaluative Instrument in Kirkpatrick Model

Competences and Indicators
Reaction Evaluation
The training is suitable with my personal needs as last year student
Facilitator/instructor has pedagogic and technical competencies
Training materials are developed in accordance with scientific writing skill standards
Training method is chosen according to the participants' characters and training aims
Facilities/Training Media supports the training program
Learning Evaluation
Title
Abstract writing competence
Introduction
Research methods
Results and discussion
Conclusion
Bibliography
Behavioral Evaluation
Suitability of practice with the tasks and responsibilities of completing journal articles for final year task
Increasing knowledge and skills in writing journal articles for final year task
The training materials and practices can be applied to complete the final thesis assignment as master's degree student
This training encourages increased cooperation and independence in completing final journal article assignments
The knowledge gained during the training can be disseminated to fellow students in completing their final year task
Results Evaluation
The training contributes to achieving the goal of improving the journal article writing competence of Master of Educational Administration students.

Data Collecting Technique

Quantitative data were collected from questionnaires, pre-tests, and post-tests to measure participant skills and training evaluations. The questionnaire used a 1-5 Likert scale with the following anchors: 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), and 5 (strongly agree) to evaluate training effectiveness. The pre-test was administered one week before the training began (on August 16, 2025), to measure participants' baseline knowledge of scientific writing. The post-test was administered one week after the training ended (on September 13, 2025), using the same set of questions to measure knowledge improvement.

Both pre-test and post-test used a 1-100 scale. The training evaluation questionnaire was distributed online via Google Forms immediately after the training concluded (on September 6, 2025). Qualitative data were collected through interviews, observations, and documentation. Semi-structured interviews were conducted with 10 randomly selected participants (5 with high post-test scores and 5 with moderate scores) within two weeks after the training (September 7–20, 2025). Observations were carried out during all training sessions (August 23 – September 6, 2025) using an observation checklist to document participant engagement and facilitator performance. Documentation studies were conducted throughout the research period to collect data related to training references, participant worksheets, and written assignments.

Instrument Validity Test

Two validators, who are experts in educational research and training evaluation, validated the questionnaire, interview guides, and observation protocols. The evaluation results showed a good fit between the questions and indicators, with a Content Validity Index (CVI) of 0.90, indicating a high level of content validity. The validators also recommended using a standardized evaluation model, namely the Kirkpatrick evaluation model, to ensure comprehensive training assessment. For reliability testing, the questionnaire was administered to a pilot group of 15 master's students who were not part of the main sample. The internal consistency of the questionnaire was measured using Cronbach's alpha coefficient, which yielded a value of 0.85 (>80%), categorized as good. These results confirm that the research instruments are both valid and reliable for measuring the effectiveness of competency-based training.

Data Analysis

Quantitative data was processed descriptively by calculating percentages and categorizing them. Meanwhile, to test the differences between pre-test and post-test data, a t-test was used. Qualitative data analysis was carried out in three stages (31):

(a) data reduction,
(b) data presentation, and
(c) drawing conclusions.

To ensure the credibility of the qualitative findings, several strategies were employed:

(a) triangulation was applied by comparing data from multiple sources: interview transcripts, observation notes, and documentation,
(b) member checking was conducted by returning the interview summaries to five randomly selected participants to verify the accuracy and interpretation of their responses,
(c) peer debriefing was carried out by discussing the preliminary findings with two colleagues who were not involved in the data collection process to minimize researcher bias.

These procedures enhanced the trustworthiness and dependability of the qualitative data.

