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Research Article

Introduction to Research-Based Practice: A Study of Students in the Early Childhood Education Teaching Degree Programme

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Abstract

This article analyses the projects and evaluations of certain students seeking a degree in Early Childhood Education regarding research-based practice. Three academic years are studied using different students each year and different databases and scientific resources. In the final year, problem-based learning (PBL) is introduced to offer a more practical and professional context. The data are collected yearly through a quantitative and qualitative study of the students' projects and a student-completed survey. The results differ depending on the databases used, the resources selected and the methodology used to start the task, among other factors. Four scales are categorized: usefulness, learning, interest and difficulty. In general, the results improve year over year, highlighting the very high perceived usefulness of research for future professionals and a high degree of learning about searching for and understanding certain research resources. Issues such as the influence of research-based practice on the continuous training of students and future teachers, the advantages and difficulties, the importance of active learning methodologies, the need to understand research topics and the implications in the educational context are presented and discussed.

Keywords: mathematics education, research training for teachers, preservice teacher education, active learning, continuous learning

1. Introduction

Research-based practice (RBP) is contextualized within the broad concept of research-based learning, which is characterized as active and experimental learning, is applied in multiple areas of higher education and seeks to reduce the separation between teaching and research (Westwell & Ingle, 2019). Minner, Levy, and Century (2010) define it as a set of student-centred approaches that are driven by research regarding learning and teaching. This vision of teaching is based on the main idea that research and activities related to it are beneficial for the development of students' cognition, skills and attitudes (van der Rijst, 2017).

This article explores the opinions and work regarding research of a group of students in early

childhood education. Consequently, the introduction of issues related to research and good practices in the early childhood education classroom is analysed to enrich the students' future work. Considering the mentioned characteristics of the RBP, it is pertinent to relate it to continuous training, lifelong learning and active learning methodologies, among other issues.

1.1 Continuing Education for Teachers

In 1999, the basis for the creation and implementation of the European Higher Education Area (EHEA) was established. Based on these reforms, competence in research (or research-based education) among education students has received growing interest from educators of future teachers, researchers in education, educational policymakers and international organizations. This interest is based on the assumption that research is a means to improve teacher training (Agud & Ion, 2019).

This competence in research among students in teacher education programmes is contextualized as the constant need to update knowledge and engage in continuous learning; ultimately, it emphasizes that in future work scenarios, workers will need analytical and research-oriented skills and therefore should be able to research and evaluate the validity of information and its various sources (Niemi & Nevgi, 2014).

In the same vein, the European Commission (2015) produced a report that delves into the skills required for initial teacher education. The report emphasizes that the initial training of teachers is the first, most crucial stage in teaching because it shapes the knowledge, skills and mentality of future teachers, laying the foundation for successful student learning. It adds that, to consolidate, develop and share best practices, teaching should be considered a continuous lifelong learning process that begins with initial training, progresses to an induction stage during the early stages of the profession and continues during professional development.

This same report points out within the key principles for continuous training in the teaching profession that different educational agents should create opportunities and environments for professional development that is practice oriented and research based. In this way, teachers' capacity for student-centred teaching and innovation will be strengthened.

In short, it is assumed that to ensure creativity and reflection in the teaching profession, educational policies and actions must support students and teachers in applying and participating in research in both their learning and their practice. To this end, an innovative teaching and learning environment in the initial training of teachers and in schools is recommended (European Commission, 2015).

1.2 Active teaching-learning methodologies: Problem-based learning

Active teaching-learning methodologies have generated considerable interest in recent years in higher education studies focused on students (e.g., Aksit, Niemi & Nevgi, 2016) and on teachers (e.g., Dutt, Phelps & Scott, 2020). The use of active methodologies, which is considered a profound change from traditional teaching, emphasizes active and autonomous learning, the ability to create collaborative knowledge and the development of self-regulated learning based on problem solving and research, among other qualities (Aksit, Niemi & Nevgi, 2016; Niemi, Nevgi & Aksit, 2016).

One of the most commonly used active methodologies is problem-based learning (PBL). According to Savery (2006), the PBL method is a student-focused educational and curricular tool that allows students to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a previously defined problem. In line with the qualities of active methodologies, PBL is related to constructivist pedagogies (Holt-Reynolds, 2000); it uses self-directed and continuous learning to solve real-life problems in a collaborative way (Hung, Jonassen & Liu, 2008) and promotes communication to solve complex problems and adapt and innovate in response to new demands and changing circumstances (Binkley et al., 2012).

