

The Use of Mobile Phones in Classrooms: A Systematic Review

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Abstract—The inclusion and use of mobile phones in education is subject to two opposing arguments, one which defends and the other which opposes their use. This work has undertaken a systematic revision of scientific production to guide researchers in their enquiries into this subject. To achieve this, a total of 60 articles indexed to the *Journal Citation Reports* data base between the years 2011 and 2020 have been analysed. These have been categorised in six specific areas: attitude and relationship with the mobile phone, communication, educational applications and classroom interventions, tension between agents, relationship between use and performance and problems deriving from their use. The conclusions of the analysis made show that, in general, scientific production would seem to back the introduction of mobile phones in classrooms as beneficial for educational purposes provided that certain preliminary work is carried out and a certain development is achieved of the digital and media skills of both students and teaching staff.

Keywords—mobile educational services, technology uses in education, educational technology, literature reviews

1 Introduction

Two opposing standpoints exist at present regarding the use of mobile phones in education. On the one hand, there are those who praise the virtues of mobile devices in education. They argue that functions such as Internet access, the capacity of the use of educational applications and their use as ‘clickers’ or as readers justify their place in the classroom. On the other hand, the discourse exists that magnifies the negative effects of these devices on education, such as their potential to distract, their use in cheating in evaluations, cyber-bullying and access to inappropriate content [1]. In fact, these are the same discourses and the same benefits and disadvantages that have been mentioned since the arrival of the computational model 1:1 [2].

Despite this, the reality is that the use of mobile phones at many education centres is banned. And if we attend to the messages in the media and to the prevailing discourse

in society, the mobile phone is perceived as a potential distraction and as technology that offers more dangers than benefits.

In this context, we ask ourselves about scientific production regarding the use of mobile phones in the field of education. To that end, systematic revisions and bibliometric analyses allow for the analysis of what and how researchers are treating the different subjects and drawing conclusions therefrom [3]. These revisions seek to explore secondary data to recover, sum up and evaluate existing knowledge on a given subject in a more logical, transparent and analytical manner [4]. Hence, revisions of scientific literature are presented as the starting point from which researchers can guide their disciplines and their scientific developments [5].

Accordingly, a systematic revision has been undertaken to seek to offer a response to the following questions. Is there sufficient scientific production to back decision making and the drawing up of policies in the field of education in relation to the use of mobile phones? What are the main trends in this field? From the perspective of scientific production, do any reasons exist that justify a negationist bias in educational policy? Does sufficient evidence exist to propose the inclusion of mobile phones in the classroom?

2 Material and methods

To achieve the objective proposed and provide a response to the questions described above, the data base of scientific literature has been opted for which, despite many detractors, is the most highly rated by researchers and academic institutions [6]: the *Journal Citation Report* (JCR). This data base is housed in the *Core Collection* of the *Web of Science* (WoS) and it made up of two sub-groups: the *Science Citation Index* (SCI) and the *Social Sciences Citation Index* (SSCI). Articles were selected that responded to the keywords "mobile phone" AND "education" between the years 2011 and 2020 in the field of research "Education Educational Research". Access was gained through the web portal of the Spanish Foundation for Science and Technology (FECYT). Throughout the whole process, the assumptions made by Alexander [7] on the quality of systematic reviews were taken into account, along with the indications of the protocol designed in *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) [8].

The first step in the analysis was data cleaning, as offered by the platform itself by including the keywords. The combination used ("mobile phone" AND "education") allowed access to articles that contain these keywords in both the title and the abstract. After reviewing the articles, it was observed that 28 of them, despite responding to the sifting parameters, did not correspond to the subject matter since, in all cases, they focused on aspects related to health sciences. Figure 1 shows the process undertaken.