Results

Training Preparation

In the preparation stage, several activities were carried out:

(a) We conducted needs analysis by analyzing article writing problems through interviews and questionnaires to students. Most post-graduate students did not yet have the skills and experience of writing journal articles.
(b) We designed a training curriculum. The training curriculum was the preparation of scientific works in the form of theses and scientific journal articles. The expected competency was the ability to compile scientific journal articles from the title, abstract, introduction, methods, results and discussion, conclusions and bibliography. This competency should be in accordance with the competency of one of the curriculums for compiling scientific works at the postgraduate level.
(c) We prepared the training materials. This stage included describing teaching materials for the ability to compile scientific articles.
(d) We prepared the process of participant selection. The selection of participants was based on the class, namely the Class of 2024-2025 semester 3. The number of participants was 43 postgraduate students from the Class of 2024-2025 semester 3,
(e) We looked for the facilitator and made appointment to some lecturer, requesting this lecturer to be the facilitator. We selected one lecturer to be the facilitator. We set requirements to select the instructor, such as holding a doctoral degree in educational administration, working as a lecturer, having

experience in publishing scientific articles in Scopus-indexed journals.

(f) We prepared the facilities and infrastructure management. Training facilities included classrooms, laptops, LCDs, whiteboards, and markers.

A summary of these can be seen in the following Table 3.

Table 3: Summary of Training Preparation

Preparation Indicator	Finding Description	Supporting Data (Score, Percentage)
Needs Analysis	The needs for conducting the training were identified through interviews and questionnaires distributed to students. All students desired to improve their technical skills and knowledge.	80% respondents stated technical training was needed; 20% knowledge
Short course in curriculum	The curriculum was designed based on university curriculum competency standards and was tailored to the needs of participants.	80% materials were focused on technical skills, 20% on soft skills
Provision for teaching material	The teaching materials were prepared by a team of teachers by paying attention to the relevance of the material, using modules and real case studies.	90% materials were appropriated with main competences, 10% revision needed
Participants selection	Participant selection was based on the level of the Master of Educational Administration student intake for the 2024-2025 academic year, semester 3, and an initial competency test was conducted.	100% postgraduate students
Selecting the instructor	Instructor was appointed based on academic qualifications and experience.	100% lecturer/instructor
Facilities and infrastructures management	Training facilities and infrastructure were adequate, including classrooms, LCD screens, and internet access. However, some facilities required maintenance.	85% of facilities were functioning well, 15% were experiencing problems (e.g. slow internet network)

Table 3 presents the needs analysis aspects with quantitative and qualitative data. The curriculum and teaching materials were aligned with the Master's Program curriculum to prepare scientific theses and scientific articles as graduation requirements. The training instructors had Master's qualified in the field of Educational Administration and had experience publishing articles in reputable journals. The training participants were Master's students from the 2024-2025 Semester 3. The weaknesses of the training preparation included the need for revision of the teaching material instrument, the use of the Kirkpatrick model for training evaluation, and the availability of facilities due to sometimes problematic internet access. Recommendations for preparation included improving the teaching materials and using the Kirkpatrick model for standardized training evaluation.

Implementation of CBT

Competency-based training (CBT) was held from August 23, 2025, to September 6, 2025. All of the 43 third semester Master's students attended. Participants were selected based on their commitment to conducting research and publishing research results in scientific journals indexed by Sinta 2 and Sinta 3. The training began with an explanation of the training objectives and competency standards. The goal of the training was to improve the skills and knowledge of Master's students in writing scientific articles. The required competency standards included the ability to select and define a title, design an abstract, write an introduction, develop a research methodology, present results and analyze research discussions, draw conclusions, and compile a bibliography. The competency standards for competency-based training are shown in the following Figure 1.