The PBL methodology is used in various areas of higher education. There are two outstanding competencies that are attributed to working with PBL at the university level: life-long learning, which has been applied in teacher training (Hemker, Prescher & Narciss, 2017), medicine (e.g., Zuberi, 2011), dentistry (e.g., Polyzois, Claffey & Mattheos, 2010), pharmacy (e.g., Kritikos et al., 2011), biology (e.g., Mierson, 1998) and engineering (e.g., Sáez de Cámara et al., 2015); and reflective practice, which has also been studied in various disciplines (e.g., Bate et al., 2014; Freeman et al., 2014; Mok, Whitehill & Dodd, 2008).

Active learning is effective for the development of professional competencies in initial teacher training, including professional education and shared problem solving (Niemi, Nevgi & Aksit, 2016; Virtanen, Niemi & Nevgi, 2017). In addition, Niemi and Nevgi (2014) associate the use of active learning methodologies with the ability to use, interpret and conduct research regarding the professional role of teachers, providing authentic learning experiences that connect knowledge creation with the teaching role. More specifically, Aditomo et al. (2013) study PBL as a valid tool to promote research-based learning.

1.3   Research-based practice in teacher education

A current trend in university education consists of proposing research-based activities for students that provide opportunities to develop essential skills for their discipline and a deeper understanding of fundamental concepts and that have the potential to be transformative experiences (van der Rijst, 2017). This aspect of research-based education is defined by Minner, Levy, and Century (2010) as a set of teaching and learning approaches driven by research and focused on students.

In the field of teacher training, this research-based educational orientation has emphasized the close connection between teachers' critical reflection on their work and their development of critical thinking; this paradigm, therefore, constructs teachers as active creators of knowledge (Niemi, and Nevgi, 2014).

The number of research-based teacher education programmes has increased since the first decade of this century. The Bologna process and initiatives of international organizations such as the Organization for Economic Cooperation and Development (OECD) have exerted strong pressure on higher education institutions in terms of addressing the relationship between teaching and research and developing strategies that meet the requirements of research-based curricula (Afdal & Spernes, 2018).

However, while some countries, such as Finland (Westbury, Hansén, Kansanen & Björkvist, 2005) and Norway (Afdal & Spernes, 2018), have a long tradition of research related to teaching practice, in others, the application of this approach is uneven. In countries such as Canada, the United States, Great Britain and the Netherlands, the extent to which research and teaching are interrelated depends on the methodology used in each education programme (Vrijnsen-de Corte, den Brok, Kamp & Bergen, 2013). According to Gleeson, Sugrue & O'Flaherty (2017), in England, the United States, the Netherlands and Hong Kong, initial teacher education is market driven. In this new way of conceiving the profession, decisions about what and how to teach and evaluate are largely made away from the classroom and without teachers.

In line with the differences mentioned, although the European Union (2015) recommends that all of its members states use research to improve initial teacher training, tensions have been detected between legal reforms of education that include research as part of teaching, the current capacities of teachers, and their practical and technical concerns regarding the "new professionalism" (Gleeson, Sugrue & O'Flaherty, 2017). Similarly, friction has been detected between teachers and education law in terms of whether practice-based research can be implemented, whether it amounts to quality research, and whether teachers lose independence due to the external control of the administration (Mausethagen & Granlund, 2012).

In the specific field of research practice in the early childhood classroom, there is controversy about its advantages and disadvantages. Afdal & Spernes (2018) describe the design of this type of

instruction as a "complex process". Previous research highlights that teacher students value research experience, learn analytically, and develop skills for the 21st century (Niemi & Nevgi, 2014). Similarly, Westbury et al. (2005) appreciate decision-making and rational arguments in continuing education, while Jyrhämä et al. (2008) consider research-based education as the basis for teacher training. Byman et al. (2009) report that early childhood education students appreciate this methodology, and Krokfors et al. (2011) present the perspectives of university professors involved in teaching it.

Among the problems that have been identified is that the research-related education of future teachers is more ideological than practical and therefore pertains more to educational policies and the university and less to schools (Säntti, Puustinen & Salminen, 2018). Afdal (2017) indicates that teacher education that is research-based goes beyond the criteria of the scientific community and is related to a broader set of social, professional and institutional activities. From another point of view, Puustinen, Säntti, Koski & Tammi (2018) report that some students perceive that research is not connected with teaching practice. Another sample of students indicated that research is frustrating and stressful, and few of these students hoped to conduct research in their professional careers (van Katwijk, Berry, Jansen & van Veen, 2019).