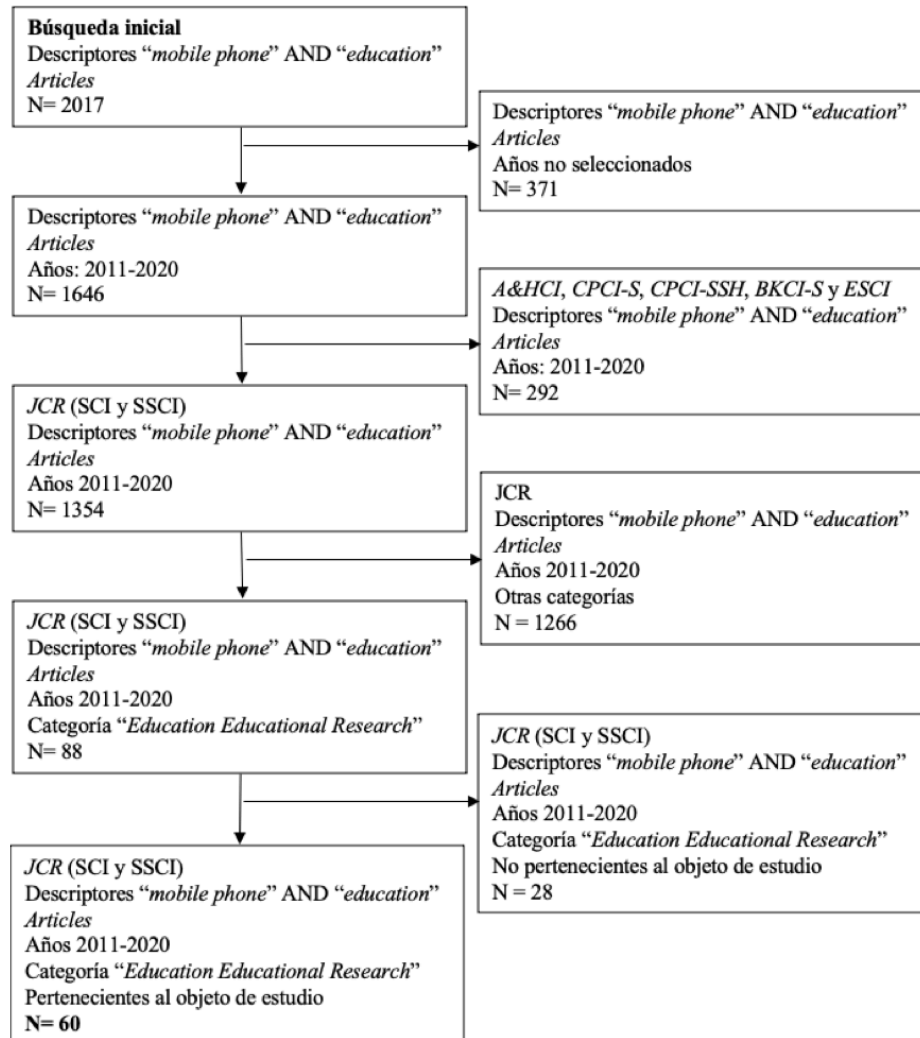


Fig. 1. Flowchart of search process undertaken

Finally, the analysis of the 60 articles selected was made. These were categorised into six specific areas: a) attitude and relationship with the mobile phone (n = 9); b) communication (n = 9); c) educational applications and classroom interventions (n = 19); d) tension between agents (n = 4); e) relationship between use and performance (n = 7); f) problems deriving from their use (n = 12). The results obtained from the analysis of the different works are set out below.

3 Results

3.1 Attitude and relationship with the mobile phone

The attitude that the people involved in the teacher-learning process have towards mobile phones has been studied on numerous occasions. For example, Xiao [9] analysed, through interviews with 45 secondary school pupils in different areas of China, how they related to their mobile phones. Students acknowledged that the devices were their life companions and not just a simple gateway to the digital world.

Lee [10] examined the relationship of the use of the phone as a visualisation tool for learning with the regulation of cognition in a sample of 502 Asian university students. The results validated this relational model. At any event, no differences were detected according to gender or age.

For their part, Nikolopoulou *et al.* [11] analysed the behavioural intent of 540 Greek university students regarding the acceptance and use of phones in their studies. The most important predictors were habit, expectation of performance and hedonic motivation. The researchers underlined that sex, age and experience did not have a moderating effect.