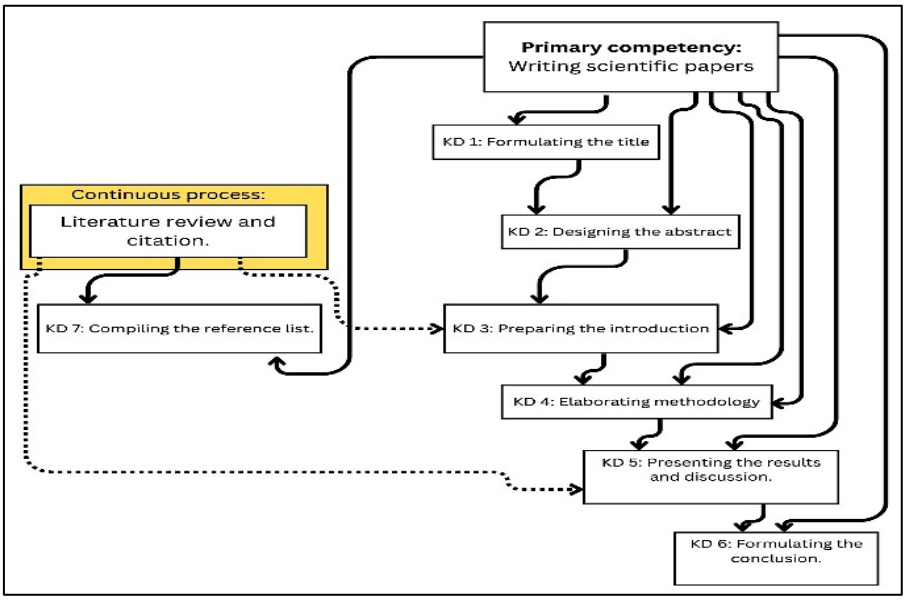

Figure 1: Map of Competencies

The designed competency standards were developed as teaching materials implemented through various training methods. The methods used during the training included interactive lectures, discussions, simulations, and hands-on practice in writing scientific articles. The instructor acted as a facilitator, guiding students to master the competency of writing scientific articles gradually through theory and practice. The training emphasized the skill of writing scientific articles as one of the graduation requirements. To ensure the success of the training, the organizers conducted monitoring and evaluation to assess competency achievement and provided feedback to students. The following are the results of instrument validation by two experts in scientific article writing competency and a training evaluation expert.

Table 4: Validation of Article Writing Competency Instrument

Indicator	Score	Ideal	%	Category
Skill to Determine Title	3.3	4.0	83	Good
Skill to Design Abstract	3.7	4.0	93	Very good
Skill to Arrange the Introduction	3.0	4.0	75	Good
Skill to Elaborate the Research Methods	3.5	4.0	88	Good
Skill to Present the Results and Discussion	3.8	4.0	95	Very good
Skill to Arrange Conclusion	3.7	4.0	93	Very good
Arranging Bibliography	3.5	4.0	88	Very good
Average	3.50	4.0	88	Good

Based on the expert validation results in the Table 4, it can be seen that the students' ability in scientific writing is generally in the good category, with an average score of 3.50, categorized as Good. This indicates that the instrument component is capable of displaying good scientific writing skills in the core sections of the research report related to the content and substance of the research.

Table 5: Instrument Validation of Training Evaluation

Indicator	Score	Ideal	%	Category
Reaction	3.4	4.0	85	Good
Learning	3.6	4.0	90	Very good
Behavior	3.7	4.0	93	Very good
Result	4	4.0	100	Very good
Average	3.7	4.0	92	Very good

Based on expert validation of the training evaluation instrument in the Table 5, an average score of 3.7 was obtained, which falls into the very good category. This indicates that the evaluation

instrument used was relevant, appropriate, and able to measure the overall effectiveness of the training. Overall, the validation results indicate that this training evaluation instrument is of high quality.

To analyze the effectiveness of competency-based training, the committee conducted pre-test and post-test on participants. The pretest was used to determine the participants' understanding of the scientific article writing material. It aimed to measure the participants' initial knowledge before receiving the training. After receiving the training, participants were given a posttest. The posttest was used to determine the increase in participants' knowledge after the training. The posttest aimed to measure the participants' final knowledge level after the training. The results of the pre-test and post-test are presented in Figure 2 below.