In line with the preceding information, the objective of this study is to understand the perceptions of future early childhood education teachers regarding the usefulness of research in their area of study and their interest in applying it in their future teaching practice. The amount of information acquired, the difficulty of acquiring it and the relevance of using an active methodology, such as PBL, are also analysed.

2. Method

2.1 Participants

The study is carried out with students in the third year of the early childhood education teaching degree programme who were taking the "Mathematical thinking and its didactics" course at the Faculty of Education and Sports (UPV/EHU- University of the Basque Country) in Vitoria-Gasteiz (Basque Country). This subject is compulsory, consists of six ECTS credits and is the only one related to mathematics for the entire degree. Other than the final thesis project (FTP), there are no courses in the degree programme specifically related to education research.

Data from three consecutive academic years are analysed (see Table 1). It is important to note that a new group of students takes the course each year.

2.2 Study design

For the three academic years analysed in this research, the following stages are followed:

1. First, the students are expected to learn to use different research databases (see Table 1). The training on the use of these databases consists of analysing and comparing each database's resources and search tools. Special emphasis is placed on the usual structure of research articles: introduction, objectives, methodology, results, discussion and bibliographic references.
   This work takes place in the computer room and involves various exercises in which students use the databases and study their academic and research resources (4 teaching hours).
2. Next, the students are organised in groups of 3 or 4, each of which is assigned one of the following topics: patterns, classifications, games, technology, counting, numbers, spatial thinking and magnitude measurement. Topics are removed or added according to the number of groups so that no two groups are working on the same topic. The proposed topics are in line with the mathematical content proposed in the course.
3. The objective of the project is determined: with the topic defined, each group must search

for an academic or research article in the previously studied databases. The students are strongly encouraged to select an article that addresses a practical issue that can be useful in professional practice. The students are given eight weeks to search for the article, summarize it in writing and present it to the class (using PowerPoint).

The weight of the project in the final evaluation is 1 or 1.5 points out of 10, depending on the academic year. Projects are evaluated according to whether the chosen article has the usual structure of a research text, the adequacy of the contents with respect to the assigned topic, the coherence of the written summary with respect to the chosen article and, finally, the clarity of the oral presentation.

Table 1. Participants and databases studied by academic year

	n	No. of projects	WoS	Scopus	Dialnet	Google Scholar	Google	Other
2017/2018	57	18	√	√	√			
2018/2019	64	20	√	√				
2019/2020	56	16			√	√	√	√

Note: WoS = Web of Science

In addition to the previous stages, in the last academic year analysed, 2019-2020, the following scenario and triggering question in PBL is proposed at the beginning of the project:

"It is the first opportunity that Nagore has to practice as an early childhood education teacher, and she will be in a classroom of 18 students aged 5-6 years throughout the whole course.

In her classroom, there is a math area, and she is beginning to gain confidence with the use of materials; it helps her to remember what she learned in the degree programme and consult her notes from the university. She thinks of activities in the developmental order that she believes applies to her students and relates them to the associated mathematical content. However, there are certain materials that fail to engage her students regardless of how much she tries to explain their use and propose activities.

She consults the other early childhood teachers at her school, but they have little experience and do not give advice. One of them suggests a material, but it does not seem appropriate to Nagore because it is completely worksheet based.

This situation worries her because there is an important topic in mathematics that she believes she will not be able to work on. What can Nagore do? "

After the problem is presented, the students brainstorm to solve it. The answers are diverse; one of them is that Nagore, the teacher who is the protagonist of the problem, can search for information through different sources, including scientific research databases. This conclusion begins the search for resources in the corresponding databases. The objective is for each group to solve the problem based on their assigned topic.

Additionally, as a novelty, during the 2019-2020 academic year, the puzzle methodology is used to study the application and contents of the four databases studied. The method involves groups of four students who complete the following stages: 1) each member of the group studies a database; 2) students break into groups according to which database they studied and share what they learned (one group for each database); 3) students return to their original groups, and each "expert" shares what he or she learned about the database he/she was assigned. Finally, what was learned is shared with the entire class.

2.3 Measurement instruments

Both quantitative and qualitative data are collected for the three academic years studied. Quantitative data are collected through an anonymous personal survey with responses on a 5-point

Likert scale (from 1: strongly disagree to 5: strongly agree). The items are categorized into four scales:

1) Usefulness: The students are asked to evaluate the usefulness of the databases for mathematics teaching in early childhood education, for future professional use and for the FTP.

