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Identifying Strengths and Weaknesses in Mobile Education: A Gender-Informed Self-Assessment of Teachers' Use of Mobile Devices

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Abstract: Mobile devices have the potential to transform education and society. Promoting mobile learning and enhancing teachers' digital and entrepreneurial skills are essential in achieving this goal. This study analyses the conditions under which the use of mobile technology can support teachers in the design, implementation, and evaluation of teaching and learning processes. Data were collected using a quantitative method based on a self-assessment instrument (Cronbach's alpha = 1.0046). A total of 327 educators filled out the survey, which included 67 items scored on a Likert scale. The self-assessment tool provided participants with feedback on their mobile device use for educational purposes and suggestions for improvement. The results indicate that the median score of the teachers was 7, which is regarded as satisfactory, with a gender gap of 3.5 points. In addition, three out of seven improvement dimensions were identified: technology learning spaces (54.74%), assessment (57.65%), and design activities (59.26%). In conclusion, the study enabled us to stratify and analyse teachers' pedagogical perceptions of mobile learning and the significance of inference in certain training areas.

Keywords: educational technology; mobile learning; teaching/learning strategies; teacher evaluation

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1. Introduction

Faced with the current educational landscape, marked by rapid technological evolution, mobile devices have consolidated as potential tools to enrich teaching and learning processes [1]. Furthermore, it is essential to recognise that contemporary education has highlighted the relevance of ICT through international reports such as the Education 2030 Agenda, Sustainable Development Goal 4, and the 2017 Quingdao Declaration. Under the Education 2030 Agenda, it is essential to bring information and communication technologies together to strengthen education systems, disseminate knowledge, facilitate access to information, and promote high-quality learning. However, despite the growing presence of mobile devices in society and in education, there is an imperative need to provide teachers with clear strategies and concrete guidelines for the effective pedagogical integration of these devices [2–4].

This research aims to analyse the conditions under which the use of mobile technology can support teachers in the design, implementation, and evaluation of teaching and learning processes. Specifically, it seeks to answer the following question of the investigation: What is the level of theoretical and practical knowledge of mobile learning perceived by the teachers themselves?

To address this issue, a self-assessment tool was developed to help teachers assess their proficiency in designing mobile device activities, focusing on the identified factors that promote their integration in the classroom: content, methodological strategies, activities, evaluation, mobile resources, technological learning spaces, and the teacher [5–9]. In this study, we present results aimed at examining and evaluating the conditions under which the use of mobile devices can support teachers in the design, implementation, and evaluation of teaching and learning processes through the self-assessment tool and analyse their use from a gender perspective.

In this framework, and to carry out the different actions of research, a collaboration was established with the teaching innovation project "PlaMòbils.edu" (Edu/1464/2019, May 27), promoted by the General Directorate for Innovation, Digitization, Study Plans, and Languages of the Department of Education of the Government of Catalonia (Spain). This three-year project sought to improve educational success by using mobile devices (these devices can include smartphones, tablets, laptops, e-readers, 'Wearables', and 'Chromebooks', among others) in the classroom.

This research participated in the second and third phases: implementation (2nd year)—finalisation of planning, follow-up, and evaluation of actions—and project finalisation (3rd year)—final evaluation and transfer. Specifically, the actions were carried out in the area of "Methodologies and resources for the improvement of teaching and learning with mobile devices" that was developed in a virtual classroom of the Campus Ágora (Moodle) for training and research actions for teachers of the Department of Education, covering the period from early childhood education to compulsory secondary education, who were enrolled in the project. The described context emphasises the significance of inter-institutional collaboration and the ongoing training of teachers, which are crucial components for ensuring research and collaboration in a real context.

2. Mobile Devices in the Educational Institutions

The use of mobile devices, such as smartphones and tablets, in educational institutions has become increasingly widespread in recent years [10–15]. These devices offer students and teachers access to a wide range of learning resources and tools and can provide a more flexible and engaging learning experience [16,17]. However, the use of mobile devices in the classroom also poses certain challenges, such as the need for schools to have a clear policy outlining their use and setting guidelines for responsible and appropriate behaviour. It is important to create clear policies for the use of mobile devices in the classroom that address teacher training and support, as this can improve the efficiency and effectiveness of using mobile devices in the classroom [18].

An effective policy should include clear rules regarding the use of mobile devices and how they should be used for educational purposes [19]. This research showed that clear policies can make using mobile devices in the classroom more efficient and effective.

The EU has published the DigComp [20] digital competence framework, which has been revised and adapted for the educational field in which it is defined as the digCompEdu, which is the framework that refers to digital teaching competence. In addition, the European Commission's [20] report, "Digital Education at Schools," highlights that many teachers still have limited knowledge on how to effectively integrate technology into teaching. Although the availability of digital resources for teaching is improving, there are still barriers to their use, such as the lack of high-speed internet access and technological devices. The report also addresses important concerns such as privacy and online security.

At a regional level, the Digital Education Plan of Catalonia (Spain) 2022–2023 [21] establishes a strategic framework for the use of information and communication technologies (ICT) in the educational system. It aims to promote digital inclusion and the development of digital competences in students, as well as to improve the training and professionalisation of teachers.

The plan includes measures for the development of technological infrastructure in schools, the integration of ICT in the curriculum, and the training of teachers in the pedagogical use of technology such as mobile devices. It also addresses the importance of security and privacy in the use of the Internet and ICT.

3. Designing Mobile-Learning Activities

This strategy encompasses initiatives for enhancing the technological infrastructure within educational institutions, incorporating information and communication technology

(ICT) into the educational syllabus, and equipping educators with the skills necessary for the effective pedagogical application of technology, specifically through mobile devices. Furthermore, it highlights the critical significance of ensuring security and privacy in the online environment and the use of ICT.

It is important to make mobile-learning activities that are both interactive and meaningful if you want to keep students interested and help them learn. A previous study has identified core elements to consider when designing mobile-learning activities [6]:

1. The content: this involves considering the intricacy of the content, ensuring it is scaffolded appropriately to cater to the diverse learning needs and technological proficiency of all students. By aligning this approach with the Technological Pedagogical Content Knowledge (TPACK) [22] framework, educators can create a balanced integration of technology, pedagogy, and content knowledge. This harmonisation is crucial for developing instructional strategies that effectively leverage technology to enhance teaching and learning, making education more accessible and inclusive.
2. Methodological strategies: innovative instructional strategies, including gamification, project-based learning, and case-based learning, serve as key elements in elevating the engagement and efficacy of mobile-learning activities. Recognising and accommodating the varied learning styles of students is paramount. By crafting activities that are tailored to meet these diverse needs, educators can ensure a more inclusive and dynamic learning experience. This approach not only enhances student motivation but also promotes a deeper understanding of the material, thereby fostering a more enriching educational environment.
3. Activities: engaging in creating activities that promote collaboration and interaction among students is crucial for enhancing engagement and motivation. The exercises should be carefully organised to not only strengthen the application of learned knowledge in real-world situations but also to progress through the many levels of Bloom's Taxonomy [23]. By following this approach, tasks can be structured to gradually push students to higher levels of thinking—first with fundamental remembering and comprehension, advancing to practical use and examination, and concluding with assessment and innovation. This method guarantees a whole educational experience that enables students to analyse content critically, utilise their knowledge in practical situations, and cultivate advanced thinking abilities, ultimately creating a meaningful and significant learning process.
4. Evaluation: a multifaceted approach to evaluation, encompassing both formative and summative assessments, alongside self-reflection and feedback from peers and instructors, facilitates a thorough understanding of the learning outcomes. This comprehensive assessment strategy not only measures the effectiveness of the learning activities but also encourages continuous improvement and adaptation, ensuring that the educational experiences are both impactful and aligned with learning objectives.
5. Technology resources: utilising technological resources like multimedia, simulations, and interactive elements can make mobile-learning activities more engaging and interactive. It is essential to consider the accessibility of these resources and ensure that they are compatible with the technological platforms utilised by students.
6. Technology learning spaces: the design of technology-based learning environments can have a significant effect on the success of mobile-learning activities. It is essential to consider the space's layout, lighting, and acoustics to ensure that it is conducive to learning and that students can interact with technology and each other effectively.
7. Teachers: the success of mobile-learning activities depends heavily on the teachers. They should be trained to utilise the technology effectively and incorporate mobile learning into their pedagogical practises. Teachers should also be able to provide students with support, such as assistance with technology and instruction on how to utilise the materials effectively.