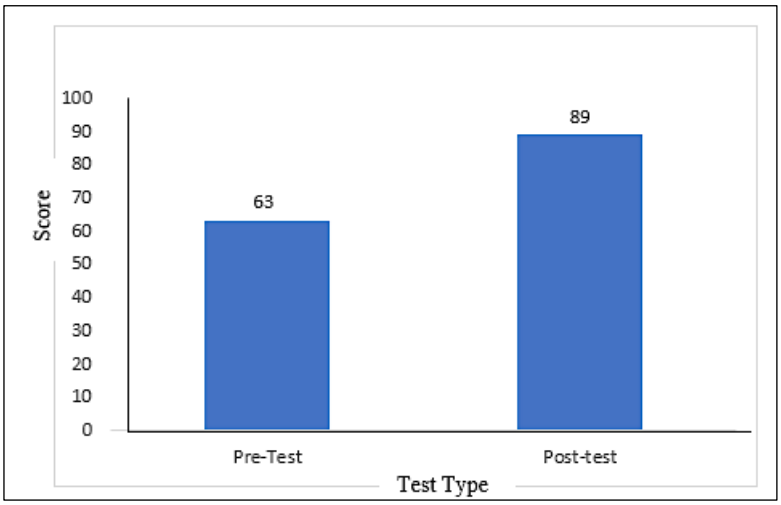

Figure 2: Results of Pre-test and Post-test of the Training Participant

Based on the results of the pre-test and post-test of participants' knowledge about writing scientific articles, there was a significant increase in all measured indicators. The average pre-test score for participants was 63, while the average post-test score reached 89. These results indicate an increase in understanding after participating in the training. A paired-sample t-test was conducted to determine the statistical significance of this difference. The analysis revealed a mean difference of 26 points ($t [42] = 8.47$, $p < 0.001$), which is statistically significant at the 0.05 level. Almost all aspects of writing scientific articles experienced improvements, both technically and conceptually. In more detail, before the training, participants still had a relatively low understanding, especially in the indicators of writing a bibliography and presenting research results. However, after the training, these two aspects experienced a significant increase with posttest scores of 92 and 82, respectively. In addition, knowledge in designing research titles, writing abstracts, and compiling research conclusions also increased consistently to above 85. This indicates that the training succeeded in strengthening participants' competencies in all components of writing scientific articles, especially in aspects that were previously considered weak.

Table 6: Skill Aspect Value

Skill Aspect	Minimum Score	Maximum Score	Average	Category
Skill to Determine Title	67	86	77	Satisfactory
Skill to Design Abstract	72	90	81	Very Satisfactory
Skill to Arrange the Introduction	70	82	76	Satisfactory
Skill to Elaborate the Research Methods	75	88	82	Very Satisfactory
Skill to Present the Results and Discussion	65	84	75	Satisfactory
Skill to Arrange Conclusion	72	90	81	Very Satisfactory
Arranging Bibliography	65	90	78	Satisfactory
Average Score	69	87	78	Satisfactory

Based on the results of the skills assessment in the Table 6, in general, training participants demonstrated abilities that were in the satisfactory to very satisfactory category with an overall average of 78. The average minimum score achieved by participants was 69 and the maximum score was 87, therefore the participants' skills were relatively even without any significant gaps. This indicated that most participants had been able to master the basic skills in writing scientific articles.

Table 7: Attitude Score

Range	Number	Category	Percentage
0-20	0	Unsatisfactory	0
21-40	0	Less Satisfactory	0
41-60	0	Fairly Satisfactory	0
61-80	0	Satisfactory	0
81-100	43	Very Satisfactory	100
	43		100

Based on the assessment results in the Table 7, all training participants (100%) were in the very satisfactory category, with a score range of 81–100. No participants received scores in the unsatisfactory, less satisfactory, fairly satisfactory, or satisfactory categories. This indicates that the participants' skills in the assessed aspects were very good and evenly distributed across all individuals.

To complement the quantitative results, qualitative data from interviews and observations were analyzed to gain deeper insights into participants' experiences during the competency based training. Several themes emerged, including increased confidence, challenges in referencing, and the value of hands-on practice. One participant stated: "Before the training, I was very confused about how to structure a journal article. Now, I feel more confident because the step-by-step practice helped me understand each section" (Participant 3, teacher). Another participant highlighted the importance of feedback: "The facilitator's comments on my draft were very specific. I knew exactly what to revise, unlike before when I only received general comments" (Participant 4, school administrator). These qualitative findings support the quantitative evidence that competency-based training effectively improves scientific writing skills.