2) Learning: The students are asked to assess what they learned about the databases studied in each academic year. For the last year analysed, students are asked about the influence of PBL the knowledge they obtained.

3) Interest: The students are asked about their interest in the mathematical topics considered in the project.

4) Difficulty: The students are asked about the difficulty of searching for resources in the proposed databases and understanding their content.

Qualitative data are collected through an analysis of the responses to open-ended questions in the survey and of the content of the students' completed projects.

The surveys are administered after the written and oral work for the course is completed.

3. Results

The results obtained for each of the three academic years studied are presented and compared below.

1. Academic year 2017/2018

3.1 Quantitative results of the survey

For the first academic year of the study, 2017/2018, the WoS, Scopus and Dialnet databases are studied. Dialnet is one of the largest bibliographic portals in the world, and its main task is to give greater visibility to the Hispanic scientific literature (Dialnet, 2020). This decision is made by teachers based on the database's offering of a diverse research overview of resources, search tools and languages.

The mean ratings and standard deviations of the survey items for this academic year are shown in Table 2. A total of 47 surveys were collected.

Table 2. Means and standard deviations of the survey items for the academic year 2017/2018 (n = 47).

Scales	Items	M (SD)
Usefulness		
	I believe that knowing how databases are used can be useful for learning mathematics for ECE.	3.57 (.80)
Learning		
	I have learned to use databases for research articles.	3.08 (.84)
	Knowing about research studies is interesting for learning about mathematics in ECE.	3.60 (.90)
Interest		
	The topic that was given to us is interesting for learning about mathematics in ECE.	3.97 (.89)
	The topic that was given to the other groups is interesting for learning mathematics for ECE.	3.77 (.75)
Difficulty		
	It has been difficult to find research articles.	3.58 (.77)

Note: ECE = Early childhood education

The belief in the usefulness of databases has a high score (between 3.5 and 4); it should be remembered that the ratings are given on a scale of 1 to 5 points. Similar high ratings were given to the knowledge gained from research articles about mathematics teaching in early childhood education and for the students' interest in the mathematical topics proposed (for both the students' group and the other groups). Similarly, the difficulty of finding articles receives high ratings. On the

other hand, the learning achieved with regard to the use of databases receives a moderate rating (between 3 and 3.5).

No open-ended questions are asked.

3.2 Results of the projects

A total of 18 projects were completed. Of the three databases, only one project analyses a resource extracted from Scopus; the other projects are based on resources obtained Dialnet. No projects were based on information from WoS.

Of the 18 resources, 11 are either review articles or do not present results or conclusions; this is the case for several conference proceedings. Of the remaining 7 resources, 3 do not clearly present the usual structure of a research article in the required summary of the resource or in the oral presentation. Therefore, only 4 resources qualify as complete research.

2. Academic year 2018/2019

3.3 Quantitative and qualitative results of the survey

In view of the projects done the previous year, in the academic year 2018/2019, the teacher decided to limit the databases to WoS and Scopus to encourage the students to choose research articles that reflect empirical studies and avoid other resources and to ensure that the students are aware of and use these two international databases.

The average ratings and standard deviations of the survey items for this academic year are shown in Table 3. A total of 48 surveys are collected.

Table 3. Means and standard deviations of items for the academic year 2018/2019 (n = 48)

Scales	Items	M (SD)
Usefulness		
	I believe that knowing how databases are used can be useful for the FTP.	4.00 (.93)
	I believe that knowing how databases are used can be useful for learning mathematics for ECE.	3.45 (.90)
	I think that knowing how databases are used can be useful for when I am an ECE teacher. Why?	3.68 (.84)
	I think I can use this type of research work when I'm an ECE teacher.	3.64 (.79)
Learning		
	I have learned to use databases for research articles.	3.36 (.94)
Interest		
	The topic that we were given is interesting for learning about mathematics for ECE.	3.85 (.83)
	The topics that were given to the other groups are interesting for learning about mathematics for ECE.	3.81 (.77)
Difficulty		
	It was difficult to find research articles. If yes, why?	4.02 (.99)
	It was difficult to understand the research articles. If yes, why?	3.68 (.91)

Note: ECE = Early childhood education

The students indicate that searching for resources in the two databases is highly valuable for both learning and for their future use as early childhood education teachers; the very high score given for the usefulness of research for the FTP (≥ 4) stands out. Regarding the proposed topics in mathematics, the students also report that they are of high interest. Finally, the participants indicate a high degree of difficulty with finding and understanding research articles.