Figure 1 shows the teaching elements of mobile learning that interrelate and constitute a learning context, taking the student into account.

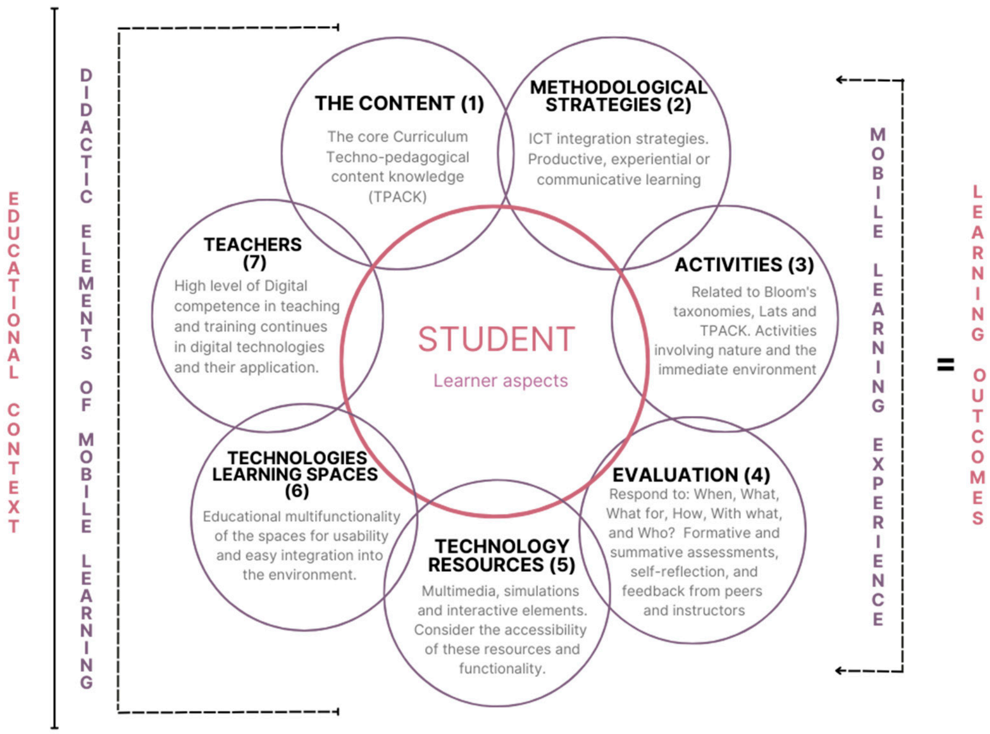

Figure 1. The core aspects of mobile learning.

For the design of mobile-learning activities, it is important that teachers are clear about all the aspects involved. Taking all these elements into account will ensure that their mobile-learning activities are effective and engaging, considering the key factors discussed in this article, such as assessment, accessibility, user experience, etc. However, mobile learning does not come without its challenges. Lack of access to technology and limited connectivity, for instance, can be a hindrance for students in rural or low-income areas. In the mobile-learning environment, the lack of privacy and security of personal information is also a major concern [14,24].

4. Method

This paper aims to analyse the conditions under which the use of mobile technology can support teachers in the design, implementation, and evaluation of teaching and learning processes. Specifically, it seeks to answer the following question of the investigation: What is the level of theoretical and practical knowledge of mobile learning perceived by the teachers themselves?

To address this issue, a self-assessment tool was developed to help teachers assess their proficiency in designing mobile device activities, focusing on the identified factors that promote their integration in the classroom: content, methodological strategies, activities, evaluation, mobile resources, technological learning spaces, and the teacher.

And if so, what is the level of teachers' own perceived theoretical–practical knowledge of mobile learning? This study was carried out under a quantitative methodology with a descriptive and inferential approach, trying to organise, synthesise, and describe all the recollected information from the self-assessment tool. Moreover, the analysis and representation of the research data aim to incorporate a gender perspective. It is currently one of the challenges in terms of gender equality policies to incorporate this perspective in the scientific field [11,12,25]. The consideration of gender perspectives in research is also essential in understanding women and men's experiences and how they interact with educational technology. The Spanish Law 3/2007 of 22 March, for effective equality of women and men, states in Article 20, "Adequacy of Statistics and Studies", that the public powers must systematically include the variable sex in the statistics, surveys, and data collection they carry out [10–13]. This legislation mandates that any research must examine the data from a gender viewpoint, thus guaranteeing that the conclusions are more comprehensive and devoid of gender bias. By following these standards, our aim is to contribute to the advancement of a comprehensive and diverse body of knowledge in the field of educational technology. Furthermore, it is crucial to acknowledge the significance of incorporating the gender variable when designing teacher training programmes and implementing instructional technologies, as these aspects differ between male and female teachers.

This study shows the results of phase 2, which is the second of three phases in the EDR method [26]. This is part of a larger study that looks at how teachers can use mobile devices to help with the design, implementation, and evaluation of E/A processes. Phase 2: In this central phase of the research, the self-assessment, usability, and practicality questionnaire was administered.

4.1. Sample

The study participants were teachers who participated in the pedagogical innovation project called "Pla Mòbils.edu" (Edu/1464/2019, May 27), promoted by the Education Department of Catalonia (Spain) [27]. The group was composed of 60 educational institutions, among them 327 teachers from Catalonia in different educational stages. The table below (Table 1) shows the frequency of participation at each educational stage.

Table 1. Educational stage of the participating teachers.

Educational Stage	Teachers (*n*)	%
Childhood Education (3–6 years)	20	6.1%
Initial cycle of Primary Education (6–8 years)	33	10.1%
Middle cycle of Primary Education (8–10 years)	37	11.3%
Upper cycle of Primary Education (10–12 years)	68	20.8%
Compulsory Secondary Education (12–16 years)	169	51.7%
Total	327	100%

The majority of teachers, 51.7%, taught in the compulsory secondary education stage (12–16 years), while the smallest number of teachers, 6.1%, taught in childhood education (3–6 years). The other stages had relatively similar representation, with 20.8% in the upper cycle of primary education (10–12 years), 11.3% in the middle cycle of primary education (8–10 years), and 10.1% in the initial cycle of primary education (6–8 years).

4.2. Data Collection Instrument

Data collection was carried out using the validated self-assessment tool [6] and was applied digitally from the project "Pla Mòbils.edu" [27] Virtual Learning Environment (Moodle). Teachers who were part of the project had automatic access to the virtual classroom. The questionnaire was designed with platform tools that allowed us to control a secure environment for both data collection and data processing (Figure 2).

Participants received specific training on digital technologies and mobile devices in education prior to the questionnaire through their enrolment in the educational program "Pla Mòbil.edu", which is based on digital resources, activities, and online seminars.

The questionnaire was divided into two parts: dimension 1 on biodata and dimension 2 on core aspects. Dimension two presented a self-assessment questionnaire consisting of 7 elements (cores aspects): (1) The Content, (2) Methodological Strategies, (3) Activities, (4) Evaluation, (5) Technology Resources, (6) Technology Learning Spaces, and (7) Teachers, with 67 items evaluated using a Likert-type scale of 4 points, 1 being "strongly disagree" and 4 being "strongly agree".

