

The Role of Mobile Technologies in the Development of Key Competencies: A Review Study

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Abstract: Modern education is based on the development of key competencies. By developing key competencies, we should prepare pupils and students for real life, i.e. for their beneficial integration into society and their professional life. At the same time, digital devices are penetrating education, of which mobile technologies have a strong position in education. Much research has looked at the impact of mobile technology on the learning process, motivation and learning fixation, but does this technology have an impact on the development of key competencies? These thoughts led the authors to produce a review study that maps the role of mobile technology in the development of key competencies. The paper aims to analyse the available literature and determine the current state of the art on the issue described above. In the theoretical part of the paper, the authors describe the theoretical background that formed the basis for the development of the review study. The theoretical part of the thesis deals with the area of mobile technologies in education, where the authors define the term mobile technologies and briefly outline their position in education. Another area discussed is key competencies, where the authors define the term, describe their role in the context of European education, and focus in detail on key competencies for learning, problem solving, communicative competencies, and digital competencies. The last theoretical area described is the research methodology, in which the authors focus exclusively on defining the concept of a review study. The research part contains the methodology of the conducted research, where the specific procedure of the review study is described. 50 publications were selected and analysed in detail, and the information found was recorded in a table. The results of the research do not only contain conclusions about which key competencies are developed by mobile technologies but also look at, among other things, what level of education uses this technology or how different countries perceive this issue. The results of the research can serve as a basis for further research that can look at the relationship between mobile technology and specific key competencies.

Keywords: mobile technology, mobile learning, key competencies, overview study, education, review study

1. Introduction

Modern education aims to prepare people for their lives so that they can contribute to society. To achieve a sufficient level of this preparation, the development of selected key competencies is necessary, which include all relevant skills. The preparation of an individual for life takes place from pre-primary education, through primary education, secondary education, higher education, and the individual himself develops his key competencies independently throughout his life. Therefore, it is a lifelong process.

Mobile technology started to penetrate education in 2006. Currently, it is one of the most widely used technologies in education. In addition to mobile technologies (specifically tablets), these include computers, interactive whiteboards, and robotic toys. In a previous investigation, the authors found that mobile technologies have a positive effect on various aspects of learning, among which we can name motivation or fixation of learning in memory. Can mobile technologies be a suitable tool for developing key competencies? This question was the authors' initial idea to conduct the research.

The thesis is a review study on the described issue. The first part of the paper introduces the reader to the topic, with a special emphasis on the area of key competencies and mobile technologies in education. The second section describes the research methodology, the theoretical foundations in the field of review studies are defined and then the procedure for conducting the research is described. In the next section, the authors present the results obtained and interpret the data using graphical processing. The conclusion of the paper is devoted to a discussion of the findings and possibilities for further research.

1.1 Key competency

The concept of competence can be defined in many different ways. A basic definition understands competence as the practical application of knowledge and skills that an individual has learned during the educational process (Chvál and Straková, 2014). Another concept extends this definition to include the element of routine and habit (Klieme et al, 2010). The development of key competencies is the basis of

modern education. Key competencies can be defined as a set of knowledge, skills, abilities, attitudes and values important for the personal development and application of each member of society (Ministry of Education, Youth and Sports of the Czech Republic, 2021). The term key competencies can also be loosely translated as key skills, and basic skills, key qualifications. The development of key competencies is mainly seen in the countries of the European Union, but, as the survey below shows (Chapter 3.3), key competencies are also an important part of education in many countries outside the European Union. The European Union recommends that its member states develop eight basic key competencies (European Commission, Directorate-General for Education, Youth, Sport and Culture, 2019):

- Literacy competence;
- Multilingual competence;
- Mathematical competence and competence in science, technology and engineering;
- Digital competence;
- Personal, social, and learning-to-learning competence;
- Civic competence;
- Entrepreneurship competence;
- Cultural awareness and expression competence.

Based on these recommended key competencies, each EU member state has defined its own key competencies on which to focus their education. The authors of the research described here key competencies for learning, key competencies for problem solving, communicative key competencies and social and personal competencies. These competencies were chosen because the educational system in the Czech Republic emphasises the development of these competencies and therefore these competencies are the focus of the authors' interest (Ministry of Education, Youth and Sports of the Czech Republic, 2021).

