

# Informática na Educação e suas Tecnologias

**Ernane Rosa Martins  
(Organizador)**



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## APRESENTAÇÃO

A nossa sociedade está em constante evolução tecnológica, visivelmente percebida no Brasil e no mundo, generalizada em todas as áreas do conhecimento. Na educação também é percebido que os avanços tecnológicos fazem parte das salas de aula, proporcionando melhores resultados, sendo uma temática atual muito importante socialmente e profissionalmente, não podendo ficar a parte desta realidade, principalmente pelo seu caráter de formação e construção do conhecimento. Assim, esta obra pretende elucidar o panorama atual da informática na educação e suas tecnologias, apresentando diversas análises sobre algumas questões relevantes, por meio de seus capítulos.

Estes capítulos abordam aspectos importantes, tais como: o uso das tecnologias de informação e comunicação, metodologia ativa, sala de aula invertida, redução das taxas de evasão, formação docente, competências digitais, *mobile learning*, aplicativos *Prezi* e *Plickers*, recursos digitais, desenvolver de *software*, linguagem de programação, biblioteca virtual, Estilos de Aprendizagem, Ambientes Virtuais, Educação a Distância, Educação Superior, Jogo Digital. Desenvolvimento Visual, Prática Docente, Inclusão digital, Ambientes Virtuais de Aprendizagem.

Nesse sentido, esta obra engloba uma coletânea de excelentes trabalhos de extrema relevância, por meio de experimentos e vivências de seus autores, socializando-os no meio acadêmico, proporcionando aos leitores a oportunidade de análises e discussões de textos científicos sobre a informática na educação. A cada autor, nossos agradecimentos pela contribuição. Aos leitores, desejamos uma leitura proveitosa e repleta de excelentes reflexões.

Ernane Rosa Martins

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## SOFTWARE SOLUTIONS FOR FINANCIAL LITERACY: A MAPPING STUDY

Data de aceite: 20/11/2019

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**ABSTRACT:** This work focuses on the software solutions utilized for initial financial literacy, which was delimited in subjects such as self-motivation, budget planning, consumption habits, debt management and savings. Using a procedure for development of systematic reviews of literature, the survey got papers with software intended for these uses and after the selection based on inclusion and exclusion criteria made use of 18 selected. Research questions were used to find out about the platforms used, the target audience and the software approach used (here separated between games and applications) and using artificial intelligence and

gamification tools. According to the proposal, were found 108 papers, so that 81 were unique (not repeated). These papers were clustered into three distinct groups and showed that most of the papers present solutions for mobile devices focused on teens and adult users (above 12 years old). And its concluded that the development of this solutions are focused on mobile application for adults use according some indicators as demonstrated.

**KEYWORDS:** Financial Literacy, Software, Games, Artificial Intelligence, Systematic Review.

### INTRODUCTION

Investment robots are reality in applications for the financial market, making use of artificial intelligence applied to stock market data to propose movements (Trippi and Turban, 1992; Bahrammirzaee, 2010). However, it is necessary to have skills in dealing with money in order to save it and thus reach the investor level. With these steps on sight, here we search for software solutions that are applied to this first stage of the looking for knowledge in financial literacy and monetary domain, that precede the investments and use of such advisory robots.

Financial literacy is considered to be the domain of eight areas of knowledge described in figure 1, which can be divided between basic (green) and advanced (blue), these steps were listed and ordered by a compilation of literatures in financial literacy area (Stanley and Danko, 1999; Lusardi and Mitchell, 2011a; Lusardi and Mitchell, 2011b; Rooij et. Al, 2011; OECD, 2005) and how it can be seen, before speaking about investments, a whole domain about consumption, budget planning and debt management is necessary. It is intended here to consolidate the approaches of educators, designers and developers in software that cover more than one stage of this initial phase of learning about finance.



Figure 1. Financial Literacy steps (Souza and Notargiacomo, 2019).