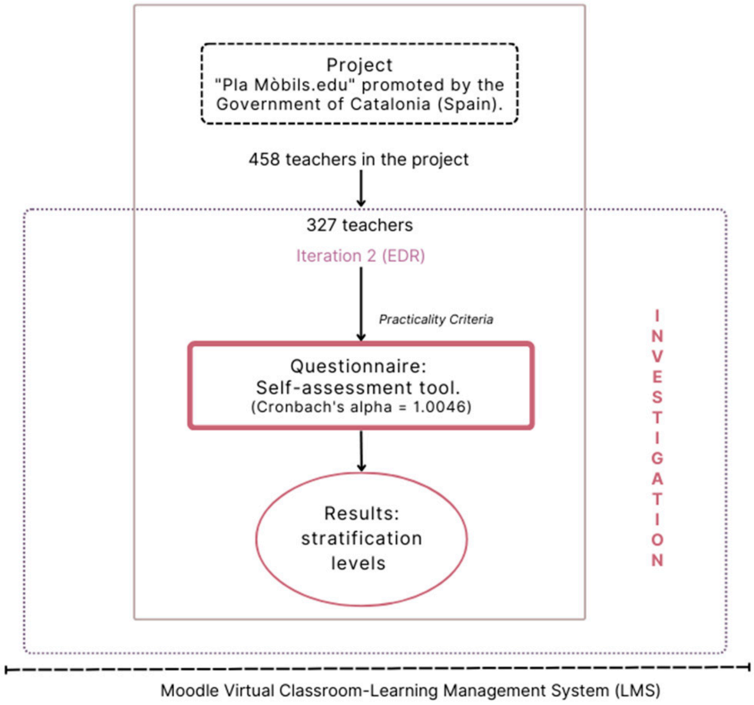

Figure 2. Data collection process.

At the end of the questionnaire, teachers were given a score based on their knowledge on how mobile devices can help them plan, carry out, and evaluate teaching and learning processes (Table 2), as well as feedback based on their scores. This feedback provided them with specific educational resources to improve their pedagogical knowledge.

Table 2. Relation of levels and scores that can be obtained from self-assessment tool.

Type	% Scores	Level
Beginner	0 < 20%	Level 1
Medium	20 < 40%	Level 2
Advanced	40 < 70%	Level 3
Expert	70 < 100%	Level 4

The interaction data from the questionnaire were first analysed with Moodle statistical analysis, and then they were put through the SPPS programme (Statistical Package for the Social Sciences).

5. Results

5.1. Dimension 1: Biodata

The data from the descriptive and inferential analyses of the participants teachers considering the moderating variable of gender are presented below. The goal is to demonstrate the existence or absence of significant differences in order to make future research and gender-specific strategic decisions. This study counted a sample of 327 participants, 34.25% male and 65.75% female. Figure 3 shows the distribution of gender according to teachers' educational stages.

Most of the participants were women, and they outnumbered men in all educational stages. We can also see that in the early stages, women outnumbered men three to one and are thus more visible. On the other hand, male representation increases at the compulsory secondary education stage, but still, women represent 30% more than men.

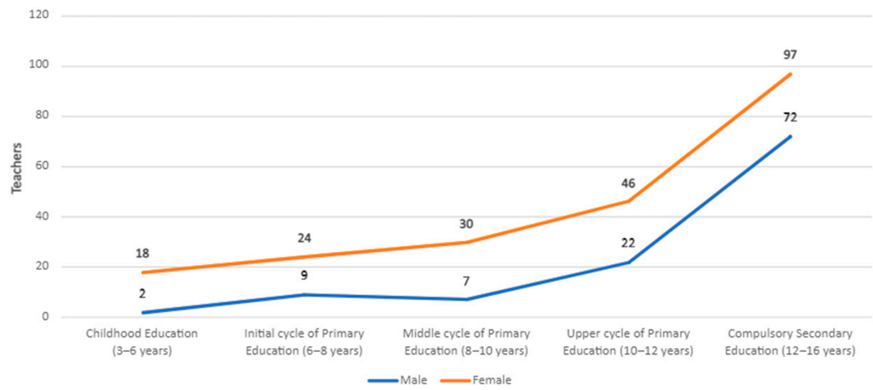

Figure 3. Comparison plot of gender and educational stage.

In Figure 4, we can observe the school subjects taught by the teachers participating in the study. The three most prominent subjects were (1) mathematics (94%), Catalan (87%), and Spanish (76%). Following were "culture and values", "art", and "natural sciences", with less than 35% of remaining subjects technological. It can be said that teachers teach one or more subjects simultaneously, so the percentages are more evenly distributed.

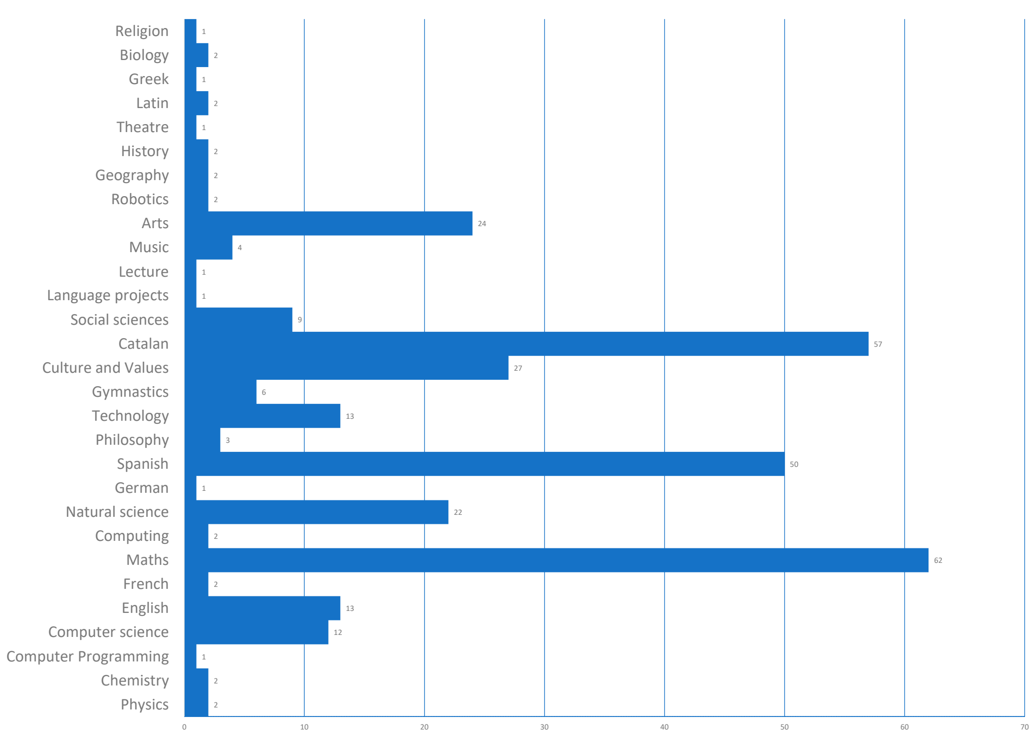

Figure 4. Subjects of participating teachers.

As for the gender distribution of the school subjects (Figure 5), this is notable in subjects dominated more by male (m) than by female (f) teachers: (1) Computing (m = 100% < f = 0%); (2) Computing programming (m = 80% < f = 20%); (3) Physics (m = 72% < f = 28%); and (4) Chemistry (m = 70% < f = 30%). On the other hand, female sex predominated in the following subjects: (1) Art (f = 90% < m = 10%); (2) Catalan, Spanish, and English (f = 80% > m = 20%); (3) Maths (f = 80 < m = 20%); and (4) Culture and Values (f = 80% < m = 20%). Gender representation was balanced in the following subjects: (1) Technology, 50% (male) = 50% (female); and (2) Robotics, 40% (male) > 60% (female).