1.2 Mobile technology in education

Mobile technology is a common part of the lives of individuals in modern society. Statistics show that in 2014, 1.57 billion users owned a smartphone, in 2017 it was 2.32 billion, and in 2020 the number of users reached 2.87 billion (Riadi et al, 2017). In 2021, 97% of Americans owned a mobile device, of which 85% owned a smartphone (Pew Research Center, 2021). In 2022, the number of users will reach 3 billion (IBM, 2022). The popularity of these devices has also translated to the education sector, where mobile technology is one of the most widely used digital tools. In addition, we can name, for example, computers and laptops, which are more numerous than mobile technologies.

Mobile technology refers to devices that do not rely on a permanent connection to the power grid and allow the user to easily manipulate the device. A mobile device consists of a two-way communication device, a computing device, and a network connection device (IBM, 2022). These devices can include smartphones, tablets, laptops, GPS navigation, etc. Tablets are widely used in education.

A mobile device can offer the user a wide range of sensors. These sensors include an accelerometer, gyroscope, compass, distance sensor, GPS, and others. In addition, the mobile device has many tools, which include a front and rear camera, microphone, speaker, internet connection, and touch screen. Many of these sensors and tools find application in education. Smartphones and tablets are based on the use of apps. There are currently a large number of apps (in the billions) on the market. Educational apps are a separate category.

1.3 Research problem

In previous research, the authors found that mobile technology has a positive effect on learning fixation. 44 students, aged 11 to 12, participated in the investigation. The authors compared the outcomes of a control group that received instruction in a traditional way and an experimental group that used mobile technology during instruction. From the comparison of the control and experimental groups, it was concluded that mobile technology had a positive effect on the fixation of new learning (Tran et al, 2019). In a further investigation of the issue at hand, the authors found that mobile technology also positively influenced student motivation and promoted an individual approach to learning (Gybas et al, 2017). Based on these findings, the question arises whether mobile technologies are a suitable tool for the development of key competencies that form the

fundamental pillar of modern education. As a first step to find the answer to this question, the authors conducted an extensive search of the international literature and produced a review study. The results of this study reflect the current state of the use of mobile devices in the development of key competencies.

2. Methodology

The second chapter of this paper describes the methodology of the survey. In the first part of this chapter, the authors describe the theoretical basis of the research methodology and define the chosen research method - a review study. The second part contains the real course of the conducted research.

2.1 Overview study

The term review study refers to a specific genre of research that maps the current state of the art in a given research area. The authors conducted a mapping review, which relies on a larger body of work on a given topic over a selected time period. The authors analyzed each research study and graphically illustrated the interpretation of the findings. Mareš recommends this procedure when preparing a review study (Mareš, 2013):

- 1. Choose a suitable topic for the review study;
- 2. Selecting the appropriate type of review study;
- 3. Conducting a literature search on the topic - creating a comprehensive inventory of works;
- 4. Analyzing basic data on each identified paper and narrowing the papers to only relevant studies;
- 5. Critical reading and detailed analysis of the shortlisted studies;
- 6. Compilation of data on all studies reviewed into a comparative table;
- 7. Identification of key characteristics of the selected topic;
- 8. Synthesis of the obtained characteristics of the selected topic into larger units;
- 9. Writing of the different parts of the review study;

The authors followed the procedure described above during the preparation of the review study. The following sub-chapters describe the process of each stage of the investigation.

2.1.1 Conducting a literature search

The initial literature search used the Scopus database, which was searched for publications based on several combinations of keywords. The table below presents the combinations of keywords used and the number of records found. A total of 1332 publications were retrieved in the initial search phase.

Table 1: Keyword combinations and number of records found

| Keyword combination | Quantity of records found |
|--|---------------------------|
| communication competency tablet learning | 16 |
| communicative competency mobile learning | 13 |
| critical creative thinking mobile technology | 23 |
| key competency for creative thinking | 66 |
| learning competence mobile technologies | 434 |
| learning competency mobile technologies | 316 |
| learning to learn competence smartphones | 29 |
| mobile learning key competency | 60 |
| mobile technology key competency | 86 |
| personal key competency mobile technology | 6 |
| problem solving competence mobile technologies | 38 |
| social competence mobile technologies | 220 |
| social key competency mobile technologies | 23 |
| Key social and personal competencies mobile technology | 2 |

2.1.2 Narrowing the initial selection to relevant studies

The initial selection was narrowed down based on an analysis of the titles and abstracts of individual papers. After a thorough analysis, 50 publications that met the criteria were included in the comparative table. These criteria include:

- The publication was published between 2010 and 2022;
- The publication addresses the relationship between mobile technologies and at least one key competency;
- The publication focuses on education at any level;
- The publication addresses education in any field;
- The publication is written in English;
- The publication contains precise procedures for the use of mobile devices;

2.1.3 Critical reading, analysis and description of relevant studies

The selected 50 publications were studied in detail. These studies were included in a comparative table in which the authors recorded the following criteria:

- title of the publication;
- Year of publication;
- Country in which the research was conducted;
- Key competencies developed;
- Target group;
- Tools or applications used;
- Role of mobile technologies, whether they had a main or supporting role;
- Keywords.

