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Requirements for Creating a Game Learning System Using Mobile Applications for Primary School Students

Abstract

An interest in integration of mobile applications in education will continue to rise. What is necessary nowadays are such didactic methods that will facilitate and accelerate the transmission of knowledge to students, activate a process of mastering knowledge, teach them to undertake independent work with the given material, and enhance the productivity of educational process and teachers' work. Such methods of studies can be realised on the basis of the use of information technologies in education. The basic problem is a requirement to develop methods and resources for support of the use of mobile technologies by elementary school students. Mobile technologies can make the learning process more interesting, answer the requirements of today, and give necessary information at the right time. In this model, the activity approach will be employed. The cognitive activity of a child will get organised in such a form that opens him or her for knowledge, so that learning becomes the main activity, as required by the discussed programmes. The article analyses the game models necessary for the education and development of children of elementary school age. The contents of mobile platform gaming models are revealed. The article also provides the classification of the proposed products that promote the learning and development of a child, the so-called soft skills and hard skills. The suggestions for using gaming models on different devices are given. The requirements for the use of gaming models of mobile platforms in the educational process are offered.

Key words: gaming models of mobile platforms, mobile devices, soft skills, hard skills, elementary school children, innovative learning, classification of educational games, BYOD

Introduction

Formulation of the Problem

At present, the school needs such an organisation of its activities, including monotonous memorisation activities, that would ensure the development of individual abilities and a creative attitude to the life of each student, which entails the introduction of various innovative programmes, the implementation of the principle of a humane approach to children, and so on. In modern school, there is an urgent need to expand the methodological potential in general, and active forms of learning in particular. Such active forms of learning include gaming technology.

Gaming technology is one of the unique forms of learning, which allows one to make interesting and exciting not only the work of students at the creative and search levels, but also the everyday steps in learning subjects. The fun of the conventional world of the game makes it positive and emotionally coloured, and the emotionality of the game action activates all the psychological processes and functions of the child. Another beneficial aspect of the game is that it promotes the use of knowledge in the new situation; thus, the material acquired by the students goes through a kind of practice, and brings diversity and interest to the learning process (Traxler, 2009).

The relevance of the game is currently increasing due to the oversaturation of the modern world with information. All over the world – and in Ukraine in particular – the subject–information environment is immeasurably expanding. Television, video, radio, and computer networks have recently flooded students with a huge amount of information. The actual task of the school is the development of assessment and selection of the information received. One of the forms of training that develops such skills is a didactic game that promotes the practical use of knowledge gained in the classroom and during extracurricular time.

The game is a natural and humane form of education for the child. Teaching through the game, we teach children not in the way that is convenient for us to give educational material, but in the way that ensures convenient and natural acquisition for children.

Analysis of Recent Research and Publications

In 2013 in the USA, the research laboratory of The Joan Ganz Cooney Center, within the framework of the Games for a Digital Age project, conducted an experiment on the adaptation of games to the educational process. As a result, let me present the following classification of the appropriateness of the game:

- 1) “we train and work out,”
- 2) puzzle games,
- 3) online learning tools,
- 4) role-playing games,

- 5) strategies,
- 6) action / adventure, and
- 7) simulation (Takeuchi & Vaala, 2013).

The worldwide organisation of UNESCO worked out recommendations on mobile education in a document authored by Mark West and Steven Vosloo (along with members of the consultative committee – Claudia Liliana Aparicio Yañez, Sarah Crampsie, Lauren Dawes, Sanna Eskelinen et al.). Researchers offer the conception of BYOD, that is, “Bring Your Own Device,” by means of which a student will be able will study through the smartphone. UNESCO believes that mobile technologies can significantly increase and improve educational opportunities in a wide range of settings (“UNESCO Policy guidelines version 2.1...”). Below I mark the improvements on this conception of UNESCO.

- 1) **Mobility.** On the one hand, it entails the possibility to realise the educational programmes wherein high quality specialists cannot participate physically. On the other hand, modern technologies – namely, the systems of cloud storage of data – allow one to carry out learning without attachment to the certain devices; a student can change a cellular telephone, but all his or her educational materials will be accessible via the cloud.
- 2) **Continuity of education.** Mobile devices that always are with a person and belong to them personally make the process of education continuous: because students can execute tasks at any time, teachers can take the passive part of educating outside the classroom, and use school hours for the development of social skills. Students can choose how and when to do their assignments outside of school.
- 3) **Personalisation of educating.** Mobile devices allow the students to choose the level of complexity of tasks and content independently, moving up in learning at their own pace. In addition, a mobile phone gives an opportunity for every student to process material in most comfortable way for them. It means that the developers of the educational programmes for mobile phones must use various methods of conveying the same information – text, charts, images, video – for greater efficiency.
- 4) **Upgrading communication.** Mobile devices make it possible to line up rapid and quality communication between teachers, students, and educational establishments. Student feedback allows teachers to monitor individual student performance statistics on a case-by-case basis. In addition, by means of mobile phone a teacher maintains continuity of educating.