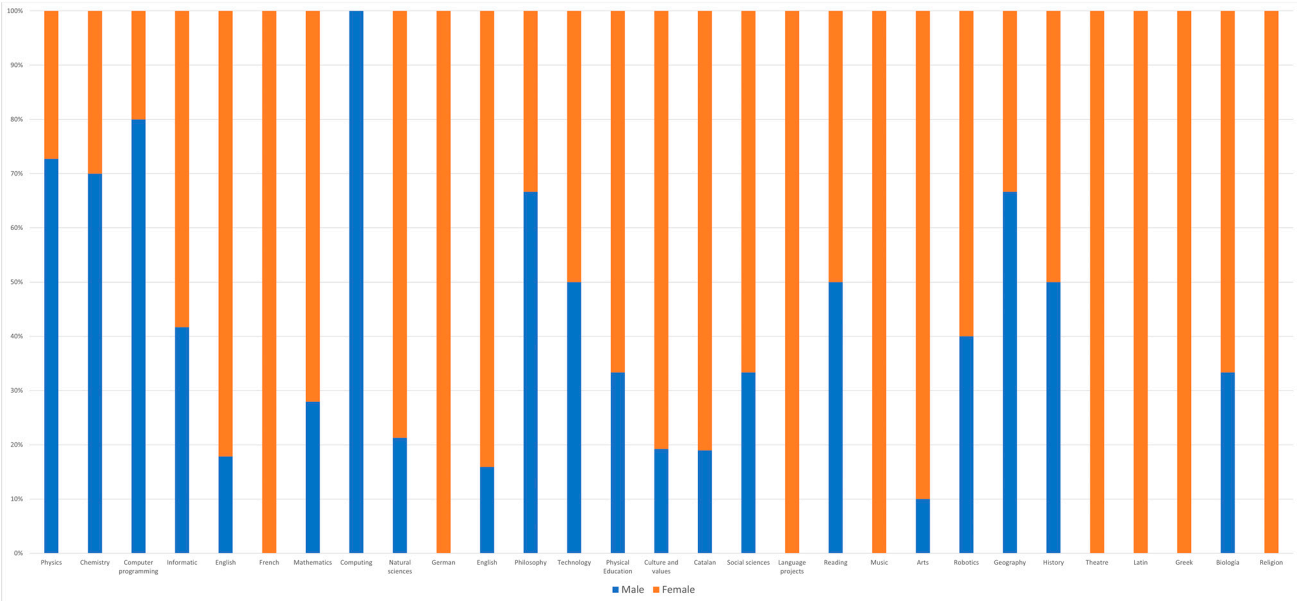

Figure 5. Subjects and gender of participating teachers.

In contrast to the humanities, which typically do not exceed 20%, it is apparent from the subjects of the technological branch that men teach them more frequently than women.

Regarding the frequency of use of mobile devices (Figure 6) as part of their teaching practices, 42.86% of the participants used them occasionally, 30.83% used them frequently, and 25.94% used them very frequently. Only 0.38% of the participants never used mobile devices in their teaching practices.

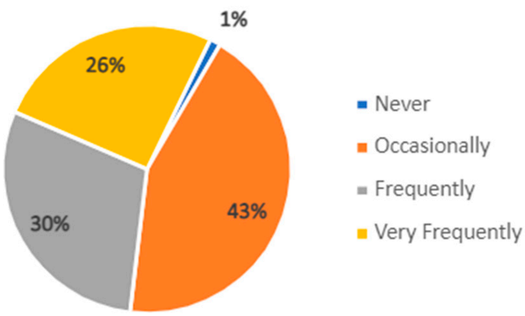

Figure 6. The frequency of using mobile devices in the classroom for educational activities.

Our data indicate that mobile devices are being used in the participants' educational context, not as a highly frequent activity, but on an occasional basis. Figure 7 shows how often mobile devices are used in the classroom.

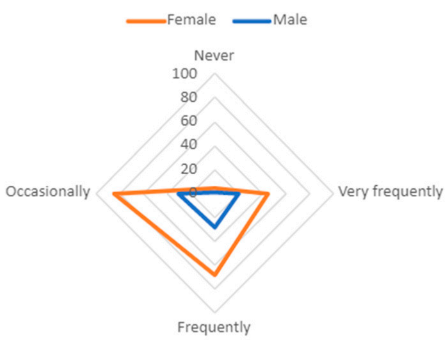

Figure 7. Frequency of use of mobile devices in the classroom by gender.

Although we can highlight that there is a higher percentage in "occasionally" (85% female, 31% male) and in "frequently" (68% female, <28% male), this is due to the high female participation, specifically 31.5% more.

5.2. Dimension 2: Content Results

The following are the results of the second dimension, which analyses the level of knowledge and use of mobile devices in education. This dimension of the self-assessment questionnaire comprises seven elements: (1) The Content; (2) Methodological Strategies; (3) Activities; (4) Evaluation; (5) Technology Resources; (6) Technology Spaces; and (7) The Teachers.

The data are presented by comparing the averages according to gender and educational stage moderators to establish whether there are significant differences found from the statistical analysis. The arrangement of the data ranges from the general scores of the tool's results to the specifications of each of the 67 items comprising the set of the seven key elements.

Table 3 shows the general median (M) of the group of teachers (n = 327), indicating a medium–advanced level of mobile device use in education. The reliability is also identified in the internal consistency, as the partial averages obtained with the different items are consistent with each other; see 1.004 (α). As for the score and the ratio of the levels, in ascending order, 2.96% obtained the middle level, 62.71% the advanced level, and 34.32% the expert level.

Table 3. Global punctuation of teacher self-assessment.

Teachers	M	Mo	σ2	S	Q1	Q3	g2	α
n = 327	7	7	1.865	1.365	6	8	0.061	1.004

The box diagram (Figure 8) allows us to visualise and compare the distribution and central trend of the numerical values of the scores (levels obtained) of teachers through their quarters. The interquartile range (IQR) is 65–77% relative to the global median.

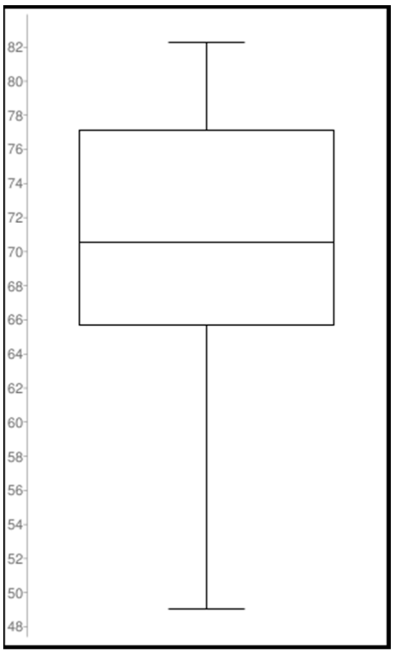

Figure 8. Statistics for the positions of the questionnaire elements.

Table 4 shows the scores obtained in the questionnaire for the seven elements, as can be observed. The Cronbach's Alpha of each element is above 80%, which means that the self-assessment questionnaire blocks have a high level of reliability and, therefore, indicate that the scores received can be used to rank teachers by levels in a consistent manner. Because there are more data values near the average and fewer values in the queues, negative kurtosis is placticurtic.

Table 4. Analysis and ratings of the seven elements of the self-assessment questionnaire.

Teachers	M	σ2	FI	σ	DI	Q3DE
(1) Content	7.75	3.803	78.78%	17.42%	53.40%	62.74%
(2) Methodical Strategies	7.42	4.442	69.80%	19.74%	64.68%	71.10%
(3) Activities	6.83	4.939	66.74%	22.27%	69.63%	75.04%
(4) Evaluation	6.40	5.277	63.41%	22.24%	65.46%	71.56%
(5) Mobile Resources	7.44	4.357	73.52%	21.52%	62.26%	69.48%
(6) Technological Learning Spaces	6.85	5.285	66.31%	23.47%	65.11%	70.25%
(7) Teachers	7.48	4.136	74.78%	20.92%	62.56%	69.78%

In relation to the seven core elements, it can be observed (Table 4) that a Facility Index (FI) between 66 and 80% is fairly easy, showing that teachers have a good understanding of the key ideas that are at the heart of the questions. The Discrimination Index (DI) is greater than 50%, indicating a strong correlation between the scores of the seven elements and the overall test scores. The items with a higher score are as follows: (1) Content 7.75 (M), (2) Teachers 7.48 (7.48), and (3) Mobile Resources 7.44 (M). The elements that show the lowest scores, meaning that teachers have had a more negative perspective on their educational capacity, are as follows: (1) Evaluation 6.40 (M); (2) Activities 6.83 (M) and (3) Technological Learning spaces 6.85 (M). These three elements in turn have variance (V) values that are closer to the median, making them more representative. The dispersion (SD) of the scores with respect to the median is around 20%, a low value, indicating that the answers are close to the median, and in the same way, the discriminative efficiency (DE) (+20%) indicates that the responses of teachers are within the pattern.