The authors then analysed the comparative table and extracted the data, which is presented in Chapter 3.

3. Results

According to the research methodology described above, the results for this paper were obtained. The results are presented in the form of a comparative table. The table contains a total of 50 records for which selected aspects are observed. The subsections below contain the results of the aspects studied.

3.1 Year of publication

The first factor that the authors looked at is the year of publication. As can be seen from the graph below, most of the publications analysed were published in 2020, 2021 and 2022. The highest number of entries that were included in the table was in the category of publications in 2021. This is 16 publications, which is almost double the number of publications in 2020. This phenomenon can be caused by several reasons. One reason may be the fact that there has been an emphasis on digital technology in education due to the pandemic situation in 2021. This situation has then been reflected in professional publications and in the issues studied. According to the annual increase in publications, it can be assumed that the number of publications will be higher at the end of 2022.

3.2 Developed key competencies

Another aspect that was investigated was the core competency, which is the focus of the analysed publication. As can be seen in the graph below, the learning competency accounted for the largest share, with 17 publications. In second place is the communicative competency, which was addressed by 14 publications. This was followed by problem solving competence, which was described in 12 publications, and the last place, with a number of 9 publications, is social and personal competency. The share of each competency may be strongly influenced by the popularity of the competencies in each country, with learning competency and communicative competency forming the basis of the education systems of most countries.

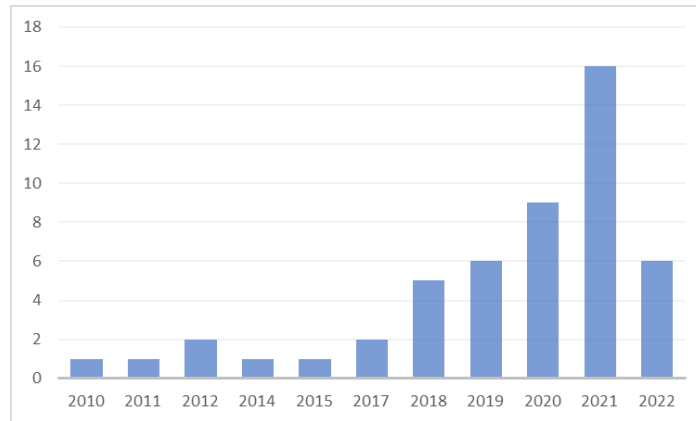


Figure 1: Number of publications found in each year

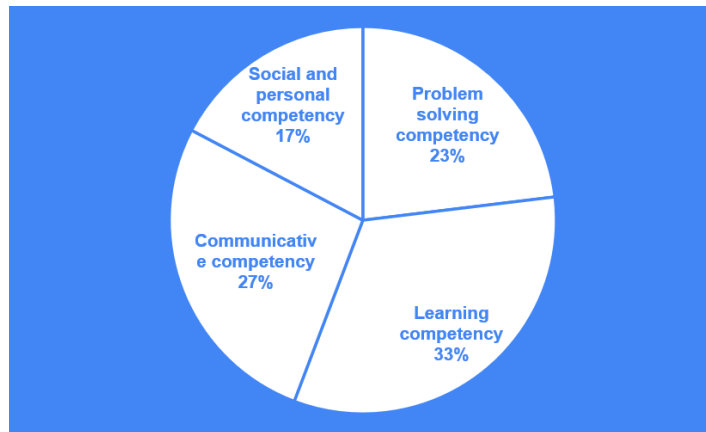


Figure 2: Proportion of key competencies in publications found

3.3 Country in which the research was carried out

The chart below lists the countries in which research was conducted in the publications analysed and, where applicable, the number of publications that covered that country. The graph shows that the highest number of publications concerned China, Spain and the USA. Taiwan was in second place, followed by Malaysia. The other countries mentioned were covered by 1 or 2 publications. As the authors are familiar with the education system in Europe, where the emphasis is mainly on the development of key competencies, they assumed that the highest proportion of publications would be within one of the European countries. It is an interesting finding that Asian countries and the USA also focus their education systems on the development of key competencies.