This academic year, the survey includes open-ended questions. In the case of item 3 (see Table 3), the responses highlight the usefulness of databases for future teaching in terms of offering tools for continuous training, proposing activities, providing new ideas for teaching and providing reliable information and significance. The open-ended answers regarding difficulty in items 8 and 9 indicate that finding and understanding resources is difficult because the texts are very technical and are written in English and because there are few resources related to ECE.

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3.4 Qualitative results of the projects

A total of 20 projects are carried out; 18 of them present research results and conclusions. Of these 18, 8 do not present clear data in the abstract or the presentation, 3 do not offer complete data, and 4 are not related to the topic assigned to the group. According to these data, only 3 projects meet all the requirements proposed at the beginning of the course.

3. **Academic year 2019/2020**

3.5 Quantitative and qualitative results of the survey

In the last academic year analysed, four databases are proposed: Dialnet, Google Scholar, Google and the database of the University of the Basque Country (UPV/EHU, 2020). The professor's decision is based on the technical and language difficulties of finding research resources using the WoS and Scopus databases that arose the previous year. In accordance with the proposed PBL (see Methods), open-access databases are proposed that the students can consult in their future teaching practice outside the university.

The means and standard deviations of the survey items for the academic year 2019/2020 are shown in Table 4. A total of 47 surveys are collected.

Table 4. Means and standard deviations of items for the academic year 2019/2020 (n = 47)

Scales	Items	M (SD)
Usefulness		
	I believe that knowing how databases are used can be useful for completing the FTP in the next course.	4.41 (.62)
	I believe that knowing how databases are used can be useful for learning this and other subjects.	4.30 (.72)
	I think that knowing how databases are used could be useful when I am an ECE teacher. Why?	4.28 (.75)
	I think I can use this type of resource when I become an ECE teacher.	4.06 (.77)
Learning		
	I have learned to differentiate among resources and to search for them in different databases.	4.00 (.82)
	I have learned what a research article is.	3.76 (.82)
	I have learned to use some databases to consult different resources.	3.85 (.76)
PBL		
	The initial problem in the ECE classroom was adequate to give the project context.	3.80 (.78)
	The initial instruction methodology (puzzle methodology) about using databases was adequate.	3.54 (.66)
Interest		
	The topic that was given to us and the resources our group chose were adequate to solve the initial problem.	3.91 (.81)
	The topics and resources chosen by the other groups were adequate to solve the initial problem.	3.59 (.65)
Difficulty		
	It was difficult to find resources. If yes, why?	3.22 (1.11)
	It was difficult to understand the research articles. If yes, why?	2.53 (1.00)

Note: ECE = Early childhood education

The means show that in the usefulness scale, all items score very high. The instruction is highly valued, both in terms of databases and resources presented and the PBL and puzzle methodologies. Similarly, the interest in the topics is high. Finally, the difficulty of finding resources is moderate, and the difficulty of understanding resources is moderately low (≤3).

This academic year, open-ended questions are also asked. For item 3 (see Table 4), the answers indicate, in essence, that the usefulness of research would materialize in 1) the ability to search for different teaching resources in known and reliable databases and 2) the ability to find new ideas to apply in the classroom. Regarding the difficulty measured by the qualitative aspects of items 12 and 13, the following stand out: 1) there are too many invalid resources related to the PBL; 2) the texts are too technical; and 3) there are few resources related to ECE.

3.6   Qualitative results of the projects

There are 16 projects; 12 use a resource that complies with the structure of a research article. In 11 of the 16 projects, the chosen resource is justified with arguments (therefore, in 5, it is not). The students are also asked to justify their reasons for rejecting the other 3 resources; 8 projects do so, and 8 do not.