In relation to the general scores obtained in Figure 9, the comparison between the educational stages and the median of teachers is shown.

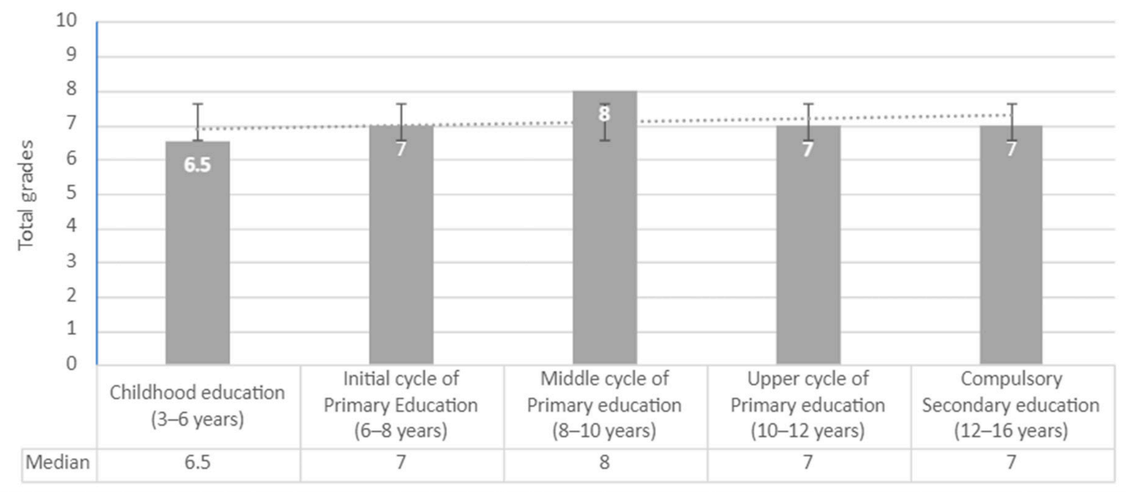

Figure 9. Plot of total grades and educational stages.

The stage with the highest score, meaning that teachers have a positive self-perception of their knowledge, is the middle cycle of primary education (8–10 years) with a median of 8, and the educational level with lowest score is childhood education (3–6 years) with a median of 6.5.

In the following figure (Figure 10), the averages are represented according to the moderating variables of gender and educational stage. As can be seen in the children's educational stages in relation to gender, we can observe that the score obtained is higher in male teachers than in female teachers, even though this is a stage in which most participants are women (6 > 8).

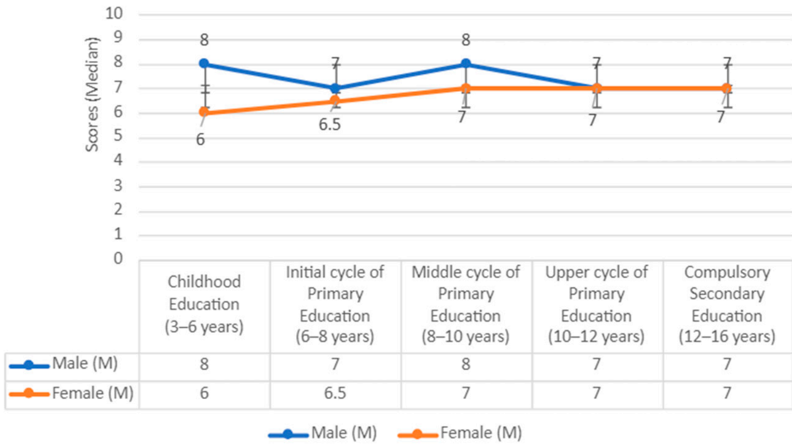

Figure 10. Comparison plot of gender and educational stage scores.

Score and gender differences are not shown during upper education stages, but there is a gender difference during childhood and early primary education stages. Even though male teachers are a minority in the sample and specifically in the childhood educational stages, their median is two points higher: 6 > 8 in childhood education, 6.5 > 7 in the initial cycle of primary school, and 7 > 8 in the middle cycle. Males have a stronger self-perception of their competence in using mobile devices (educational technology) in the classroom than female teachers (relative to the obtained medians). As mentioned above, the sample is made up of 31.5% more women than men, and the declaration of the frequency of use is higher in women (+40%) than in men.

The data collected from each element and items evaluated by teachers are then presented using descriptive analysis. These have enabled us to identify and correlate higher and lower values with various levels of use.

Element 1, "the Content", evaluates and refers to the techno-pedagogical knowledge of the content (TPACK). As can be seen in Figure 11, an advanced level (Level 3) has been obtained with an average of 7.75 (M) and a discriminative efficacy index of 53.40% (FI).

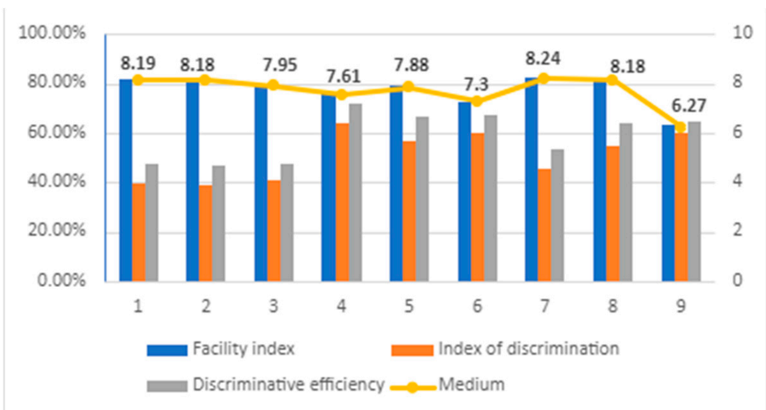

Figure 11. Descriptive results of element 1: content.

The highest and lowest scores were:

- Item 7: I search and select information or open educational resources that best adapt to the educational needs of my students. (M = 8.24, FI = 80%).

- Item 8: I reuse, improve, or create new learning resources that adapt to the educational needs of the students. (M = 8.18; FI < 80%).
- Item 9: I make open access educational resources I've created available to the educational community. (M = 6.27; DE < 60%).
- Item 6: I contrast similar educational experiences that work with mobile devices. (M = 7.3; DE = 65%).

Following the analysis of element 2 (Figure 12), we can see that methodological strategies such as the support of students help in the process of appropriation of knowledge by students through productive, experiential, or communicative learning activities. In this section, teachers obtained an advanced level (level 3) with an average of 7.42 (M) and a discriminative efficiency of 71.10% (DE).

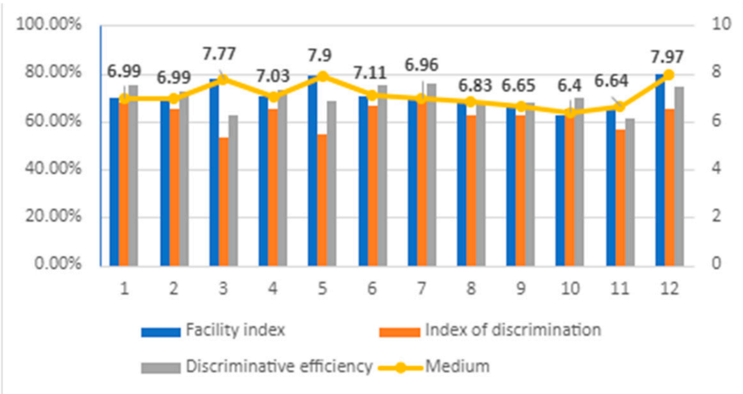

Figure 12. Descriptive results of element 2: Methodological Strategies.