Evaluation

Competency-based training evaluation in this research has been conducted by using the Kirkpatrick evaluation model. The Kirkpatrick evaluation model is an evaluation model consisting of four levels: reaction, learning, behavior, and result.

Level of reaction

The reaction evaluation is the assessment stage conducted to determine participants' responses, satisfaction, and perceptions of the training. This evaluation includes the suitability of needs, facilitator, materials, methods, and resource persons. The results of the reaction evaluation can be seen in the following Table 8.

Table 8: Evaluation of Reaction

Competencies and Indicator	Score	%	Description
The training suits my needs as a final year student	3.48	87	Good
Facilitator/instructor has pedagogical and technical competencies	3.58	89	Good
The training materials are prepared in accordance with the competency standards for writing articles	3.38	84	Good
Training methods are selected according to the characteristics of the participants and the training objectives	3.65	91	Excellent
Training facilities/media support the implementation of training	3.73	93	Excellent
Average	3.56	89	Good

The results of the competency-based training evaluation indicate that the training quality was generally considered good, with an average score of 3.56 (89%). This indicates that the training was able to meet the needs of participants, although there are still several aspects that could be improved. Based on the indicator on overall evaluation, the aspect with the highest score was

training facilities or media with a score of 3.73 (93%) and training methods with a score of 3.65 (91%), categorized as Excellent. Thus, the training was deemed very effective in terms of material delivery and the tools used. Meanwhile, the aspect with the lowest score was training materials (score 3.38; 84%), which, although still in the good category, indicates room for improvement in the material's suitability to article writing competency standards.

Learning Evaluation

Learning evaluation is the second stage of evaluation to measure the extent to which participants have acquired new knowledge, skills, attitudes, or competencies after participating in the training. Learning evaluation in this study has been conducted through pre-test and post-test. The pretest and posttest were conducted to measure participants' abilities before and after the training. The pretest and posttest showed a significant increase in participants' knowledge of scientific article writing across all measured indicators. The average pretest score was 63, while the average posttest score was 89. These results indicate an increase in understanding after participating in the scientific article writing training.

Behavioral Evaluation

Behavioral evaluation is the third level of all evaluation procedure in this research, designed to determine the extent to which participants apply the knowledge, skills, and attitudes gained from the training to journal article writing. The results of the behavioral evaluation are shown in the following Table 9.

Table 9: Behavioral Evaluation

Indicator	Score	%	Description
Suitability of practice with the tasks and responsibilities of completing journal articles for final assignments	3.60	90	Excellent
Increasing knowledge and skills in writing journal articles for final thesis assignments	3.35	84	Good
The training materials and practices can be applied to complete the final thesis assignment as a student	3.48	87	Good
This training encourages increased cooperation and independence in completing final journal article assignments	3.40	85	Good
The knowledge gained during the training can be disseminated to fellow students in completing their final assignments	3.28	82	Good
Average	3.42	86	Good

The behavioral evaluation results showed that the overall training achieved an average score of 3.42, with a percentage of 86%, and was categorized as Good. Based on these results, the evaluation of participant behavior was considered as quite effective in helping students complete journal articles for their final assignments, although several aspects still needed improvement.

Result Evaluation

The fourth level of evaluation, result evaluation, measures the training's tangible impact on its ultimate objectives. Approximately 70% of students had completed the process of writing scientific articles and were ready for submission to Sinta level 2 and Sinta level 3 indexed journals.

Discussion

Based on the research findings, it can be concluded that the training preparation aspects, including needs analysis, material development, participant selection, provision of teaching materials, and instructor selection, were implemented well and in accordance with ideal training standards. This indicates that the organizers had systematic and focused planning to support the effectiveness of the training activities (32–34). However, this study also identified weaknesses in the training evaluation instrument that still need to be improved to be able to more comprehensively measure the achievement of training objectives. Improvement of the evaluation instrument is important to generate valid and reliable feedback, which can then serve as a basis for decision-making in continuously improving the quality of

the training program (35–37). Thus, even if the preparation aspect is adequate, refining the evaluation instrument is key to ensuring the success of future training (38, 39).

