The Skill of Analysis and Synthesis for Teaching Research Competence: A Study in Higher Education

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The ability to analyze and synthesize is a crucial cognitive skill in teachers' initial research training. This competence involves various mental actions for processing both theoretical and empirical information. It enables students to accurately present and understand their investigative experiences, fostering new knowledge from their interpretations. This research aims to evaluate student and teacher assessments during the research training regarding analysis and synthesis skill development. A mixed-method approach was used, with a qualitative focus through case studies. Results indicate that students engaged effectively in analysis and synthesis activities during training, demonstrating skill achievement. This success is linked to a supportive learning environment with participatory teaching methods and positive interactions among educators. Challenges encountered were addressed effectively, providing valuable insights for enhancing future training experiences in developing analytical and synthesis skills in teaching and research contexts.

Keywords: competence, teacher, training, skill, research, university

INTRODUCTION

The challenge for improving educational quality focuses on the training of future teachers in didactic and pedagogical skills (Castro & Egido, 2024), but also research skills that allow them the ability to propose, design and implement educational research projects linked to the professional practice they develop (Rodríguez et al., 2020; Sabariego-Puig et al., 2020). Among the research competencies, the ability to analyze and synthesize stands out (Garrido et al., 2019), which involves strengthening the students' abilities to identify the essential aspects and fundamental characteristics of the object and/or situations under study. (Maybee et al., 2019). Quispe (2020) highlights the function that this skill plays during the dynamics of doing research, particularly, during the observation and recording of the phenomena or situations

investigated, as well as from the application of the procedures inherent to the analysis of research results, the writing and discussion of the results, the construction of the conclusions and, finally, the completion of the entire process through the writing of a research report (García-Gutiérrez & Aznar-Díaz, 2019). Understanding the conceptual dimension of the skill of analysis and synthesis involves a necessary operationalization of it, through indicators that show its execution during learning experiences. García et al. (2010) describe a total of eight indicators that reflect in students the development of the ability to analyze and synthesize: (1) identification of the constituent elements of a text, situation or case; (2) establishment of some type of relationship between the constituent elements of the text, situation or case; (3) effective organization of the identified elements and their respective relationships; (4) use of graphic organizers to support the achievement of the synthesis process; (5) coherent integration of the constituent elements of the text, situation or case; (6) development of inferences about the elements that have been identified and organized from the work material; (7) synthetic inclusion of all elements and their relationships; and (8) generation of a quality final product consistent with the analysis process initiated until the writing of the synthesis.

Trejo (2019) makes an interesting reclassification of the competence of analysis and synthesis, stripping it from the solely cognitive space to relocate it within a more holistic framework: as a reflective and investigative capacity of the teacher (Perrenoud, 2007), which forms part of the characteristics of knowing "learning to be". Salamanca et al., (2020) maintain that to develop generic competencies, special emphasis must be placed on the redefinition, organization and management of the curricular proposals (Lluch et al., 2017), implementing methodological strategies that favor the development of this skill (Eizaguirre et al., 2017); using innovative (Estévez et al., 2021) practical materials and resources for the quality of teaching. Other studies consider that promoting the reading habit enhances this skill (Guzmán-Simón & García-Jiménez, 2014) generating logical reasoning in students (Torres-Perdigón, 2017). For its part, Virtanen & Tynjälä (2018) describes that these strategies must also have an affective, motivational and supportive nature within the framework of a learning climate characterized by positive interdependence between equals (García & Gaviria, 2021) and constant support from teachers throughout the training process (Carlín et al., 2020). In definitive, the review of the empirical literature has made it possible to verify how in those teaching and learning experiences, based on the competency-based approach (Cacheiro-González et al., 2020), the analysis and synthesis one was of the most increased skills (Cretton, 2017). However, in an antagonistic way, Álvarez-Álvarez & Diego-Mantecon (2019) argues that, one of the main causes that limit the ability of analysis and synthesis in students, to face literary texts in general and those specific to the field of research, has to do with the lack of reading habits on their part. Consequently, the urgent need to generate and design educational guidelines that incorporate strategies to continue strengthening this ability of analysis and synthesis is evident (Salamanca et al., 2020) such as the use of certain types of interactive graphic organizers recovered from virtual spaces, along with constant and precise feedback from the teacher to benefit the development of the analysis and synthesis skills of students training to become teachers.