In the extended materials of the UNESCO recommendations, the authors present the main benefits of mobile learning that are confirmed by international practice:

- 1) empowerment and provision of equal access to education,
- 2) personalisation of learning,

- 3) instant feedback and evaluation learning outcomes,
- 4) training at any time and in any place,
- 5) efficient use of time in classroom lessons,
- 6) formation of new student communities,
- 7) support of situational training,
- 8) development of continuous “seamless” learning,
- 9) ensuring communication between the formal and informal learning,
- 10) minimisation of the consequences of break in the educational process in military conflict zones or areas stricken by natural disasters,
- 11) assistance to students with limited opportunities,
- 12) improvement of the quality of communication and management, and
- 13) maximising cost effectiveness (“UNESCO Policy guidelines...”).

In Ukraine, the problem of mobile learning was addressed by a number of scientists, among them: Valery Bykov, Victoria Vember, Andriy Gurzhiy, Miroslav Zhaldak, Vasil Kremen, Natalia Morse, Oleg Spirin, and many others.

The research of Natalia Boyko, Valentina Panchenko, Vladyslav Gavlovsky, and other scientists reveals the importance, role, and influence of information flows from global networks for the modern educational process.

Most researchers in the field of mobile learning emphasise that the use of mobile means in the learning process helps overcome the communication barrier, build research skills, as well as increase the motivation to acquire skills, thinking, and competencies and use them in life.

The purpose of the article is to formulate the requirements for the use of gaming models of mobile platforms during the educational activities of a junior student in view of the improvement of thinking and learning.

Theoretical Bases of the Research

The world of the latest information technology contributes to the systematic movement of the learning process to the mobile space, in which children are more versed than many adults. Every day, millions of students launch mobile apps on their smartphone, contributing to the rapid development of this isolated culture. This is the lifestyle of children, their comfort zone; ignoring or forbidding attitudes of teachers and parents will cause an increase in conflicts and even more alienation from the school. We see the opportunity to prevent such a trend in the transformation of gadgets from the means of communication and entertainment into the means of training (Marshall, 2011).

Nigel Paine, a member of the International Advisory Board at the University of Pennsylvania in Philadelphia, highlighted the elements of mobile learning, of which the main ones are as follows:

- 1) mobile learning provides the opportunity to use free time intervals;
- 2) mobile applications should be compact and activated from the place where the work was interrupted;
- 3) mobile applications must be available on the Internet, and be synchronised with mobile learning tools.

In his research about mobile education, Paine presented the following comments:

- 1) people are ready to use mobile telephones in such situations in which they will not choose to use a book or notebook;
- 2) mobile educating is at its peak right now: it is attractive because of not only its novelty, but also comfort and practicality, so the majority of employees would be thankful for it;
- 3) in mobile devices, one competes for attention of users mainly in games, so that countless pages of text formatted for a mobile screen will not contribute to keeping the user's attention;
- 4) "idle time" is precious and can be used;
- 5) the level of possible concentration excels the ordinary level of concentration at an office;
- 6) if it is not an infringement of the copyright policy in one's educational institution, one is advised to create mobile applications for iPhone, Blackberry, Google Android, or Windows Phone;
- 7) applications must be small-sized, but they must be capable of continuing from the same spot where one left off;
- 8) if one's applications are supposed to be accessible online through a laptop or a computer, it is necessary to synchronise them with a mobile phone; having used the application on one type of device and switching to another, one ought to be able to continue at the same spot where one left off;
- 9) it is not crucial to study all the Software Development Kit – there are numerous specialists who process the given material to make an application for iPhone or Google Android;
- 10) one's applications must be exciting and involving – they should be able to compete with games in this respect (Paine, "10 элементов мобильного обучения...").

Basing on Paine's opinion, I wish to formulate a number of requirements for gaming models for using devices during learning.