In Spain, Fernandez-de-Arroyabe-Olaortua *et al.* [12] defined the online consumption, creation and spread of audio-visual content patterns of 2,426 secondary school pupils in Gipuzkoa. They reported differences according to sex, whereby videogames were the backbone of male consumption, while photographs and videos of themselves (selfies) to share on the social media were the backbone of female consumption. The use of the phone to search for information, particularly in Wikipedia, to complete formal education, was also detected.

On another note, Arthur-Nyarko *et al.* [13] undertook a study that sought to explore the preparation of students in Ghana to implement the use of digital materials in the Faculty of Education. With a sample of 306 students, the results showed that they were predisposed to this implementation. It highlighted that access to these materials would be obtained through their phones, since they had no access to such other devices as computers and tablets.

With the aim of establishing a conceptual framework in which the theory of consumerism, self-efficacy and addictive conduct of university students was combined, Fu *et al.* [14] analysed 1,033 students in Shenzhen. To achieve the goal, they measured the frequency of the use of phones in learning environments, the reason for their use, the self-efficacy in behavioural control, the use of time, problematic use, multitasking habits and impulsivity.

As regards trainee teachers, Maden [15] explored the digital reading habits of 140 Turkish students. The results highlighted that the use of the phone, among other factors, contributed to their efficacy in these habits.

O'Bannon and Thomas [1] examined the perceptions of 245 future teachers in Kentucky and Tennessee to determine their support for the use of mobile phones in the classroom, along with their perceptions of their use for school-related work and the potential educational pros and cons. They reported that only half of the teaching staff were in favour of their use. This was due to the fact that, although they reported benefits

in general, they were against their use because of potential interruptions, cyber-bullying and access to inappropriate content.

As regards the age of the teachers, O'Bannon and Thomas [16] explored whether this factor influenced the relationship between the type of phone they owned, their support for the use of mobile phones at school, their perceptions of the benefits in the classroom and their perceptions of the barriers they entailed. To this end, they took a sample of 1,095 teachers from two states in the southeast of the United States. The results showed that there were differences, but not as many as originally thought. These differences were basically detected between the younger staff and those aged over 50. In general, the older staff saw more problems than benefits.

3.2 Communication

As regards the use of devices as communication tools, Huk [17] investigated the use of mobile phones in secondary education in Poland. Accordingly, and despite the ban on their use on school premises, he observed that both pupils and teachers used their mobile phones in class and in break times. However, by investigating their use, more than half of the sample of students limited themselves to checking the time, playing or using the camera. As regards the teaching staff, almost all of them referred to communications with the families and with their pupils on strictly educational matters.

This relationship between teachers and families by phone was studied by Ho *et al.* [18] in primary school education in Taiwan. By analysing a sample of 315 teachers, it was argued that the communications established with families, and with colleagues and senior staff, helped teachers take decisions on daily issues in the classroom. However, this was more conditioned and limited by school policies than by the intention of the teacher to use the phone in educational actions.

In the case of Aker and Kcsoll [19], the study was set in the context of Nigeria. With the aim of improving the level of responsibility of teachers and the performance of students, an intervention by mobile phone was designed in which phone calls were made to the village chief, to the teacher and to two students selected at random. Compared with other control groups, the improvements in maths skills and reading were striking. A similar case was analysed by Auld *et al.* [20] in an indigenous community in Australia. In this study, following a survey of 95 teachers and students on the use of mobile phones, their benefits for both communicating among themselves and with educational communities in other geographic areas were observed.

For their part, Uddin *et al.* [21] explored a longitudinal electronic mail communication network with 38 university students. The results showed contradictory behaviour by the students. Some of them intensified their communications when the workload was greater while others acted in the opposite way, drastically reducing their communications. The authors underlined that there was no middle ground.

Urien *et al.* [22] focused on the WhatsApp application and on how university students used it, analysing the engagement of cognitive processes in group work. A sample of 200 students was used with the premise that communication could only be made through this application. The results on the use and perceived efficacy by users to coordinate were excellent.