This study makes use of a systematic literature review protocol to delimit the researches and techniques applied to the commented area. Briefly, the steps used are presented as follows (Kitchenham, 2004; Brereton et al., 2007; Moher et al., 2015; Proença et.al., 2017):

1. Definition of the questions that the study seeks to explore.
2. Delimitation of research terms.
3. Definition of inclusion and exclusion criteria.
4. Selection of academic databases.
5. Application of research terms to the selected databases.
6. Application of the inclusion and exclusion criteria to the presented results.
7. Categorization and data extraction of relevant studies.

The difference between mapping studies and systematic reviews is in the scope of the approaches. In mapping studies, the search terms are broader, as well as the questions, aiming to take an overview of a research area to be explored (Brereton et al., 2007). In a complementary way to the steps presented to develop a systematic

mapping, Peterson (2008) developed an image that enchains steps and deliverables as shown in figure 2.

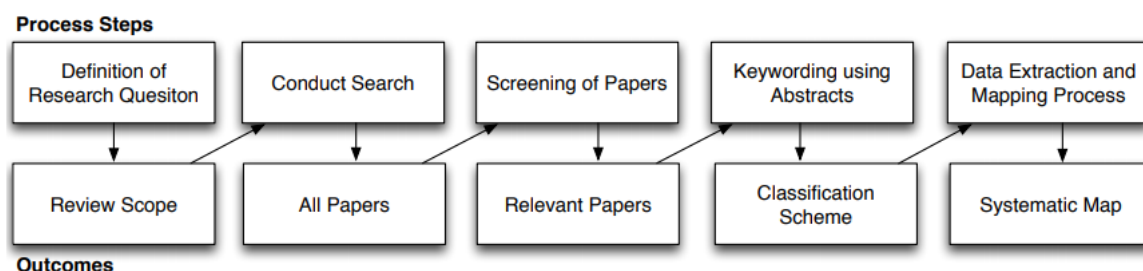


Figure 2. Systematic Mapping Process (Peterson et al., 2008)

## MATERIALS AND METHODS

Following the steps presented previously (Brereton et al., 2007; Peterson et al., 2008), it begins by elaborating the questions that should be answered by the survey with a focus on the theme of the proposed research. With the scope defined, the primary questions (PQ) to be answered are as follows:

- PQ1. What are the software approaches to financial literacy?
- PQ2. What Artificial Intelligence and gamification techniques are used?
- PQ3. Which platforms are most used?
- PQ4. What is the target audience which these software are intended for?

In order to organize the work of searching in knowledge bases and to reach the greatest number of results and researches related to the proposed questions, the following strings (S) with the relevant terms were created:

- S1. "Financial Literacy" AND Software
- S2. "Financial Literacy" AND Game
- S3. "Financial Literacy" AND "Artificial Intelligence"
- S4. "Financial Literacy" AND Gamification
- S5. "Financial Literacy" AND "Intelligent Tutoring System"
- S6. "Financial Literacy" AND "Expert System"
- S7. "Financial Education" AND Software
- S8. "Financial Education" AND Game
- S9. "Financial Education" AND "Artificial Intelligence"
- S10. "Financial Education" AND Gamification
- S11. "Financial Education" AND "Intelligent Tutoring System"
- S12. "Financial Education" AND "Expert System"

With purpose to consolidate and group the returns and also to evaluate the relevance of the studies found, the following inclusion (IC) and exclusion (EC) criteria were considered in category format as follows:

- IC1. Designs and Models for financial literacy software
- IC2. Technical approaches in financial literacy. Ex: Artificial Intelligence, Tutoring System, Augmented Reality, Virtual Reality, etc.
- IC3. Developed software for financial literacy
- EC1. Investment or Risks evaluation tools
- EC2. Corporate or Public institutions financial management tools
- EC3. Not a financial literacy software paper (out of the scope)
- EC4. Full texts not available

To execute the search in a broaden way, looking for avoiding biases, the selected knowledge bases were ACM Digital Library, IEEE Xplore Digital Library and Scopus, given the focus on information technology jobs. IEEE research was conducted using the advanced search tool. The JabRef reference management software (JabRef, 2018) was used to help to find repeated papers among strings and bases. The searches were performed on April 30, 2018 applying the strings to these databases, the following results were obtained and tabulated in table 1.