The highest and lowest scores were:

- Item 12: Proposal for incorporating multimedia into methodological strategies for presenting and teaching content. (M = 7.94, FI < 75%).
- Item 5: I apply methodologies that promote students' key competencies. (M = 7.9; FI = 70%).
- Item 10: I apply the Game-based Learning methodology, with the help of mobile devices. (M = 6.4; DE < 65%).
- Item 9: I know that mobile devices can be used to make the Seamless Learning method even better. (M = 6.65; DE < 65%).

Element 3, "Activities" (Figure 13), on the other hand, is concerned with the process of designing activities that are aligned with taxonomies: Bloom, LATs, the TPACK model [28], and activities integrated with the environment [29]. The level obtained corresponds to an average level (level 2) with a median of 6.8 (M) and a discriminatory effectiveness index of 69.63% (DE).

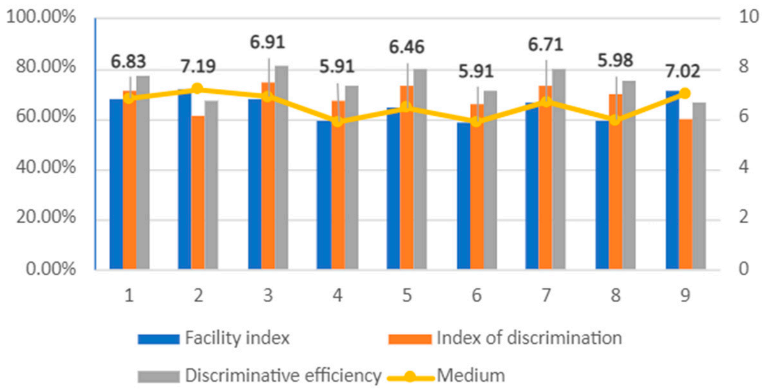

Figure 13. Descriptive results of element 3: Activities.

The highest and lowest scores were:

- Item 2: I differentiate and diversify the activities I propose with mobile devices. (M = 7.19; FI < 75%).
- Item 9: I apply methodologies that promote students' key competencies. (M = 7.2; FI < 70%).
- Item 4: Propose activities related to the taxonomies: 1. cognitive mastery, 2. procedural mastery and 3. attitudinal mastery in educational interventions carried out with students. Attitudinal mastery in educational interventions designed with mobile devices. (M = 5.9; DE < 60%).
- Item 6: Propose activities aimed at projecting, calculating, and reconstructing using mobile devices. (M = 5.91; DE < 60%).

The fourth element, "Evaluation," talks about the steps and questions that need to be thought about when evaluating activities that use mobile devices. In Figure 14, an average level (level 2) with a median of 6.40 (M) and an index of discriminative effectiveness of 65.46% (DE) is shown.

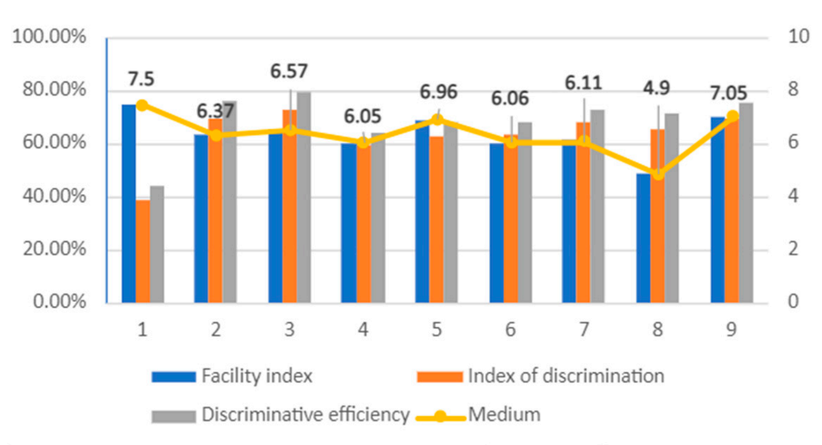

Figure 14. Descriptive results of element 4: Evaluation.

The highest and lowest scores were:

- Item 1: I develop an assessment that answers the following questions: who? (Teachers, students, etc.): What? (Didactic objectives), How? (Quantitatively or qualitatively), When? (Initial, continuous, final, or deferred), Why? (Diagnostic, formative, or summative evaluation), With what? (Information collection instruments) (M = 7.5; DE > 45%).
- Item 9: I will use a variety of evaluation tools in my mobile media activities: interviews, questionnaires, focus groups, observation diaries, reports, projects, checklists, e-portfolios, surveys, individual tests, or observation scales. (M = 7.5; DE = 70%).
- Item 8: I know how to assess students from the 360-degree assessment or integral assessment in the educational interventions that I design with mobile devices. (M = 4.9; DE < 70%).
- Item 4: I have an assessment that contemplates the summative aim of the educational interventions that I design with mobile devices. (M = 6.5; DE < 60%).

Regarding element 5, "Technology Resources," this reflects how technology should be used both in its educational functionality and in its structure [1]. As can be seen in Figure 15, an advanced level (Level 3) has been obtained with an average of 7.44 (M) and a discriminative efficacy index of 62.26% (DE).

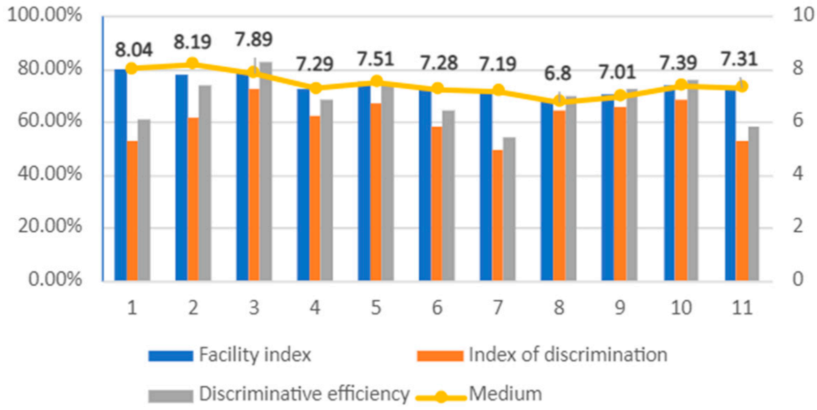

Figure 15. Descriptive results of element 5: Technology Resources.

The highest and lowest scores were:

- Item 2: I know the main characteristics of the mobile applications that I use, and I check their functionality beforehand. (M = 8.19; DE < 70%).
- Item 1: Know the main characteristics of mobile devices. (M = 8.04; DE < 60%).
- Item 8: When I plan learning activities with mobile devices for students, I use both online and offline devices and apps. (M = 6.8; DE < 65%).
- Item 9: I try to establish accessibility criteria in the selection of mobile devices and applications for learners to use. (M = 7.01; DE < 70%).

Element 6, "Learning Space Technologies" (Figure 16), deals with mobile devices, and contemplates their usability and facility integration in the environment so that they do not create protagonism or, at the same time, hinder the educational multifunction of spaces. Teachers here obtained an average level (level 2) with a median of 6.85 (M) and a discriminatory effectiveness index of 70.25% (DE).

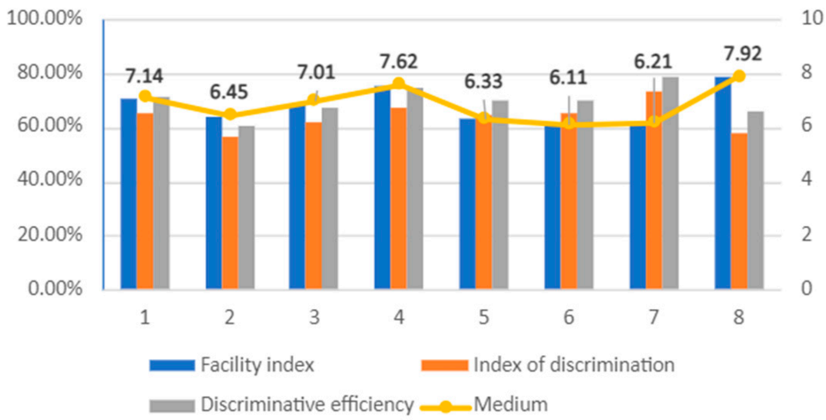

Figure 16. Descriptive results of element 6: Learning Space Technologies.