This research aims to identify the evaluations of students and teachers during the research training process regarding the development of the skill of analysis and synthesis.

METHOD

The research adopted a mixed approach (Acosta-Faneite, 2023), supported by the design classification framework proposed by Hernández-Sampieri & Mendoza (2008): Embedded or Nested Concurrent Design of the dominant model, characterized by addressing the data from perspectives, both quantitative and qualitative, with a predominant method guiding the project. In this study, the qualitative approach (Flick, 2015) assumes the dominant position, since the research followed each of the phases of the case study method (Canta-Honores & Quesada-Llanto, 2021) evaluative type (Pérez-Serrano, 2001).

Context and Participants

The context where the research took place was a public university in Honduras, in charge of the initial training of teachers for the entire national educational system. The participants and key informants in the

research are made up of three groups each one with particular characteristics in correspondence with the purposes of the research: (1) Eighty students (61 women and 19 men); (2) Five female teachers designated as experts (with more than 20 years of experience in university training and educational research); and (3) Three female teachers designated as novel (with experience in research training in education). To select the sample, the intentional qualitative sampling procedure (Hernández & Carpio, 2019) was used for convenience (Loayza-Maturrano, 2020).

Information Obtaining Instruments

Qualitative techniques (Alegre-Brítez, 2022) were used in data collection. For the students, a qualitative interview is applied through a semi-structured questionnaire (Tojar, 2006), addressing demographic data and issues related to the five study categories. In the case of novice teachers, participant observation was used (Castillo, 2021) during the implementation of the research training program (Sánchez-Maream et al., 2021). The expert teachers carried out external observation through specific visits during the program, recording appreciations and narrative details with a checklist (Coronado-Hijón, 2015). The validation of the instruments included a content review process by expert judgment, and those who reviewed and offered suggestions to improve them.

Procedure

The study phases were:

- Initial: research design and plan. The instruments for obtaining information were built and validated
- Development: immersion in the field and application of the instruments to the participants. The ethical guidelines were taken into account during the research process: informed consent, confidentiality and protection of the anonymity of the informants.
- Final: the organization, treatment and representation of the data, generation of the discussion and conclusions were carried out.

Data Analysis

The data were analyzed using procedures specific to their nature. For quantitative data, the frequency distribution was applied (Hernández-Sampieri et al., 2014) and descriptive matrices were generated with Microsoft Excel. Regarding the qualitative data, the steps suggested by Sánchez-Maream et al. (2021) were followed: (1) application of analytical induction; (2) comparative method to examine similarities and differences systematically; (3) coding to organize and categorize information; (4) dense description for detailed data representation; (5) content and discourse analysis to explore meanings and narrative structures; (6) mapping to visualize relationships between identified elements; and (7) triangulation to confirm findings with various sources. The AQUAD 6 program (Huber, 2003) was used to process qualitative data.

RESULTS

Category 1. Evidence of Achievement

Evidence of achievement is derived from the testimonies provided by the participants that confirm the mastery of the skill of analysis and synthesis (Table 1).

TABLE 1
CATEGORY 1 EVIDENCE OF ACHIEVEMENT

Codes	***Absolute Frequency***
1.1. Achievement assessment	71
1.2. Application of paraphrasing during redaction	43
1.3. Identify main ideas	31
1.4. Brief and precise description of the main ideas	19
1.5. Interpret ideas	16
1.6. Relate ideas	16
1.7. Disaggregate the whole into its parts	8
1.8. Use of lexical connectors for coherent writing	8
1.9 Management of synthesis techniques for information organization	4
Total	216

With the highest score, the participants' positive assessment of the achievement of the ability to analyze and synthesize to do research is collected (code 1.1):

> *Well, I feel that the part that I strengthened quite a bit was synthesizing. (Student 45)*

> *At the same time, expert and novice teachers, as a result of their observations, recognize the achievement of student's analytical skills: It allowed analysis and synthesis of the central elements and ideas of the topic to be discussed. (Novel Teacher 2)*

Another assessment with high scores was when they were able to apply paraphrasing in writing (code 1.2.), evidencing the achievement of the students' ability to analyze and synthesize:

> *Because synthesis is taking the most key points of a literature and expressing it with my own words and that comes easy to me. (Student 65)*