Databases	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	Repeated	Total Found
ACM-DL	1	3	0	1	0	0	1	1	0	1	0	0	3	5
IEEE Xplore	2	1	0	43	0	0	1	1	0	0	0	0	4	44
Scopus	8	12	2	3	0	0	5	20	1	1	0	0	20	32
<b>Total</b>	11	16	2	47	0	0	7	22	1	2	0	0	27	81

Table 1. Results count of each searched strings per database

The results obtained do not consider filters by date, that is, papers published on any date were considered to increase the comprehensiveness of the results of the searched terms. We excluded results that were replicated in different databases or that appeared in more than one searched string, different publications of the same research were considered for evaluation. These steps are duly detailed in the flowchart of figure 3. When applying the inclusion and exclusion criteria to the results of the previous table, the total of selected works can be seen in table 2.

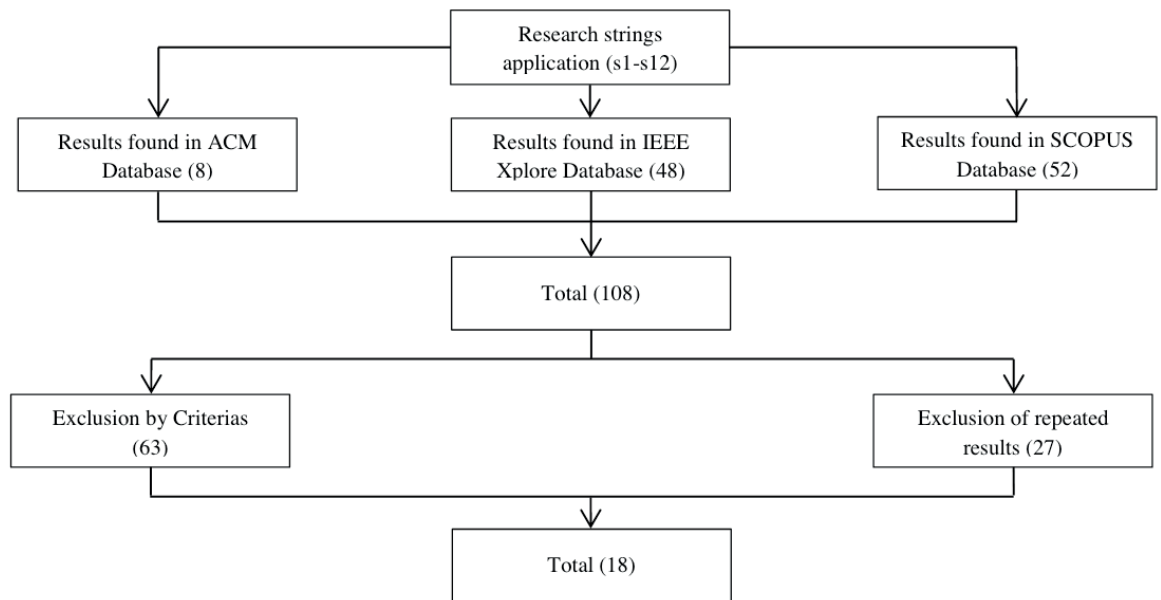


Figure 3. Research flowchart

	Inclusion Criteria			Exclusion Criteria				Total
	IC1	IC2	IC3	EC1	EC2	EC3	EC4	
<b>Papers</b>	4	3	11	14	1	46	2	81
	18			63				

Table 2. Application of inclusion and exclusion criteria

## RESULTS ANALYSIS

Evaluating the number of papers included in the inclusion criteria is shown in figure 4, there is a constant number of publications per year from 2008 onwards, with no publications in 2014 and 2015, even if there are no more than 4 papers.