4.   Comparison among academic years

3.7   Comparison of quantitative and qualitative survey results

The means and standard deviations of the four scales analysed in the three academic years are shown in Table 5:

Table 5. Means and standard deviations of scales by academic year

	Usefulness	Learning	Interest	Difficulty
	M (SD)	M (SD)	M (SD)	M (SD)
2017/2018 (n = 47)	3.57 (.80)	3.35 (.91)	3.93 (.83)	3.58 (.77)
2018/2019 (n = 48)	3.70 (.87)	3.36 (.94)	3.83 (.79)	3.84 (.97)
2019/2020 (n = 47)	4.27 (.72)	3.75 (.77)	3.75 (.75)	2.87 (1.11)

The data show that the perceived usefulness progresses from high in the first two years to very high in the third; learning follows the same trend, but ranges from moderate to high. Interest remains high in the three years. Finally, difficulty increases from the first year to the second, being moderate in both years, and decreases to moderately low in the third year. It is important to note the similarity of the means for the first two years (with an increase in difficulty in the second year) and the change in the third year (when usefulness and learning increase and difficulty decreases). There is also an increase in the future usefulness of the information for the FTP from the second to the third year. It is worth remembering that the third year introduces the project with PBL and provides instruction about the databases through the puzzle methodology, in addition to discarding the Scopus and WoS databases and introducing others.

Regarding the answers to the open-ended questions posed in the 2018/2019 and 2019/2020 academic years, the students' responses regarding the future usefulness the databases are very similar for both years. Regarding the difficulty of understanding the research resources, the students agree that they are very technical texts; in 2018/2019, the students report that the language (English) added difficulty. Regarding the difficulty of finding resources, in 2018/2019, the students note there are few resources for ECE in the databases used, while in 2019/2020, they indicate there are many invalid resources for resolving the proposed PBL.

3.8   Comparison of the qualitative results of the projects

From the first to the second year, there is an increase in projects that select resources with the structure of a research article; however, this does not translate into a significant number of clear or well-explained resources. In the last year, although there is a small decrease in the total number of projects based on a resource with an appropriate structure, the selected resources are better justified and are closer to meeting the objective of being useful for teaching practice in early childhood education (the objective proposed in the PBL).

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4. Discussion

The main objective of this study is for students in early childhood education to be aware of and value research published in different databases and to use it in their future work as professional teachers. Based on this purpose, the teacher changes both the databases and the methodology of the proposed project based on student feedback and projects from previous years. Taking into account these changes and the results obtained, it is convenient to review and discuss the project's usefulness, interest, learning and difficulty.

One aspect studied in the usefulness scale is the future use of databases for the completion of the FTP, which is highly valued by students. Previous research agrees on the importance of research resource search competencies for the FTP (Paipare, Enģele & Blauzde, 2018; San Pedro, López & Suárez, 2018; Toom et al., 2010). Other authors emphasize the need for good knowledge of information and computer technology (Faura-Martínez, Martín-Castejón & Lafuente-Lechuga, 2017), the effective use of information resources (Olmedo-Torre, Martínez, Perez-Poch & García, 2018) and the correct use of databases (Berns, Palomo Duarte, Calderón Márquez & Dodero, 2018; Moreno & Martín, 2018) when preparing the FTP.

Another result to be analysed is the students' interest in the proposed research topics, which are directly related to the teaching of mathematics in early childhood education (ECE). Although there are few previous studies that address this issue, Pérez-Tyteca & Monge (2013) warn of the lack of knowledge among future teachers regarding research topics in early childhood mathematics education. Therefore, the positive responses to the proposed topics in the present study indicate that such topic can help orient students in their search for specific research resources.

According to some studies, the difficulty of understanding research topics is combined with problems associated with the incorrect use of databases. Among active teachers, little dissemination, consultation and discussion of education research is detected (Crook & Gu, 2019). Active teachers also show a lack of attention to learning to search the web (Kao, 2016) and a tendency to acquire resources quickly and easily at university libraries (Cameron & Conroy, 2019). Similarly, among teachers in training, reports indicate the use of technology with little focus on students (McGarr & Gallchirir, 2020), resistance to the use of technology in teaching (Laffey, 2004) and little use of information and computer technology tools for educational purposes (Cózar-Gutiérrez, De Moya-Martínez, Hernández-Bravo & Hernández-Bravo, 2016; Prendes, Castañeda & Gutiérrez, 2010). Consequently, the data obtained in this study indicate a move in the right direction since year after year, the students indicate greater perceived learning regarding the use of databases and understanding research articles.

In line with the search for resources, it is convenient to analyse the yearly changes in the course's focus on the awareness and use of databases, which yield conflicting results. The first change, the exclusive use of WoS and Scopus in the academic year 2018/2019, improves the quality of the research resources that the students select but hinders both technical and language comprehension. The second and last change, the use of only open access bases, promotes the selection of better resources, better-justified choices and less difficulty but reduces the range of resources; additionally, the students state that many of the articles consulted do not respond to the problem posed.