Chuang and Tsao [23] explored the effectiveness of instant messaging by mobile phone with 111 pharmacology students at a university in Taiwan. They established a control group and another experimental group that received information relating to a subject with a frequency of twice a day. The results showed that the experimental group had attained greater knowledge of the subject than the control group. It was also observed how the students that positively assessed this form of communication obtained better marks.

In this regard, the power that the social media have over students should not be forgotten. For example, Ayvaci and Bakirci [24] explored how 360 primary, secondary and university students in Turkey perceived nuclear energy. They observed how opinions altered according to age and, more specifically, according to the discussions and information that each group found on different social media sites. The power that these media have in the field of non-formal education is significant. Along this line, Ricoy and Martínez-Carrera [25] explored the patterns of how mobile phones are used by adolescents in the System for the Protection of Minors in Spain. The researchers observed extensive use of the social media for the purpose of communicating with peers and with their sentimental partners.

3.3 Educational applications and classroom interactions

In relation to educational applications managed through mobile phones, Mansouri, *et al.* [26] specified the characteristics that these applications can have. The researchers, through different focal groups, specified 37 codes that could be used in their design. The main characteristics were grouped into eight main subjects: visual richness, scientific rigour, hearing richness, affordability, ease of use, self-assessment, interactive content and user support. This study comes on top of that of Muñoz-Organero *et al.* [27], who determined whether the speed in the reproduction of phone audios was related to learning. To achieve this, they took a sample of 100 Spanish students from different education cycles. The results concluded that, as long as they could be understood, there was no problem. The researchers placed the optimum speed at 206 words a minute.

Xiao [7] undertook a bibliographic study of the data bases of Science, Scopus and ScienceDirect on the use of mobile phones and their applications in English-language teaching. The findings showed that the use of mobile phones and their applications had positive effects on learning English as a foreign language, particularly in the development of the vocabulary of the students and in motivating them. However, the researcher called for more studies to confirm these results. And it is clear that learning vocabulary in other languages through the mobile phone is one of the most common strategies, as shown by Zhang *et al.* [28] through an experimental group and a control group of Chinese university students. The results showed how the experimental group, which worked with short phone messages, significantly improved its level compared with the control group. Sandberg *et al.* [29] also worked with an experimental group and a control group, in this case with primary school pupils in the Netherlands. The results showed how the experimental group, which was allowed to continue using an application to learn vocabulary in English as a second language outside school, significantly

improved their performance. For their part, Hsu and Lee [30] explored the implementation of m-learning in a group of 50 tourism students in Taiwan. The results confirmed the benefits of this methodology to improve vocabulary and some key concepts of the profession.

However, not all the opinions on the use of mobile phones in language teaching have been positive. Geertsema *et al.* [31] explored the opinion of 22 language teachers in secondary schools in South Africa. The results concluded that most of the sample considered that the language pupils used in SMS messages had a negative influence on writing skills.

Continuing with the subject of second languages, Wang and Smith [32] examined both the viability and the limitations of developing reading and grammar skills in English through telephone interfaces. To achieve this, they used a sample of Japanese students from different levels of education. They reported that the success of any learning project through these devices could be limited, unless certain criteria are met, such as providing interesting teaching materials that are not too long or demanding, offering an accompaniment service throughout the process, incentivising the participation of students, offering incentives, guaranteeing respect for privacy and creating a mobile and technical learning environment that is safe and protected.

Furthermore, in the educational interventions proposed, Seery *et al.* [33] examined collaborative learning and evaluations among peers through videos recorded with mobile phone by students in laboratory practices. The results were very positive, developing, in addition to specific skills in the area, other digital, evaluation and self-assessment skills.

Voelkel and Bennett [34], in turn, carried out a study in which they sought to see the adaptation of the mobile phone as an evaluation element in secondary schools. The results were very positive on the part of the pupils. Similarly, and in relation to evaluations, on this occasion with WhatsApp, Güler [35], through a group of students that used group chats and another that communicated anonymously, concluded that anonymity contributed to a better opinion from students on the use of this application in said evaluation. In a similar study, Kizito [36] worked with a control group that took a maths exam in a physical format and another experimental group that took the exam by mobile phone. The conclusions described how, despite problems related to the ease of use and availability of mobile phones, this proved to be a very useful evaluation tool as it allowed continuous monitoring of the progress of students.