From my own teaching experience in school, I have observed that students willingly use their mobile devices in search of solutions to problems. During computer science lessons, students used special mobile applications for the topics of classes; for example, using programming on the screen, children could build their

game after building the application, and read obvious errors in the development of the programme and correct them in real time. The students built their own algorithms themselves, played their games in the class, found errors and described them. Learning success rates were improved as children felt free to choose and could implement their own ideas based on the acquired knowledge.

This approach was based on the recommendations of the UNESCO Mobile Education Policy and the work of Nigel Paine, who presented proposals for the use of mobile devices as a learning tool, for the tablet devices shown in Figure 1, for the tablet in Figure 2, for the game console in Figure 3.

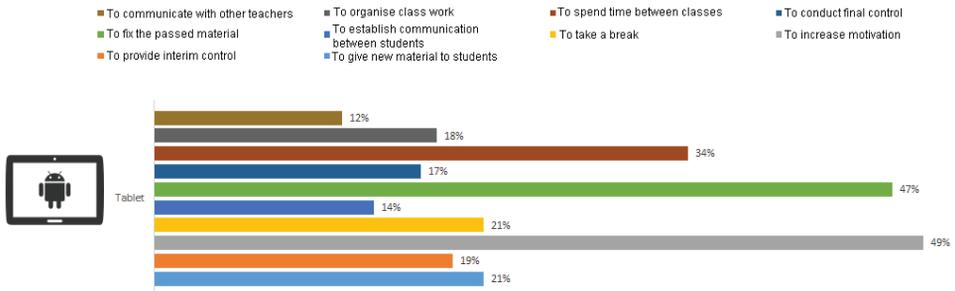


Figure 1. Purposes for tablets.

Source: Own work.

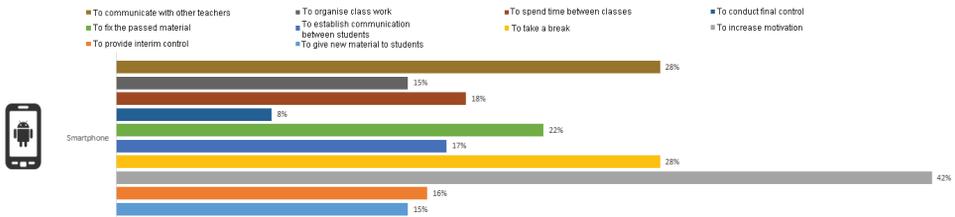


Figure 2. Purposes for smartphones.

Source: Own work.

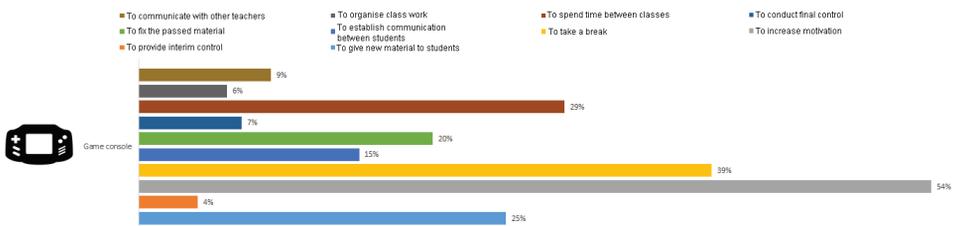


Figure 3. Purposes for gaming consoles.

Source: Own work.

Gaming technology is an integral part of educational technology. Pedagogical technologies differ in terms of the prevailing methodology when using game technologies:

- in the field of activity: physical, intellectual, labour, social, and psychological;
- in the nature of the psychological process: teaching, training, controlling, generalising; cognitive, educational, developing; reproductive, productive, creative; communicative, diagnostic, career guidance, psychotechnical;
- in game technique: subject, plot, role, business, imitation, and dramatisation;
- in the subject area: mathematical, physical, ecological; musical, theatrical, literary; labour, technical; physical training, sports, military and applied, tourist and folk sports; social, administrative, and economic sciences;
- in the game environment: without subjects / with subjects; desktop, room, street, terrain; computer, television; technical, with means of transportation.

The duration of various games is different:

- short games – these include subject, story, and role-playing, and other games used to develop interest in learning activities and to solve specific problems: mastering a specific rule, working out a skill, and so on;
- the gaming shells – these playful forms of organisation of educational activities are more time-consuming; most often, they are limited to one session, but can last a little longer; these include the technique of creating a single game shell, that is, presenting the lesson in the form of a holistic study – the game;
- long-lasting educational games – games of this type are designed for different time intervals and can last from a few days or weeks to several years; they are focused on a distant ideal goal and are aimed at the formation of the mental and personal qualities of the student. The special features of this group are its seriousness and business-like character.