The highest and lowest scores were:

- Item 8: I consider that spaces with mobile devices must be accessible and facilitate the integration of students from diverse backgrounds. (M = 7.92, DE < 60%).
- Item 4: I take into account the distribution of mobile devices in the classroom for autonomous and group use by the students. (M = 7.62, DE < 70%).
- Item 6: I can create environments in my classroom using mobile devices to create experiences and pique students' interest. (M = 6.11; DE < 65%).
- Item 7: I design spaces with mobile technologies that promote the self-management of information, planning, and reflection on learning by students. (M = 6.21, DE < 75%).

Concerning element 7, "Teachers," the evaluative items assess digital teaching competence and how teachers are trained to use mobile devices in the best way for each situation [13]. As can be seen in Figure 17, teachers obtained an advanced level (Level 3) with an average of 7.48 (M) and a discriminative efficacy index of 69.78% (DE).

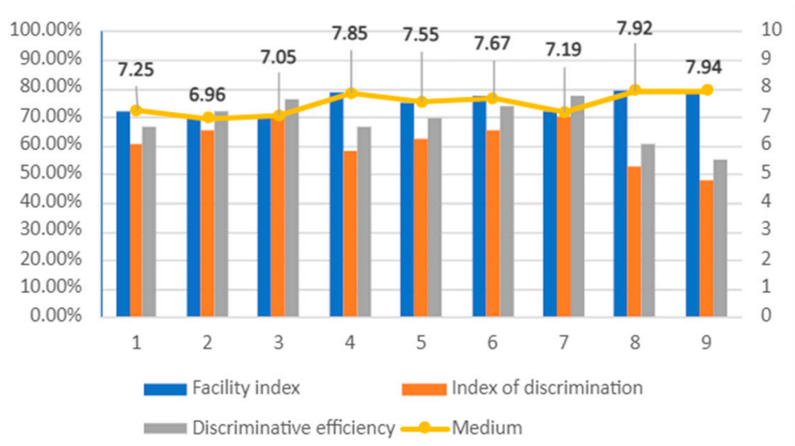

Figure 17. Descriptive results of element 7: Teachers.

The highest and lowest scores were:

- Item 9: I have a high level of teamwork competence with other teaching colleagues at the school. (M = 7.94; DE > 55%).
- Item 8: I believe that I am able to participate in a safe and civic way using my digital identity. (M = 7.92; DE > 65%).
- Item 2: I have a good understanding of ICT and how to incorporate it into the learning process. (M = 6.95; DE < 70%).
- Item 3: I am able to propose techno-pedagogical learning activities for the design, transformation, and application of the content. (M = 7.05; DE < 75%).

In general, this study underscores teachers' proactivity and commitment to adapting and customising educational resources to meet the individual needs of students, leveraging open and mobile technologies. This willingness reflects a positive trend towards educational innovation and the effective use of technology to enrich learning processes. However, it also emerges from the findings that there is a certain reticence or lack of experience in assessing students through mobile devices, suggesting a potential gap in teacher training in this specific area. Assessment, being a critical component of the educational process, requires strategies and tools adapted to technology-mediated teaching modalities. Less confidence or experience in this aspect could limit teachers' ability to fully integrate mobile devices into the classroom in a way that maximises their pedagogical potential. Therefore, it is imperative that professional development programs and teacher training incorporate specific modules on digital assessment, focusing on methodologies and tools that allow for the effective and adaptive measurement of student performance and understanding in technologically enriched environments.

Lastly, the detailed analysis of technology integration in education, as presented in this study, highlights the complexity of this process and the variety of skills required for its successful implementation. As we continue to explore and better understand these dynamics, maintaining a collaborative and research-based approach to developing strategies that support teachers in all facets of technology-mediated education will be crucial.

6. Discussion

The central aim of this research was to analyse the conditions under which mobile technology can support teachers in the design, implementation, and evaluation of teaching and learning processes. More specifically, our investigation sought to unravel the following research question: "What is the level of theoretical and practical knowledge of mobile learning as perceived by the teachers themselves?". To address this, we utilised data derived from a specially designed self-assessment tool, enabling us to capture teachers' perceptions of their use of mobile devices in educational settings.

According to the study's object, teachers use mobile devices in the classroom at a middle–high level (40–70%). Our analysis has revealed insightful details across seven critical dimensions: content, methodical strategies, activities, evaluation, mobile resources, technological learning spaces, and teachers' self-perception.

- Teachers exhibited a strong engagement with content delivery and mobile resources, as evidenced by their high mean scores of 7.75 and 7.44, respectively. The facilitation indices showed that teaching practices effectively facilitated approximately 78.78% and 73.52% of the content and mobile resources domains. These areas also exhibited relatively lower variances, suggesting a consensus among teachers on their comfort and competence in these domains. The robust Cronbach's alpha values (0.855 and 0.897) underscore the reliability of these findings, highlighting content and mobile resources as strengths within the current pedagogical framework.
- Methodical Strategies, Activities, and Evaluation: The domains of Methodical Strategies, Activities, and Evaluation, while still rated positively, indicated areas where teachers may benefit from further support. Mean scores in these categories were slightly lower, with corresponding increases in variance, pointing to a diversity in teacher experiences and comfort levels. Notably, the discriminative efficiency in these areas suggests that these aspects of mobile learning could have a big effect on the quality of teaching, as long as gaps in professional development are filled.
- Technological Learning Spaces and Teachers' Self-Perception: Technological Learning Spaces and Teachers' Self-Perception areas presented a mixed picture. While the facilitation index remained above 66% for both, indicating a generally positive outlook, the higher standard deviations and variances reveal a broader spread of responses. This spread suggests varying levels of confidence and experience among teachers in integrating technology-rich learning environments and reflecting on their own pedagogical practices. The kurtosis values closer to zero indicate a distribution that resembles normality, suggesting diverse experiences that merit further exploration and support.

The findings articulate a clear narrative: teachers are embracing mobile technology in education, recognising its potential to enrich teaching and learning processes. However, the variance in comfort and proficiency levels across different elements underscores the necessity for a nuanced approach to professional development. Specifically, enhancing teachers' skills in assessment, technological learning spaces, and methodical strategies could significantly elevate the quality and efficacy of mobile-learning initiatives.

Reflecting on our research objective and question, it is evident that while teachers possess a foundational theoretical and practical knowledge of mobile learning, as indicated by their perceptions and self-assessment, there remain considerable opportunities for growth. The self-assessment tool has proven to be a valuable instrument in identifying these opportunities, guiding both educators and policymakers in focusing their efforts on areas that promise the greatest impact on pedagogical effectiveness.

These insights should drive policymakers and educational leaders to consider tailored support and professional development in leveraging mobile technologies within the classroom, focusing particularly on areas such as assessment and technological learning spaces where gaps have been identified.

For instance, our findings related to the strong engagement of teachers with content delivery and mobile resources echo the results of studies [30] that emphasise the growing significance of mobile devices as tools for accessing and interacting with educational content. However, our study extends these insights by quantitatively measuring teachers' self-assessment scores and facilitating indices in these domains, thus providing a more granular understanding of their competencies and confidence levels.

Additionally, the research methods, activities, and evaluation parts of our study show areas of mobile learning that need more attention. This is what [31] says about the difficulties teachers face when they try to use mobile technologies effectively in their lessons. Our research adds to this discourse by offering specific data on the variance in teacher experiences and comfort levels, informed by a comprehensive self-assessment tool.

The incorporation of a gender and educational stage perspective also sets our research apart, contributing to a more nuanced understanding of how different demographics engage with mobile learning. This approach resonates with the work of [32], who discusses the importance of considering diverse teacher backgrounds in educational technology research but goes further by providing empirical data on these differences.