Birt *et al.* [37] explored how mobile applications reinforce online learning, in this case, in the training of paramedics in Australia. Through the use of 3D and augmented reality, they trained university students before carrying out work experience. The results of the study showed statistically significant improvements in several key performance indicators in students that were studying remotely, but also showed methodological problems by including these applications in their training.

The use of mobile phones has been applied to reinforce or supplement traditional methodologies. For example, Uluyol and Agca [38] worked with 188 education students from the Middle East Technical University, Gazi University and Ankara University. Through bar codes inserted in texts, students could access narrations and animations of the content they had to learn on their mobile phones. The results showed an

improvement in both the retention and transfer of what they had learned. A similar study was carried out by Ozcelik and Acarturk [39] with 44 students from Atılım University. In their case, they wanted to compare the use of mobile phones with the use of computers. The results showed the benefits of mobile phones over computers.

For their part, Barden and Bygroves [40] explored the use of mobile phones to create academic texts with university students in the United Kingdom. They concluded that if students were receptive to their use, it was perfectly feasible to write sophisticated texts with the different applications offered by mobile phones.

There have also been comparisons between the use of mobile phones and other multimedia resources, as in the case of the study carried out by Iskrenovic-Momcilovic [41]. The researcher worked with 120 primary school students from Serbia distributed into a control group and another experimental group that used an application in their respective phones designed for the subject of biology and botany. The results showed that the use of the mobile application contributed to a better quality and more lasting knowledge in students compared with multimedia teaching at cognitive levels (analysis, evaluation and synthesis).

As regards teaching staff and professional development, Nazari and Xodabande [42] explored the experience of teaching staff of second languages in Iran. The experience served, in addition to contributing to continuous training, to modify and improve the opinion of teaching staff on the use of mobile phones in education.

However, the inclusion of mobile applications in education has not always had its supporters. For example, Drew and Mann [43] sought the opinion of 38 university students in the United States on an interactive application. They felt its use was awkward and an unnecessary waste of time as they did not feel it was suitable for use in education.

3.4 Tension between agents

On such a controversial subject as the use of mobile phones in education, as is to be expected, several research works have addressed the latent tensions between the different agents. Accordingly, Gao *et al.* [44] explored the differences perceived in policies on mobile phones among Chinese teachers, students and families in five different aspects: the impact of the policy, the decision, the implementation of the policy, the evaluation of the policy and improving the policy. With a sample of 1,226 agents involved in both primary and secondary education, they detected significant differences in the responses from each group on the use and the ban on mobile phones. However, they all agreed that its use should be banned in class and in exams. They all concluded that current policies on their restriction were ineffective.

Lindell [45] researched the opinion that pupils had of the knowledge of secondary school teachers in Switzerland on the use of mobile phones. The conclusions highlighted the belief by students that they had stimulated the teachers to use mobile phones, thus building bridges between the two groups.

For their part, Ott *et al.* [46] explored the use of mobile phones by Swedish secondary school pupils. They claimed that tensions arose every day and that they had to table negotiations with teaching staff over their use. They expressed the paradox that despite

students using their mobile phones to do schoolwork, teachers confiscated them, guided by the policy at educational centres. To avoid this, they resorted to deceit and used them secretly. This created a circle in which, according to the students, a lack of understanding by the school authorities on real needs forced them to use deceit to improve their own education.

However, these tensions are not always negative. Ariel and Elishar-Malka [47] addressed the perspectives of 236 lecturers and 336 students at Israeli university centres on the role of phones in the classroom. Although the students envisaged more possibilities in the use of phones than the lecturers, both groups highlighted the benefits of their inclusion. Despite this, they also warned of the interference they could cause to daily activities, particularly in relation to concentration and attention.