In the lives of people, the game performs such important functions as:

- entertaining (the main function of the game is to entertain, give pleasure, inspire, arouse interest);
- communicative (mastering the dialectic of communication);
- self-fulfilment (the game as a “human practice training base”);
- therapeutic (overcoming various difficulties arising in other types of activity);
- diagnostic (detection of deviations from the regulatory behaviour, self-knowledge in the game);
- corrective (making positive changes in the structure of personal indicators);
- international communication (assimilation of sociocultural values that are common for all people); and
- socialisation (inclusion in the system of social relations, the assimilation of the norms of human society).

Results of the Research

Educational mobile applications should have an interactive design of user interface, dialogic functions, and multimedia elements that are intended for independent work of kids (under the guidance of a teacher or without it); they should help solve the actual tasks in educational and cognitive activity of the user, motivating him or her for further education. The main obligation here is didactic content. This means that the didactic application is perceived as a mobile training programme, designed by developers taking into account the optimal set of key principles of didactics and methodology teaching.

In the pedagogical process, the game acts as a method of training and education, transferring the accumulated experience, starting from the very first steps of human society along the path of its development. In a modern school that relies on the intensification of the educational process, the activity of playing is used in the following cases:

- 1) as independent technologies for the development of the concept, topic, and even section of the academic subject;
- 2) as elements of a more extensive technology;
- 3) as a lesson (occupation) and its part (introduction, explanation, fixing, exercise, control); and
- 4) as a technology extracurricular work (Traxler, 2009).

The concept of “gaming pedagogical technologies” includes a rather extensive group of methods and techniques for organising the pedagogical process in the form of various pedagogical games. These differ in general from games in that they have the goal of learning and the corresponding pedagogical result, which are in turn justified, highlighted in form, and characterised by educational and cognitive orientation. The peculiarity of the pedagogical game is that the situation of the class–lesson learning system does not allow the game to manifest itself in the so-called “pure form” – the teacher must organise and coordinate the children’s play activity. The game form of classes is created in the classroom with the help of game techniques and situations that should act as means of motivating and encouraging students to learn activities (Rekkedal & Dye, 2009). The implementation of gaming techniques and situations in the regular form of classes is held in the following main areas:

- 1) the didactic goal is set for students in the form of a game task;
- 2) educational activities are subject to the rules of the game;
- 3) educational material is used as its means;
- 4) competitions are introduced into the educational activity, contributing to the transition of didactic tasks to the category of games; and
- 5) successful execution of the didactic assignment is associated with the game result.

During the school year, in the centre of development of own recommendations on the use of mobile system, an article by Nataliia Morze was written, which described the basic knowledge and skills for each level, from beginner to expert. Accordingly, at each level of studying, the following recommendations for the whole game system are formed. Based on all levels and requirements, examples are given that include one common system (Morze, 2010).

Requirements for gaming systems in education are as follows:

- 1) the playing shell must be given a game plot that motivates all students to achieve game goals;
- 2) the team as a whole and each player personally ought to be included;
- 3) each student should have the possibility of action;
- 4) the result of the game should differ depending on the efforts of the players – there must be a risk of failure;
- 5) game tasks must be selected so that their implementation is associated with certain difficulties; on the other hand, tasks should be accessible to everyone, so it is necessary to take into account the level of participants in the game and tasks to pick from easy ones (practising the training skills) to those which require considerable effort (the formation of new knowledge and skills);
- 6) the game should not be the only possible way to achieve the goal; and
- 7) different means must be provided to achieve game goals.

The following needs should be realised:

- the presence of own activities,
- creation,
- communication,
- self-determination through role-based experimentation, and
- self-determination through the trials of activities.

The structure of the game as an activity of a person includes the following stages:

- 1) goal setting;
- 2) planning;
- 3) achieving the goal;
- 4) analysis of the results; and
- 5) opportunities of choice and elements of competition, satisfaction of needs, self-affirmation, self-realisation.

The structure of the game as a process must include:

- the roles assumed by the players;
- game actions as the means of implementing these roles;
- game use of objects, i.e. replacement of real things with game-based, conditional objects;
- real relations between the players; and
- the plot (content) – the area of reality, conditionally reproduced in the game.