Identifying main ideas (code 1.3) refers to the fact that, during the process of doing the research, the students achieved the skill of analysis and synthesis, when they were able to distinguish and point out the basic and relevant notions of the theoretical-practical materials under discussion and study:

> *Having to read and extract the most important things has been a great achievement personally, knowing that not everything in a text is important. (Student 31)*

Brief and precise description of the main ideas (code 1.4) confirms that the students' achievement of the ability to do analysis and synthesis was demonstrated by the disposition and ease expressed by them when developing the most important ideas of an author explicitly and synthetically:

> *I learned to synthesize the information quite a bit. In getting the most specific…what I really want to express, the central idea. (Student 72)*

Interpreting ideas (code 1.5) refers to the fact that the achievement of the students' ability to analyze and synthesize is confirmed when they were able to make logical deductions from the ideas developed in the theoretical-practical materials on research:

My strongest points within that competence are that it was possible to discover in a text what it wants to make me understand, what it is telling me. (Student 65)

Likewise, novice teachers confirm the achievement of the students' ability to analyze and synthesize, manifesting in their ability to understand with certainty the instructions on the text, regarding the development of each of the phases of the research process:

The students previously read the text and understood without any problem the procedures to be carried out. (Novel Teacher 2)

Relating ideas (code 1.6.) shows that establishing relationships between the different ideas raised in the theoretical-practical materials on research shows that students have achieved the ability of analysis and synthesis to carry out research:

All that information that We have been building and we identified main ideas and made connections with the contexts that affect teachers, as well as other emerging ideas. (Student 76)

Breaking down the whole into its parts (code 1.7) points out that, another evidence of the achievement of the ability of analysis and synthesis on the part of the students is manifested in the skill achieved by them during the process of doing the research, to disaggregate the information into its different structures and in a coherent way:

[…] In the analysis categories, there, I was able to understand how to deploy the topic in subsections without losing the meaning. (Student 09)

Consistent with what was pointed out by the students, the novice and expert teachers confirm that a sample of the students' achievement of the ability to analyze and synthesize was evident when they applied this cognitive ability to understand and fragment the theoretical and empirical information generated during the development of the research:

Students show mastery in identifying patterns and themes in the data collected in the interview. (Expert Teacher 5)

Use of lexical connectors for coherent writing (code 1.8) indicates that the achievement of the ability to analyze and synthesize was reflected in the successful application that the students made of the textual connectors to establish the desired coherence when preparing synthesis during the process of doing the research:

I made the synthesis, I wrote it up from what I had obtained, but I used connectors... so that the paragraph made sense. (Student 07)

In a concordant manner, the novice teachers confirm that the use of textual connectors was present and was a promoter during the process of making synthesis for the development of said skill:

The use of connectors is evident, in order to establish a common thread between an idea to other. (Novel Teacher 1)

Management of synthesis techniques for information organization (code 1.9), it is indicated that, during the development of the research, the students appropriately selected and used graphic and textual organizers as resources to synthesize, thereby accounting for the achievement of the ability to synthesis:

Regarding the synthesis, I consider that in the conclusions we developed a hierarchical and a relationship map that allowed us to write the conclusions. (Student 01)

Likewise, novice teachers confirm the use and benefit generated by the application of certain techniques to support the synthesis activity during the development of the teaching-learning process to be investigated:

Reading cards; This technique allowed students to enhance their…synthesis skills. (Novel Teacher 2)

Category 2. Favorable Aspects

The favorable aspects refer to certain teaching programming practices experienced by students and teachers, which have contributed to their own development of the ability of analysis and synthesis to carry out research (Table 2).

TABLE 2
CATEGORY 2 FAVORABLE ASPECTS

Codes	***Absolute Frequency***
2.1. Pedagogical workshop	85
2.2. Comprehensive reading	67
2.3. Teacher feedback	24
2.4. Peer feedback	8
Total	184

The pedagogical workshop strategy (code 2.1) has been highly valued as a factor that benefited the achievement of the ability to do analysis and synthesis:

We are developing several competencies such as analysis and synthesis when working with each workshop... in the writing of the same research report. (Student 64)

In relation to what was expressed by the students, novice teachers value the relevance that the workshop strategy adds to the curricular process for the development of the skill of analysis and synthesis:

The workshops are very useful, especially for students who begin an investigative process, since it is of utmost importance to understand each element and then place it within a whole. (Novel Teacher 1)

On the other hand, expert teachers refer in a more particular way to the different techniques used in the teaching-learning process, as contributors to the achievement of analytical and synthetic skills in students:

The use of graphic schemes, conceptual maps are observed and it favors the analysis. (Expert Teacher 4)

Similarly, comprehensive reading (code 2.2) is described as part of the curricular programming to teach research, which favored the achievement of the ability of analysis and synthesis in the student:

Throughout the process there was a lot of reading...which also helps a lot for analysis. (Student 75)

Observers have also indicated this perception:

> *The comprehensive reading techniques "The Summary based on incomplete sentences" helps the student to promote analysis and synthesis skills… The reading cards; This technique allowed students to enhance their analysis and synthesis skills. (Novel Teacher 2)*

The participants also consider teacher feedback (code 2.3) as an aspect that helped this procedural acquisition of synthesis:

> *With the help of the teacher, she has given us that support and feedback when we had doubts. (Student 64)*

Finally, peer feedback (code 2.4) and, specifically, interpersonal relationships between colleagues were beneficial and significant for achieving the ability to analyze theoretical-practical materials related to research:

> *When working with my colleagues, it kind of helped me a lot... they told me we have to analyze and synthesize... then when I decided to read by myself, I realized that it wasn't really important, so working together can help develop those skills. (Student 10)*

Category 3. Difficulties

Difficulties refer to the limitations that, to some extent, restricted certain students from achieving the ability to analyze and synthesize in research (table 3).

TABLE 3
CATEGORY 3 DIFFICULTIES

Codes	***Absolute Frequency***
3.1. Synthetic production	30
3.2. Main ideas interpretation	25
3.3. Comprehension of technical research vocabulary	18
3.4. Absence	15
3.5. Main ideas identification	10
3.6. Lack of reading habit	8
3.7. Negative attitude	7
Total	113

The difficulty most pointed out by the participants is deciphered as synthetic production (code 3.1), reflecting the students' difficulty in exposing the main ideas of the text in an alternative way and in their own words:

> *I need to release my vocabulary and take more ownership to have a greater breadth of the topic at the time of writing and synthesizing it. (Student 15)*

The main ideas interpretation (code 3.2) is identified as a difficulty faced by students in developing their ability to analyze and synthesize when they are unable to understand or decipher the meaning of some content when reading academic documents on research:

Analyzing and synthesizing is something that goes beyond what is meant... grasping the essence of what is meant was not very easy for us. (Student 63)

The novice teachers observed the difficulty of certain students in understanding certain ideas developed in the texts under study:

The weakness observed is on the part of the students who cannot assimilate and understand the ideas expressed in the section. (Novel Teacher 2)

The comprehension of technical research vocabulary (Code 3.3) refers to the fact that the little knowledge and use of technical vocabulary specific to the field of research made it difficult to develop the ability to analyze and synthesize:

Analysis is sometimes complicated because we have to understand terms that the class requires to be able to do research. (Student 60)

Similarly, the novice teachers expressed their opinion that one of the difficulties present in the students regarding carrying out analysis and synthesis was their limited knowledge of a vocabulary specific to the field of research:

Despite what was asked in class if they understood what they should do and the students mentioned that yes, I was able to identify that certain concepts were difficult for them to understand. (Novel Teacher 1)

The absence of difficulties (code 3.4) raises the manifest recognition of some students that they did not have any difficulty in achieving the ability to do analysis and synthesis during the research process:

It was not that difficult for me to analyze and synthesize. (Student 51)

The main ideas identification (code 3.5) indicates that the development of the ability to do analysis and synthesis was diminished by the difficulties that certain students faced in being able to identify the key notions of a text:

Regarding the analysis, I consider that at the beginning I couldn't get the main ideas out. (Student 72)

Likewise, novice teachers report the existence of students who, while reading research texts, demonstrated difficulties in identifying the most important concepts in the text:

Students... with difficulties in identifying main ideas in a text. (Novel Teacher 3)

The lack of reading habit (Code 3.6) is revealed as a difficulty for the development of the ability of analysis and synthesis due to the limitation that some students have for the practice and enjoyment of academic reading:

I have always had that weakness because I did not like reading and when I came to this type of class I saw the weaknesses. (Student 62)