3.5 Relationship between use and performance

The relationship between use and academic performance has been broadly studied. Kates *et al.* [48] carried out a bibliographic review of the subject on Google Scholar, analysing 39 articles. They concluded that, despite the fact that they detected benefits in some cases, they detected a negative effect on academic performance in general. Along the same line, Joyce-Gibbons *et al.* [49] explored the opinion of 225 pupils aged between 11 and 14 in Tanzania and their respective teachers. Although they observed some pupils who advocated the use of phones, most of the participants stressed the risk of improper use and potential interruptions to classes. At any event, everyone was opposed to their use in the classroom because of the potential harm to school performance.

Addiction and its relationship with performance was also studied by Hawi and Samaha [50]. With a random sample of 293 university students in Lebanon, they concluded that both men and women were susceptible to addiction and that this was closely tied in to academic performance. For their part, Felisoni and Godoi [51] analysed the relationship between the time that 43 university students in Brazil used different phone applications daily and their academic performance. This relationship was highly negative.

However, studies such as that of Olufadi [52] analysed the relationship between conduct with mobile phones and academic performance of 286 Nigerian university students. The only predictor of this performance was the time allocated to phone calls. The rest of the variables (addiction, distraction, dependence, multitasking, time spent on social media and self-perception) were not related to academic performance.

A very enlightening study in this regard was made by Kessel *et al.* [53]. They analysed the effects of banning the use of mobile phones in 1,432 Swedish pupils aged between 15 and 16 and observed no benefit whatsoever. The conclusions include the consideration that these were pupils with whom work had been done over many years to improve their media literacy. Hence, they considered that since they were educated to a certain degree in the responsible use of mobile phones, banning them had no effect on academic performance.

For their part, Asongu and Odhiambo [54] evaluated the data offered by the World Bank on the importance of ICT in primary education in 49 countries in Sub-Saharan

Africa between 2002 and 2012. The conclusions underlined how the penetration of mobile phones reduced certain educational problems and how their use was more positive in countries with education deficiencies than in countries without them.

3.6 Problems derived from use

Some researchers have focused directly on the different problems that can stem from the use of mobile phones in different areas of education. For example, Sevim-Cirak and Islim [55] studied nomophobia (the sensation of anxiety or fear of being out of mobile phone contact) in trainee teachers in Turkey. With a sample of 1,066 trainee teachers, they concluded that the variables of gender and age significantly affected nomophobic conduct, while experience using mobile phones and accessibility did not affect this. Ozdemir *et al.* [56] also studied nomophobia and its relationship with self-esteem, solitude and happiness in a sample of 729 university students in Turkey and Pakistan. The results confirmed that student gender was related to self-esteem. They also observed the differences in all the cases between students in Turkey and students in Pakistan. For their part, Gentina *et al.* [57] explored whether the emotional intelligence of teenagers could halt nomophobia. This involved the participation of 472 French secondary school pupils. The results showed how emotional intelligence significantly reduced nomophobia.

As regards dependence, Nikolopoulou and Gialamas [58] analysed 504 Greek secondary school pupils. Although motivational aspects were detected in phone use, an unconscious loss of control was detected caused by this dependence. This was more pronounced in the case of girls. They observed that age did not influence this loss of control. Nayak [59] measured the addiction of 429 university students in India. The results showed that this addiction is greater in the case of women than of men. However, the effect on performance was more pronounced in the case of men, who neglected work and suffered from anxiety. A similar study, but in Pakistan, was carried out by Soomro *et al.* [60] with 438 university students. The results showed a high level of addiction that was related to a lack of well-being in the classroom and which, in turn, negatively affected cooperative learning. No differences were detected according to gender or the specialised field under study.

In the case of Spain, this dependency has been studied from the fear of missing out and the perspective of family communication. To this end, Santana-Vega *et al.* [61] worked with 519 students. Although the results were similar to those of other students already set out in this article, they detected that those students that used their mobile phones for fewer hours had more parent-child communication.

For his part, Olufadi [62] designed an instrument that allowed the determinants of continuous use of mobile phones in class to be examined. The results of the exploratory and confirmatory factorial analysis ratified the existence of six dimensions in the measurement instrument proposed. These dimensions are boredom, classroom-related use, social connection, emergency, addiction and perceived behavioural control.