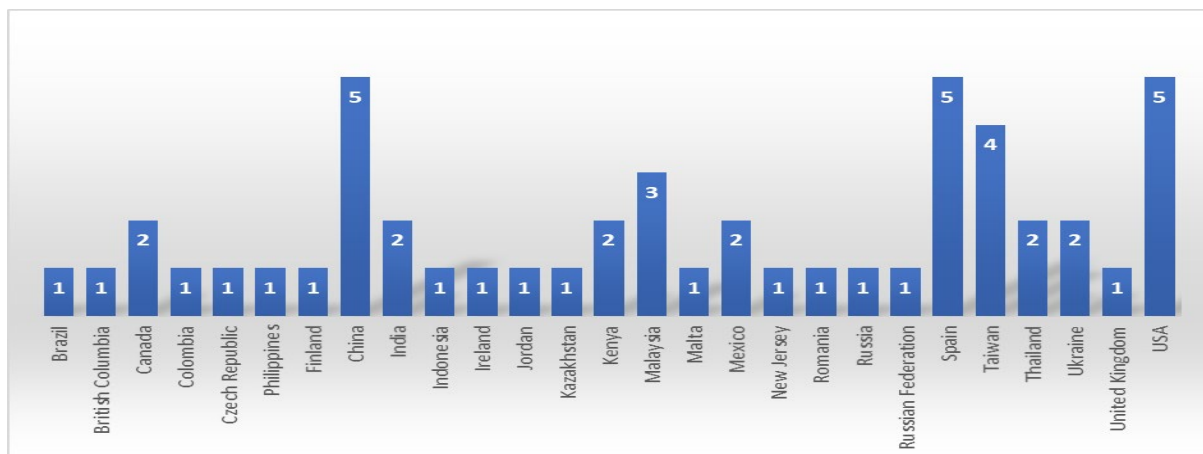


Figure 3: Overview of the countries in which the research of the analysed publications was carried out

The fourth chart (figure 4) shows the share of each competence for specific countries. More than half of the states focus on developing learning competencies, 14 states. Communicative competency comes in second place, with 9 states. An interesting indicator is that none of the publications from China focus on communicative competency and most focus on learning competency. The US has the opposite situation, with the largest number of publications addressing communicative competency and none addressing learning competency.