Therefore, the effect of the active PBL methodology used in the final year is noteworthy. It intends to place students in a context of educational practice and encourage them to propose a solution supported by research. The improvement results from greater awareness of research as a useful didactic resource; hence the substantial rise in the usefulness scale scores. Similarly, there is an increase in learning, which is driven by the active methodology and translates into better knowledge of the resources and the databases used.

According to these data, it can be considered that in the third year of study, in which PBL is introduced, the students' performance on their projects improves. This result coincides with numerous studies that affirm that active methodologies, including PBL, positively influence school

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performance in various fields in higher education (e.g., Freeman et al., 2014). In the particular case of teacher training, active learning has become an important topic at the international level in relation to professional development (Niemi, Nevgi & Aksit, 2016) and the improving teachers' performance competencies (Virtanen, Niemi & Nevgi, 2017).

In addition, based on the results of the surveys conducted for this study, the perceived usefulness and interest was highest for the course that included PBL. This change is compatible with the statement that the reinforcement of active learning leads to greater motivation to develop professional skills in the context of initial teacher training (Virtanen, Niemi & Nevgi, 2017). Specifically, PBL makes learning more meaningful by promoting better integration of theory and practice (Mok, Whitehill & Dodd, 2008; Savery, 2006), and the reflective use of this practice can help develop the attitudes and characteristics expected of them (Bate et al., 2014; Darling-Hammond, 2006). Finally, the PBL methodology predisposes students toward continuous training through lifelong learning linked to problem solving (Darling-Hammond, 2006; Hung et al., 2008) and promotes the ability to adapt and innovate in response to new demands (Binkley et al., 2012).

The change in methodology proposed through the use of PBL in the present study aims to deepen students' familiarity with the research to help them in their future teaching. This approach to seeking and using scientific resources is the essential objective of this report. Previous research focuses on the importance of reading for integrating research-based knowledge with teacher education (Afdal & Spernes 2018; van Ingen & Ariew, 2015), and reading is particularly effective when the texts focus on empirical research since it allows students to explore professional problems analytically. Specifically, in early childhood education degree programmes, both teachers and students positively value research-based literature as a means of learning to rethink previous opinions about school and teaching (Alvunger & Wahlström, 2018). Mausethagen & Granlund (2012) warn of the need to differentiate between good and bad research and how this distinction can enable the implementation of published experiences. There are also shortcomings in discussions between teacher educators and students regarding research reading, particularly when texts are not addressed in the context of RBP and instead focus exclusively on the research project (Brew & Saunders, 2020; Munthe & Rogne, 2015).

Another issue to debate is the relationship between theory and practice in initial teacher training and the research methods proposed in this training. The European Commission (2015) states that learning from theory is often limited after the initial teacher training period and recommends combining theoretical ideas and research results to help develop reflective teaching. Johansson, Sandberg & Vuorinen (2007) analyse this issue among preschool teachers to meet the demand for a better quality of service and focus on ways to connect the development of knowledge from research with knowledge generated in professional practice. For Flores (2018), it is necessary to challenge the binary concept of theory and practice by combining teaching and teaching research. This implies a need to advance the vision of teaching to encompass practising as a process of adapting or applying theory (Flores 2016). Hennissen, Beckers & Moerkerke (2017) confirm these needs by affirming that students in early education experience a reasonably strong link between practice and theory within their study programmes.

However, this union between theory and practice is unstable. Puustinen et al. (2018) observe that theory is neither justified nor connected with practice in the context of research-based teacher education in Finland; in addition, they identify the need for more practical education. According to Kazu & Demiralp (2016), the Bologna Process is inadequately developed within the framework of academic activities in education programmes in Turkey. This study concludes that teacher training programmes are insufficient to improve lifelong learning competence and lack opportunities to apply learning processes in practice. Agud & Ion (2019) conclude that teacher training programmes should focus on the effective implementation of a research-based approach. The objective is to ensure a closer relationship between classroom realities and pedagogical theories and practices, thus preparing teachers in training to integrate research into their future careers.

Along the same lines, other relevant factors in education are associated with research.