Likewise, novice teachers consider that the lack of a discipline for carrying out academic readings becomes a difficulty for the development of the skill of analysis and synthesis:

Students with little reading, with little reading habit. (Novel Teacher 3)

Finally, the negative academic attitude (Code 3.7) states that, during the process of doing analysis and synthesis as part of the research process, there was a lack of alacrity and diligence on the part of certain students to face the difficulties that arose in this regard:

> *In this part of the synthesis I was blocked, because I did not understand and I did not seek help from anyone as I did before. (Student 82)*

Category 4. Actions to Solve Difficulties

The actions to solve the difficulties refer to the positions assumed and actions carried out by the participants to solve the identified difficulties (table 4).

TABLE 4
CATEGORY 4 ACTIONS TO SOLVE DIFFICULTIES

Codes	***Absolute Frequency***
4.1. Peer feedback	43
4.2. Comprehensive reading	34
4.3. Use of application portals on the WEB	14
4.4. Teacher feedback	6
Total	97

Peer feedback (code 4.1) and mutual help between colleagues during the development of the process of learning to research, appears as the most significant action that counteracted the difficulties that arose with respect to achievement:

> *At some moments one gave support to another of the group... to know what was relevant and what was not and make the synthesis. (Student 49)*

Followed by the previous one, comprehensive reading (code 4.2), identified as the practice of continuous and in-depth reading of the didactic textual material to carry out research, eliminated the obstacles to achieving the skill of analysis and synthesis:

> *I read and understand and when I don´t understand I read again to be able to analyze and synthesize. (Student 13)*

The use of digital portals (Code 4.3.) and academic resources available in cyberspace allowed them to resolve certain difficulties in carrying out analysis and synthesis during the process of learning to do research:

> *Through the Internet, online, through the virtual programs offered by the university, the virtual books it offers. (Student 64)*

Finally, it is noted that the teacher's feedback (code 4.4), with the commitment assumed and empathy manifested during the teaching-learning process, had a largely beneficial effect in resolving the difficulties of analysis and synthesis during the research process:

With the patience of the teacher... and the permanent support that she was giving us at the group level and in individual moments, we managed to advance to make a certain type of analysis and synthesis. (Student 54)

Category 5. Improvement Proposal

The improvement proposals refer to the suggestions made explicit by the participants, based on their own learning experience and regarding possible alternatives, to better develop the skill of analysis and synthesis during the research process (Table 5).

TABLE 5
CATEGORY 5 IMPROVEMENT PROPOSAL

Codes	***Absolute Frequency***
5.1. Strategies to develop the skill	45
5.2. Academic motivation	28
5.3. Promote the habit of comprehensive reading	18
5.4. Longitudinal and transversal approach	10
Total	101

It is suggested that strategies be incorporated into the curricular programming to develop the skill of analysis and synthesis (code 5.1) translated into all those didactic experiences that enhance this skill in the student body:

More activities in the instructions on how to perform analysis and synthesis, on how to write a text. (Student 16)

It is also identified that students must assume an attitude of academic motivation (Code 5.2) towards their learning process:

Do not close your mind, since it is a personal attitude not to block yourself, do a comprehensive reading and write. (Student 54)

To the above, in the third position, is added the suggestion of promoting the habit of comprehensive reading (Code 5.3) in the academic training of students, as a way to strengthen the ability of analysis and synthesis to learn to do research:

The teacher cannot make the student learn to analyze in an academic period, but he can if one does not have the habit of reading. (Student 78)

Finally, the importance of giving a longitudinal and transversal approach (Code 5.4) to the development of the ability of analysis and synthesis in students is projected, integrating learning experiences that induce the development of said synthesis ability:

As I said, maybe in previous pedagogical spaces and to already carry the capacity for synthesis. (Student 75)

DISCUSSION

The results released on the evidence of achievement of the skill of analysis and synthesis as a fundamental skill in any educational research process allow us to confirm the achievement of this skill in the participating students. Cretton (2017) confirms that the students' self-perception is equally satisfactory regarding the development of this skill. Actions and implications typical of a text or information analysis process have been identified, such as highlighting central ideas, relating them, disaggregating them and interpreting them. These findings are linked to what was stated in the research by García et al. (2010) who propose these conditions as indicators of the presence of analytical ability in students. This entire analysis process, achieved by the students, took shape when they were able to synthesize and produce their own writings using lexical connectors for coherent, brief and precise writing of the main ideas and with the application of paraphrasing in writing (García -Gutiérrez & Aznar-Díaz, 2019).