Furthermore, limited internet access was a major obstacle experienced by students in searching for scientific article references, despite the high demand for academic reference sources. This situation indicates a gap between academic demands and available infrastructure, which can impact the quality of students' scientific work (40, 41). This finding aligns with previous research confirming that limited digital infrastructure significantly impacts students' information literacy and academic productivity (42–45). Therefore, strategies are needed to strengthen facilities and infrastructure, such as providing equitable internet access and developing alternative reference access to meet academic needs.

The training was proven effective in improving participants' knowledge, skills, and attitudes regarding the concepts and practices of journal article writing. This improvement indicates that the materials, methods, and learning strategies implemented during the training provided participants with a more comprehensive understanding (19, 46). This is in line with adult learning theory, which emphasizes the importance of direct experience and the relevance of the material to participants' needs to achieve optimal learning outcomes (47–49). Therefore, the results of this study confirm that training can be a strategic intervention in academic capacity development, particularly in improving the ability to write quality journal articles that meet scientific publication standards (46, 50–52).

The behavioral evaluation results indicate that the training is quite effective in helping students complete journal articles for their final assignments, and the results of the evaluation indicate that some students have successfully submitted scientific articles to scientific journals. Thus, the training has proven quite effective in improving students' ability to complete journal articles as part of their final assignments. This is evident in the increased student engagement in the writing process, independence in structuring articles, and the ability to integrate scientific references more appropriately (1, 53). The performance evaluation results indicate that some students have successfully submitted scientific articles to target journals, which is a clear indicator that the training not only impacts conceptual knowledge but also the achievement of measurable academic outcomes (54–56). These findings confirm that the training has positive implications for improving students' academic capacity, although further mentoring is still needed to ensure consistent article quality and the sustainability of the scientific publication process.

This study has several limitations since the competency-based training only involved one group of students in one study program, that is the Master of Educational Administration. Therefore, the findings cannot be generalized to a broader context, such as different study programs at different faculties, universities, colleges, or regions. Furthermore, this study was conducted over a relatively short period of time, so it did not observe the sustainability of the article submission results until the overall publication stage in journals indexed at least by Sinta level 3 in Indonesia.

Conclusion

Based on the research objective to examine the effectiveness of competency-based training in improving students' scientific writing skills in higher education, the results of the study indicate that competency-based training is able to improve students' knowledge, skills, and attitudes in compiling scientific articles, which is seen from the increase in pre-test to post-test scores, writing skills in each article component, and the ability to apply knowledge in the practice of compiling manuscripts up to the stage of submission to journals. The application of CBT not only helps students understand the structure and rules of scientific writing better, but also encourages independence, cooperation, and motivation in the writing process, so this training is considered effective and relevant to be implemented sustainably in higher education programs. The implication is that competency-based training is effective in improving students' scientific writing skills, therefore, it is recommended that this training model be implemented sustainably and integrated into the curriculum of study programs in Higher Education.

Abbreviations

CBT: Competency-Based Training; CVI: Content Validity Index; Sinta: Science and Technology Index.

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Author Contributions

Marinu Waruwu: Conceptualization, Data Collection, Analysis, Writing, Review, Editing, Halida: Data Collection, Analysis, Review, Editing, Eka Suryanti: Investigation, Review, Editing, Agnes Nofanita: Analysis, Investigation, Review, Editing, Wati Irnawati: Analysis, Review, Editing, Lilis Kholisoh Nuryani: Review, Editing, Yari Dwikurnaningsih: Review, Editing, Sophia Tri Satyawati: Editing.

Conflict of Interest

The authors have no conflict of interest to declare.

Declaration of Artificial Intelligence (AI) Assistance

The authors declare no use of artificial intelligence (AI) for the write-up of the manuscript. The authors take full responsibility for the originality, interpretation and accuracy of the content.

Ethics Approval

This study was approved by the Research Ethics Committee of the Faculty of Teacher Training and Education, Universitas Tanjungpura, Indonesia (Approval Number: 0062/UN22.6/AL.04/2025). Participants provided informed consent prior to participation.

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