Mobile education apps must meet a number of requirements, namely:

- compactness – the components of mobile learning should be short due to the fact that they are available in an environment in which potential interruptions in communication are likely to occur;
- high level of microergonomics – high quality image / sound at small screen size, and small size of the output file (download speed);
- comprehensiveness and accessibility – the mobile educational application should be obtained regardless of one's location; an increasing range of mobile network operators and the availability of mobile devices provide a widespread presence of mobile learning services convenient for the student at any time;
- on demand access – by its nature the mobile device provides access on demand for the student, maximising the potential of delivering valuable content at the moment of need.

Using mobile devices, kids and educators from different countries receive access to large educational resources, can discuss information and share it with other students, receive support from colleagues and teachers, and learn to communicate effectively. Of course, mobile technologies are not and will never become a panacea for education; however, this powerful and often underestimated means may take education to a whole new level (see Sarrab, 2014; Sarrab, Al-Shihi, Al-Khanjari, & Bourdoucen, 2018).

Let us take a look at some of the benefits of mobile learning, highlighted by employees of UNESCO.

1. Enhancing opportunities and ensuring equal access to education. Prices of mobile phones are constantly falling, so an increasing number of people, even in the poorest regions, have the opportunity to purchase these devices and know how to use them. At present, there are many projects in different countries working on the application of mobile technologies and on providing modern training materials for everyone.
2. Personalised training. Mobile devices are usually at their owners' disposal all day and have plenty of features that can be customised. That is why mobile technologies provide wider possibilities for personalisation than non-mobile ones.
3. Instant feedback and evaluation of learning outcomes. Mobile technology makes the process of assessing the learning results considerably faster, and gives students and teachers the ability to quickly track the students' progress.
4. Training anytime and anywhere. Because most of the time mobile devices are with their owner, he or she can study anytime and anywhere. Mobile training applications are given to the user.
5. Possibility of choice. One can perform an exercise that takes a few minutes, or completely concentrate on the task within a few hours, which contributes to flexibility of the learning time ("UNESCO Policy guidelines version 2.1...").

Conclusion

Analysing works of scientists in area of the use of mobile devices in education, we can reach the conclusion that these technologies will improve the process of education, because what they entail are both fast access to the authentic educational, certified resources and programmes at any time and in any place, and permanent feedback with a teacher and an educational institution. This requires the following:

- 1) an account of individual features of a student useful in diagnostics of problems or an individual pace of learning;
- 2) increasing the motivation of technical equipment and virtual learning;
- 3) organisation of autonomous educating;
- 4) creation of personalised, professionally oriented educational facilities for children;
- 5) quick access to authentic educational resources and programmes anytime and anywhere;
- 6) constant feedback from the teacher and the learning community;
- 7) development of skills and capacities for the continuous educating throughout life.

The traditional approach of teachers of elementary school to the formation of competences of students contributes to the problem of students' loss of interest and motivation in the study of general curriculum. As a result, there is a necessity for modernising the traditional system of teaching by means of online tutorials. Mobile online tutorials are highly sought today among the primary school students; these tutorials are able to become the effective means of increase in motivation if on the prototype stage of development of the mobile programme the optimal methods (proper functions, motivational necessities, and features) are used. In this article, I described the process of creation of mobile applications for studying. It also turned out that the problem of developing only the classification of the principles of methodology of primary school students' subjects study remains relevant. This aspect made it much more difficult to identify functional ways of implementation in mobile resources. In the context of educational mobile applications, it makes sense to work out the programme whose functions correspond both to a child's needs and motivation, and to methodical or didactic principles and terms.

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Wymogi tworzenia systemu gier edukacyjnych dla uczniów szkoły podstawowej z wykorzystaniem aplikacji mobilnych