The aspects that favor the ability to analyze and synthesize were adjusted to a single reality, referring to the learning environment where three intervening elements converged: (1) the pedagogical workshop strategy as a guide for the entire process; based on experiences that linked theory to practice (Sáez, et al., 2022) and that influenced the development of the skill of analysis and synthesis (Eizaguirre et al., 2017; Sáez et al., 2022); (2) the comprehensive reading practices also considered by Guzmán-Simón & García-Jiménez (2014) as fundamental in the purpose of promoting the ability of analysis and synthesis, as well as for logical reasoning in students (Torres-Perdigón, 2017); and (3) effective pedagogical communication relationships between educational actors (Villalpando et al. , 2020).

Regarding the difficulties, which were present during the research training process, for achieving the skill of analysis and synthesis, the following four aspects are observed: (1) those that refer to procedural limitations inherent to the analysis and synthesis processes, specifically, to the identification and interpretation of ideas for synthetic production and, therefore, it is necessary to review and adjust the curricular proposals (Lluch et al., 2017); (2) difficulties that are related to deficiencies in their previous academic experiences, such as lack of reading habits and, consequently, limitations in understanding certain technical vocabulary about research; a finding that is supported by the research of Álvarez-Álvarez & Diego-Mantecon (2019), who point out that the absence of a systematic reading practice limits the development of students' capacity for analysis and synthesis; (3) attitudinal conflicts, on the part of the students, in relation to the lack of personal initiative to assume a commitment to overcome their deficiencies in this ability. In this regard, Trejo (2019) considers the importance of continuing to support the development of this skill, from a comprehensive point of view and associated with the change in people's attitudes; (4) and, finally, the group of those who did not encounter difficulties in achieving this skill has also been identified; This data is encouraging regarding the importance of this generic instrumental competence in the training of students (Maybee et al., 2019).

The actions to solve the difficulties in achieving the skill of analysis and synthesis are evident in two clear orientations: (1) The leading role assumed by the student to solve their own difficulties regarding analysis and synthesis based on intensification that make comprehensive reading (Torres-Perdigón, 2017) a promoter of a critical and argumentative attitude in students (Guzmán-Simón & García-Jiménez, 2014) and the use of application portals on the web for the development of the ability to analyze and synthesize (Garrido et al., 2019) that are part of the innovative resources; and (2) the conditions of the environment where the learning process took place, which was characterized by adequate and favorable relationships between classmates (García & Gaviria, 2021) and with the teacher (Carlín et al., 2020)

Regarding the proposals for the improvement to achieve the ability to analyze and synthesize research, three lines of action are identified: (1) institutional in nature, concerning integrating transversal learning experiences into university education that develop in students the ability to analyze and synthesize along with the reading habit. This consideration is identical to that suggested by Salamanca et al. (2020) on the need to establish systematic guidelines that mark routes for the development of skills; (2) at a particular level, in relation to incorporating participatory strategies and techniques to develop the ability to analyze and synthesize (Lluch et al., 2017) given the need to organize curricular designs aimed at developing competencies in students; and (3) personal and attitudinal, in relation to the interest or motivation that each

student must express to achieve said skill. In this regard, Virtanen & Tynjälä, (2018) consider that, to generate motivation in students, it is necessary to continue betting on those methodologies nourished by affective and motivational strategies for the student.

CONCLUSIONS

It is successfully concluded that the students have achieved the ability to carry out analysis and synthesis in the field of research. This achievement is supported by the demonstrated ability of the students to systematically apply the procedures inherent to this cognitive process. Furthermore, it was developed in a learning environment enriched by innovative and effective teaching strategies, as well as the support of both the teaching guide and the interaction between classmates, and the efficient use of technological and computer resources.

Despite the challenges faced during the process, these were addressed effectively generating valuable suggestions to improve future learning experiences. These recommendations aim to continue to strengthen these skills in the university population in teaching and research training, through programs that cover the entire training stage of the students. Likewise, it is suggested to expand exploration in the field of educational research, to continue to strengthen the fundamental skills for authentic teaching and research training.

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