As regards the social media, Durak and Saritepeci [63] focused on the relationship between social media, communication, literacy and the problematic use of mobile phones. To do this, they established a theoretical model of application in which, on the

one hand, they established a relationship between social media and disruptive use and, on the other, a relationship was observed between social media and the level of literacy. The main conclusion was that the intensive use of social media and the Internet is indicative of a low level of literacy in new media.

As regards distraction, Beeri and Horowitz [64] explored how this is related to pupils and the leadership style of teachers. This involved a sample of 144 teachers and 591 secondary school pupils. The results indicated that a permissive style appeared to be more effective in reducing mobile phone use and the distraction this causes. However, a more authoritarian disciplinary style contributed to excessive use and the ensuing distractions.

One of the problems with the greatest repercussion is cyber-bullying. Eden *et al.* [65] explored the opinion of 328 teachers from different education cycles in Israel on this matter. The conclusions highlighted the concerns of teaching staff, which suggested that urgent attention should be paid to the establishment of policies, to enhance the awareness of the educational community and the strategies to deal with the issue with parents. The most concerning issue was that more than half of the teaching staff reported that they were aware of the cyber-bullying of students and even of themselves. It was observed that the gender of the teachers (women more than men), the level of education and the age of the students (more pronounced in nursery and special education) affected their level of concern over cyber-bullying.

Li *et al.* [66] researched the same conclusion on a sample of 2,327 young Chinese students aged from 9 to 22. The results showed that 6.2% of the sample were bullies, with a larger proportion of males. They also detected that participants of the social media *Renren* opted to take part in forums with different famous people and to play online, and that they were the ones who most frequently participated in cyber-bullying.

4 Conclusions

This study sought to analyse scientific production on the use of mobile phones in classrooms to determine whether evidence exists that justifies the inclusion or exclusion of these devices in schools.

The results show that different focuses or fields exist in recent research on the use of mobile phones in classrooms and that, depending on these, the conclusions that can be reached on their inclusion or not in schools are also different.

If we focus on their use and the relationship established with mobile phones, it is clear that they are highly present in the lives of many pupils, who tend to use them, among other ends, for educational purposes. But it has also been observed, as we shall conclude later, that the use of the mobile phone may bring certain problems with it. The possibility of the emergence of some of these problems, such as distractions, interruptions, etc., is the reason why some teachers are reticent about their use in classrooms.

In terms of the field of communication, the general perception is good as a tool that improves communication and academic results. Many professionals harness their ease of use and immediacy to communicate with families and pupils, thus improving this aspect of the education process.

The use of mobile phones is quite usual in language teaching, through specific applications and others that are commonly used, even allowing work with sophisticated texts. Other fields in which their use has been observed include formative evaluations to boost cooperative learning and teacher training (whereby the higher the level of training, the better the opinion of teachers on the use of mobile phones for educational purposes).

The use of mobile phones in classrooms often leads to tension between teachers and pupils. Restrictive policies lead to a dynamic of invigilating-cheating-punishment and also diminishes any educational use or initiative when the parties are in agreement.

As regards the use of mobile phones and their relationship with academic performance, some studies point out that their use negatively affects performance, although there are others that highlight the contribution of mobile phones to overcoming deficiencies in education systems in some countries, thus improving performance. What is fundamental in this field is that, if there is suitable training and development prior to media literacy, negative effects on performance can be avoided.

Something similar happens regarding problems stemming from the use of mobile phones. The most commonly studied problems, like nomophobia and loss of control and dependency can be avoided if there is sufficient emotional education and good development of media literacy. The imposition and an authoritarian disciplinary style are negatively related to the problem of dependency. Furthermore, the most present and most concerning problem is cyber-bullying although, despite this, the lack of prevention is striking. A commitment to this emotional education and the development of digital skills could help mitigate this problem.

The general conclusion to come out of this study is that scientific production would seem to back the benefits of introducing mobile phones into classrooms for educational purposes provided that preliminary work is done and a certain development of digital and media skills is achieved in both pupils and teachers. Hence, education policies should be geared towards this twofold objective.

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