Additionally, [33] highlighted the transformative potential of mobile learning, which our study aligns with and expands upon. By quantifying the self-perceived proficiencies of teachers across various pedagogical elements, our research provides insights into the specific supports needed to leverage mobile technology effectively within educational practices.

This research identifies challenges and opportunities related to the adoption and effective integration of mobile learning, which are in line with [34]. However, our analysis, when viewed through the lens of self-assessment and professional development, provides a unique perspective by elaborating on the manifestation and practical solutions for these challenges.

Our study adds to the ongoing discourse on mobile learning within educational contexts by exploring the intricate aspects of how teachers perceive and utilise mobile devices for pedagogical purposes. While previous research has extensively explored the adoption and broad impacts of mobile technologies in education, our investigation seeks to fill a specific gap by focusing on the nuanced pedagogical elements that underpin mobile learning. Through the utilisation of a self-assessment tool, we have been able to gather detailed insights into the areas where teachers feel proficient as well as those where they see potential for further growth. This approach allows us to provide a granular view of mobile learning's implementation challenges and successes, thus offering a complementary perspective to existing literature on the subject.

6.1. Challenges and Opportunities of Self-Assessment Tools of Teacher's Knowledge

Self-assessment tools for teachers in the context of mobile-learning activities present both challenges and opportunities. On one hand, self-assessment tools can help teachers evaluate their own effectiveness and identify areas for improvement. This can lead to more effective and efficient teaching practices [35–38].

The implications of these findings for policy and implementation are profound. By providing teachers with the means to self-assess and reflect on their pedagogical practices, we not only promote personal and professional growth but also pave the way for the development of more dynamic, responsive educational environments. Therefore, it is imperative that educational policymakers and stakeholders consider these insights when formulating strategies for the integration of mobile devices in classrooms. However, the use of self-assessment tools also presents several challenges. One challenge is ensuring the accuracy and reliability of the self-assessment results. Another challenge is the need for teachers to have adequate training and support in using the self-assessment tools. Despite these challenges, self-assessment tools offer several opportunities for teachers in mobile-learning environments. For example, self-assessment can help teachers reflect on their teaching practices and identify areas for improvement.

Policymakers and educational institutions should therefore prioritise the development and dissemination of comprehensive training programs. These programmes should not only focus on the technical aspects of mobile learning but also address pedagogical strategies to enhance teaching and learning outcomes. Self-evaluation is an important tool for personal and professional growth because it lets a person evaluate how well they performed a certain task or activity. Bandura [39] states that self-assessment is an effective strategy for improving self-awareness and self-efficiency. According to the data, out of

n = 300 female teachers, 25% did not participate, and out of n = 158 male teachers, 72.68% did not participate, so we can say that women are more likely than men to self-assess their level of use of mobile devices. Despite this, female participants perceive themselves as less knowledgeable of the pedagogical uses of mobile devices than the male ones. According by Dunning and Kruger [40], women tend to underestimate their abilities, while men tend to overestimate them. This phenomenon is called the Dunning–Kruger effect. In other words, women are more self-critical and have less confidence than men. In addition, even when both sexes have the same outcome, women tend to evaluate their ability in each task lower than men. The term for this phenomenon is "self-assessment bias" [35].

The future action plans should specifically aim to empower female teachers through targeted training and professional development initiatives. Enhancing their confidence and competence in using mobile devices for educational purposes will contribute to a more equitable and effective educational technology landscape [41–43].

The future action plans should focus on capturing female teachers so that they can be trained and trained in the use of mobile devices and thus have a more positive self-perception of their professional abilities. The great participation in the thematic areas of that field is also manifested in the increased participation of the lower educational stages (infantile, primary, and primary), yet there are more teachers in the higher stages. Therefore, training spaces should be provided to teachers to promote the implementation of the use of mobile devices in the initial stages and incorporate training for non-technological subjects.

6.2. Limitations and Future Research Directions

Although our study benefits from a large sample size, it is critical to recognise key limitations that will guide future research. Focusing on teachers in the "Pla Mòbils.edu" project allowed us to analyse mobile device integration in education from a unique and committed standpoint. This unique feature has given us great insights into how these teachers, who are already predisposed to adopting educational technologies, perceive and use mobile devices in their pedagogical practices. Our findings are based on the experiences of instructors in "Pla Mòbils.edu" who are interested in integrating mobile technology into the classroom. This may differ from teachers' perceptions and practices in other educational settings. As a result, one drawback of our study is that the findings may not be applicable to all teachers, particularly those who have not participated in previous projects or who have limited access to resources and training in mobile educational technologies. This highlights the need for additional study with teachers outside of "Pla Mòbils.edu". Expanding our research to include a broader range of educational settings would allow us to determine whether the tendencies observed in our study apply in diverse contexts with varying levels of access to technology and institutional assistance. Future research including instructors from many educational contexts would help us better understand the integration of mobile technology into education by emphasising common obstacles, possibilities, and effective solutions that can be used in a larger range of educational scenarios. Thus, by investigating teachers' adoption and use of mobile devices in a broader range of educational contexts, we can begin to construct a more comprehensive map of mobile technology in education. This will not only enhance our understanding of current dynamics, but will also serve as a strong foundation for the development of policies and practices that support the effective and equitable integration of new technologies at all levels of the educational system.

Currently, society is questioning the educational use of technology, highlighting the need for reflection. Questioning the use of technology in educational environments reflects a maturity point in our society, allowing us to recognise associated risks and highlighting the importance of its proper application through relevant studies. Therefore, monitoring and updating the self-assessment tool in research is crucial in ensuring its long-term relevance. In this sense, the resulting tool must be accessible and free to use for the educational community through the web of research and project 'Pla Mòbils.Edu', aligned with the UNESCO recommendations on Open Science, which promote the sharing of data and results, to facilitate its discussion, feedback, and continuous improvement, allowing the tool to evolve and adapt to the emerging needs of the education field.

As we consider the evolution and expansion of research in the domain of mobile learning, it is crucial to outline potential directions and approaches that could further enrich the field. This study has laid a foundation by exploring the integration of mobile devices from the teacher's perspective, using a self-assessment tool to gauge their comfort and capabilities with these technologies in educational settings. However, the journey does not end here. The horizon of this research encompasses the development of new exploratory phases aimed at broadening the scope of our understanding.

One significant future strategy involves launching a new Educational Design Research (EDR) phase focused specifically on monitoring an entire academic cycle. This phase aims to observe how teachers integrate the self-assessment tool and mobile devices into their pedagogical practices on a day-to-day basis, offering a more nuanced view of the practical challenges and successes encountered. Such an approach will enable a deeper investigation into the impact, adaptability, and long-term viability of mobile-learning tools, fostering a richer comprehension of their effectiveness and potential areas for enhancement within the real-world classroom setting.

In addition, while the insights derived from teachers have been invaluable, a comprehensive assessment of mobile-learning strategies cannot be complete without considering the students' perspectives. It is essential to understand how students perceive, interact with, and impact mobile devices in their learning environments. Their experiences, outcomes, and feedback can provide a complementary lens through which the efficacy of mobile-learning approaches can be more fully evaluated.

Therefore, a pivotal area for future research is to delve into students' viewpoints on mobile learning, examining the perceived benefits, challenges, and overall influence on their educational experiences. Such investigations promise to significantly broaden our understanding of the effectiveness of mobile learning and guide the development of more refined, learner-focused methods for integrating technology into educational frameworks.

By embracing an inclusive approach to research that encompasses both teachers' and students' perspectives, we can ensure that the evolution of mobile-learning environments is informed by a comprehensive understanding of all stakeholders involved. This approach will not only deepen our insight into the dynamics of mobile learning but also aid in crafting policies and practices that genuinely align with the needs and preferences of the wider educational community. By incorporating students' perspectives into our research framework, we ensure that an in-depth appreciation of all parties' experiences shapes the advancement of mobile-learning settings, resulting in more effective, engaging, and inclusive educational experiences.

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Informed Consent Statement: Informed consent was obtained from the participant involved in the study.

Data Availability Statement: The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

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