Pedagogical decision-making is one competency derived from the promotion of RBP in teacher training (Byman et al., 2009), specifically when the teacher observes his or her pupils and critically analyses their teaching (Niemi, Nevgi & Aksit, 2016). Another basic skill acquired is the increased reflection on teaching practices (Johansson, Sandberg & Vuorinen, 2007) and the ability to conceptualize everyday phenomena, observe them as part of a broader educational process and justify decisions and actions based on what was done during this process (Toom et al., 2010). Likewise, the influences of teachers' beliefs and attitudes about their profession are reported. According to Lynch (2017), enabling preschool teachers to share why a practice may or may not work in their classroom helps to focus and reinforce their beliefs about professional learning. For their part, Niemi & Nevgi (2014) emphasize the attitude of thinking like a researcher, constantly trying to find new solutions and looking for new evidence to improve teachers' professional work. In line with this evidence, Aulls, Magon & Shore (2015) differentiate between research-based instruction and other instruction, pointing out that the former places students at the centre of the learning process, while the latter focuses on the teacher and the content.

Nonetheless, practice- or research-based learning is not without criticism. Munthe & Rogne (2015) found that requiring students to engage in a small project to learn about research that was unrelated to the necessary skills for teaching added to a lack of discussion of scientific literature; they recommend distinguishing between *inquiry*, which analyses scientific text, and *research*, which aims to produce and publish new information. Puustinen et al. (2018) also believe it is appropriate to make this distinction to clarify certain inconsistencies in Finnish teacher education programmes. Gleeson, Sugrue & O'Flaherty (2017) warn of the mismatch between political intentions and the real capacities of teachers to conduct research. In turn, Säntti, Puustinen & Salminen (2018) report that RBP is more often ideological and more dependent on educational policies and the university than based on the daily practice of teachers. In this sense, Mausethagen & Granlund (2012) identify tensions between educational policies and the practices of active teachers related to excessive demand and external control; Gleeson, Sugrue & O'Flaherty (2017) agree that tensions exist between the growing emphasis on research and the more practical and technical daily concerns of early childhood professionals.

In conclusion, the studies reviewed show, first of all, a great disparity among countries, faculties and even teacher educators in the academic programmes proposed for the initial training of teachers in relation to practical research. The examples of Finland, Norway and Singapore stand out as the most developed in this practice (Agud & Ion, 2019; Gleeson, Sugrue & O'Flaherty, 2017), while countries apply methodologies that are not linked to research. Certain specialized higher education centres offers even more diversity in their programmatic planning; some include a practical methodology based on research, while others do not (Agud & Ion, 2019; Vrijnsen-de Corte et al., 2013), and in some cases, the difference is based on individual teacher educators' decision to apply a research-based methodology in their courses (Aulls, Magon & Shore, 2015). The results of the present research invite us to think that if, for any reason, the curricula do not consider teaching practices based on research, the introduction of these techniques will offer present-day students tools to enrich their ability to engage in ongoing learning in their future teaching practice.

Second, we want to highlight the professional usefulness of reviewing scientific articles related to good practices in the ECE classroom. This competence can allow greater reflection and teacher involvement and can stimulate motivation and continuous improvement. Faced with the debate on whether education is an field in which evidence-based practice can be applied as it is in other professional fields (Slavin, 2008), we agree that educational knowledge must be understood as non-static and influenced by context, an idea that takes into account the limits of knowledge and the nature of social interaction (Biesta, 2010; Gang Zhu & Jun Xu, 2020). This complexity does not prevent enriching students through projects and practices that can be adjusted both to the personal context of the teacher and to the socio-economic and cultural context of his or her future students.

Third and last, this study has reports relevant advantages, but also significant contradictions, regarding the focus on practice and research in the initial training of teachers. We understand how costly it is to learn of and apply research findings, whether during the teaching degree programme or

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during in service teaching. However, we believe that it is worth instilling in students an understanding of the importance of extending practical knowledge and, if possible, contributing to advances in that knowledge. Toom et al. (2010) make the following statement regarding research-oriented practical education for teachers:

The aim is not to produce researchers but rather to provide students with skills and knowledge to complete their own studies, observe their pupils, and analyse their thinking. Future teachers should be able to base their pedagogical decision-making on a theoretical foundation and reflect on their work as teachers (p. 333).

To conclude, it is convenient to look at the limitations of the study. The proposed research project completed by the students in the sample is only a small introduction to the knowledge available in educational research. However, it is difficult to select appropriate databases due to their scarcity or a lack of previous research experience. Despite this, the year that the PBL was proposed, students had favourable opinions on the future usefulness of research resources, and their practical justifications and awareness that several articles did not answer the proposed problem was noteworthy. In general, more emphasis on preparation for RBP, more subjects and a larger sample are needed to obtain more accurate results; more complete instruction on this topic would provide greater competence and confidence for future teachers in research regarding teaching practice.

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