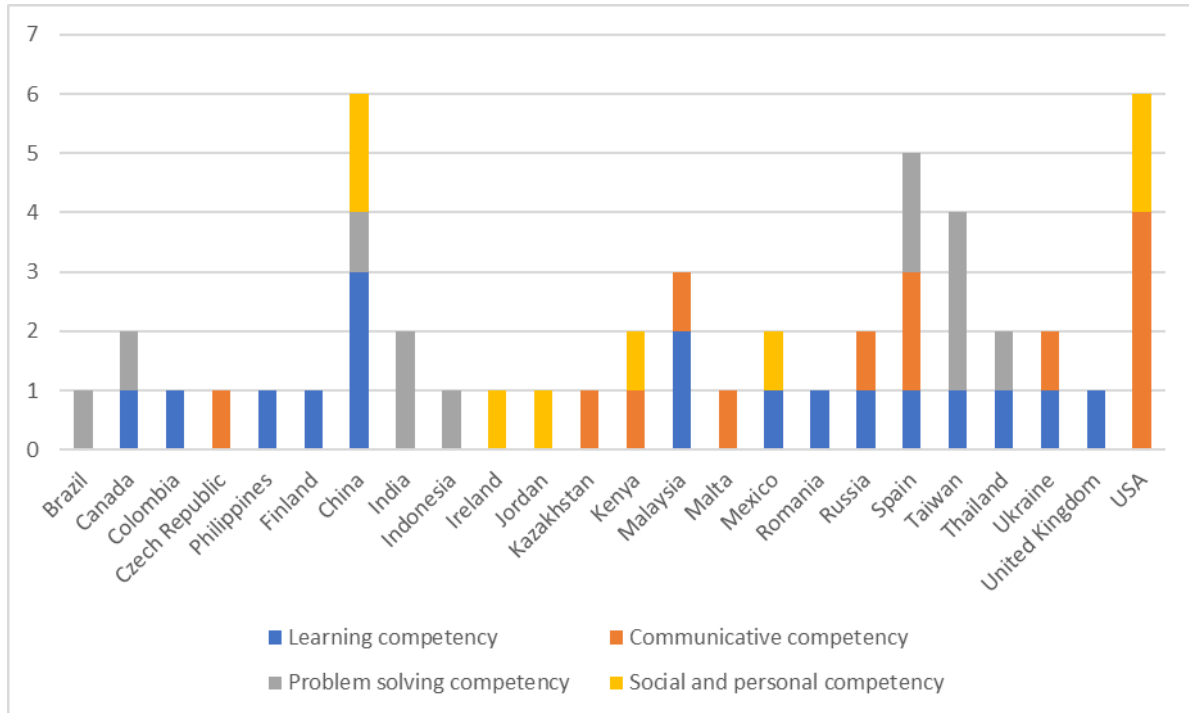


Figure 4: Share of individual competencies for specific countries

3.4 The role of mobile devices in the development of key competencies

The last aspect studied was whether mobile technology played a major role in the development of key competencies in the analysed publication or whether it was only a supporting tool. In 33 publications, mobile technologies were used as the main tool for the development of a given key competence. In 17 publications, it was only a supporting tool.

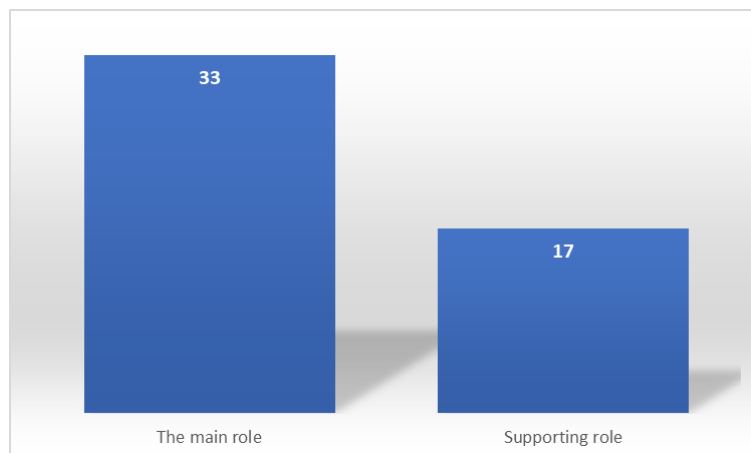


Figure 5: The role of mobile devices in the development of key competencies

4. Discussion

With the advancement of digital technologies in education, mobile technologies have gained a strong position in teaching students. For this reason, the authors focused on analyzing the relationship between mobile

technologies and key competencies in previously published research. In this paper, the authors present the investigation methodology of the conducted and the analysis of the findings.

The results show that the research problem addressed has been the focus of interest since approximately 2018, with the number of publications increasing. To date, the highest number of publications that could be found on the topic described above was published in 2021. Based on the analysis, it can be concluded that the most addressed competencies are learning competency, communicative competency and problem-solving competency, where the number of publications differs only by a maximum of five publications. As the authors mentioned above, this phenomenon may be due to the fact that these three key competencies form the basis of the educational system of many countries and are competencies that are essential in the education of an individual. Section 3.3 presents a list of the countries within which the publications analyzed were researched. China, Spain, and the United States have the highest number. Interestingly, the result is heterogeneous in terms of world continents. Despite the assumption that the highest number would be in Europe, the results show a fairly even spread also in Asia or the Americas. The last aspect analysed was whether mobile technology was the main means of developing a given key competence or whether it was only a supporting tool. The data obtained show that most publications saw mobile technology as the main tool. A variety of tools and applications were used in the studies analysed. These include educational apps, virtual and augmented reality, communication tools, social networks, applications for teaching coding, or other web-based applications.

In the context of a review study, other aspects that can be gleaned from the publications studied could also be pursued. These could be, for example, specific mobile applications and tools, the teaching methods and organisational forms used, the subject taught, etc. Another weakness of this study is the limited number of databases studied, as only the Scopus database was searched. The Web of Science, Google Scholar and other databases could also have been focused attention. Studying other databases may bring new insights into the problem and may influence the presented results. The review study is of a relatively general nature. In the context of further research it would certainly be interesting to focus attention on the individual core competencies separately. An overview study on a given key competence could look at its conception in individual countries or at specific practices in developing this competence using mobile technologies.

The development of key competencies is an important part of modern education. It is necessary to take care of the development of appropriate key competencies of pupils and students, to prepare them for their future professional life, and to make them contributing members of society. The results of this review study may form the basis for a more extensive research or further investigation. The authors plan to expand the number of articles analysed and to focus on other key competencies, such as digital competencies, work competencies, or mathematical competencies.

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