Streszczenie

Zainteresowanie zintegrowaniem aplikacji mobilnych z edukacją będzie stale wzrastało. W dzisiejszych czasach potrzebne są takie metody nauczania, które ułatwią i przyspieszą przekazywanie wiedzy uczniom, zaktywują proces opanowania wiedzy, nauczą samodzielnej pracy z materiałem, a także zwiększą efektywność nauczania i pracy nauczycieli. Takie metody nauczania mogą być realizowane dzięki wykorzystaniu w edukacji technologii informacyjnych. Podstawowym problemem jest wymóg opracowania metod i zasobów wsparcia użycia technologii aplikacji mobilnych w nauczaniu i uczeniu się z szkole podstawowej. Technologie mobilne mogą uczynić proces nauczania i uczenia się bardziej interesującym, spełniającym wymogi współczesnych czasów oraz dostarczającym koniecznych informacji we właściwym czasie. W opisywanym modelu wykorzystane jest podejście oparte na aktywności uczniów. Poznawcza aktywność dziecka ma zostać zorganizowana w takiej formie, by uczeń mógł się otworzyć na wiedzę, a uczenie się stało się główną aktywnością, zgodnie z wymogami programów. W artykule przeanalizowano modele gier potrzebnych w rozwoju i edukacji dzieci w szkole podstawowej. Przedstawiono treść platform do gier dla aplikacji mobilnych. W dokonanej przeglądnę zaproponowano klasyfikację proponowanych produktów, które promują uczenie się i rozwój dziecka, jego umiejętności określane jako kompetencje twarde i miękkie. Podano propozycje wykorzystania modeli gier dla różnego rodzaju urządzeń. W końcu przedstawiono wymogi dla wykorzystania modeli gier dla platform mobilnych w procesach edukacyjnych.

Słowa kluczowe: modele gier dla platform mobilnych, urządzenia mobilne, kompetencje miękkie, kompetencje twarde, uczniowie szkoły podstawowej, innowacyjne uczenie się, klasyfikacja gier edukacyjnych, BYOD

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Требования к созданию игровой системы обучения с использованием мобильных приложений для учащихся начальных классов

Аннотация

Интерес к интеграции мобильных дополнений в обучение сохраняется на высоком уровне. Сегодня необходимы методы обучения, которые облегчают и ускоряют передачу знаний студентам, активизируют процесс усвоения знаний, учат приемам самостоятельной работы с материалом, способствуют образовательной активности и повышают эффективность труда учителя. Такие методы обучения могут быть реализованы на основе использования информационных технологий в образовании. Основной проблемой исследования является потребность в разработке методов и ресурсов для поддержки обучения в младшей школе с использованием мобильных технологий. Мобильные технологии могут сделать процесс обучения более интересным, предоставить необходимую информацию в нужное время, что отвечает требованиям сегодняшнего дня. Реализуется активный подход, познавательная деятельность ребенка организуется в той форме, при которой он открывает для себя знания, учеба становится пред-

метод активной деятельности, так как программы требуют активного управления. В статье анализируются игровые модели, необходимые для воспитания и развития детей младшего школьного возраста. Раскрыто содержание игровых моделей мобильных платформ. В обзоре предлагается классификация предлагаемых жанров, способствующих обучению и развитию ребенка, так называемых «Soft Skills» и «Hard Skills». Даны предложения по использованию игровых моделей на разных устройствах. Предложены требования к использованию игровых моделей мобильных платформ в учебном процессе.

Ключевые слова: игровые модели мобильных платформ, мобильные устройства, Soft Skills, Hard Skills, дети младшего школьного возраста, инновационное обучение, классификация обучающих игр, BYOD

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Requisitos para crear un sistema de gamificación usando aplicaciones móviles para estudiantes de Educación Primaria

R e s u m e n

Existe un gran interés por la integración de las aplicaciones móviles en la educación. Estas metodologías mejoran la adquisición de conocimiento por parte del alumnado y la productividad docente. Estos métodos están basados en el uso de las tecnologías de la información en la educación. Se pretende apoyar a los estudiantes de Educación Primaria desarrollando metodologías y recursos basadas en el mobile learning que genera una mayor motivación y permite dar la información necesaria en el momento adecuado. Estas metodologías permiten un aprendizaje más personalizado y activo por parte del alumnado. El artículo analiza los modelos educativos basados en la gamificación necesarios para el desarrollo educativo de estudiantes de Educación Primaria. Se muestran contenidos de gamificación en plataformas móviles. La revisión sugiere la clasificación de los géneros propuestos para promover el desarrollo y el aprendizaje de los estudiantes en las llamadas Soft Skills and Hard Skills. Se ofrecen sugerencias para usar modelos de juegos en diferentes dispositivos. Se informa de los requisitos para el uso de estas metodologías y recursos en el proceso educativo.

Palabras clave: modelos de juegos de plataformas móviles, dispositivos móviles, soft skills, hard skills, estudiantes de educación primaria, aprendizaje innovador, clasificación de juegos educativos, BYOD