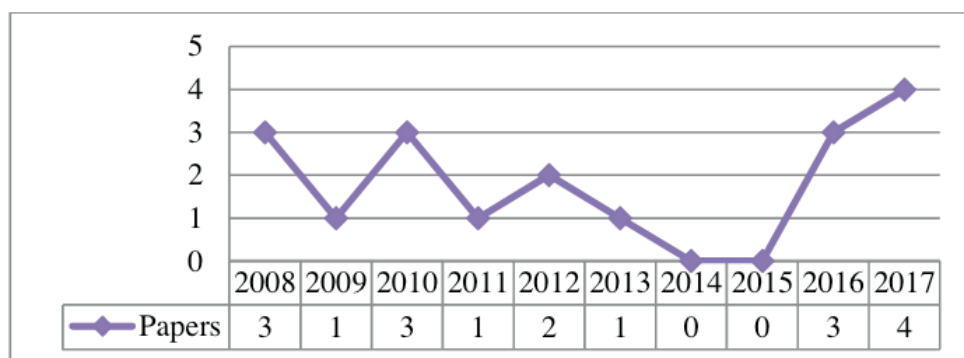


Figure 4. Financial literacy software papers per year

These numbers are pulverized among several countries of the world, being presented here the country of use of the tool developed or evaluated by the paper analyzed as can be seen in figure 5 below.

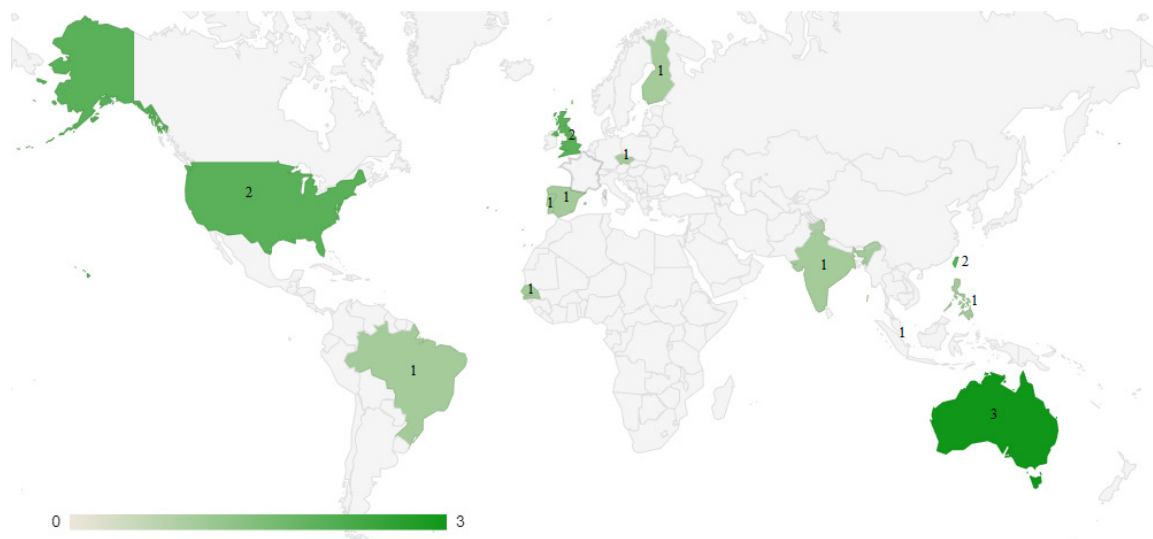


Figure 5. Countries of use of encountered Software solutions

For the grouping of the papers the standard of inclusion criteria was used and within each group the papers received ids ordered by author and year of publication, as can be seen below. In the IC1 were related the works that even though they did not have a software developed, demonstrate the operation through an application model or design, or even analyzes of other software not developed by them, as presented in table 3.

ID	Authors	Year	Title	Country
i01	Hašek & Petrášková	2016	Financial education in teacher training with technological support	Czech Republic
i02	Kalmi	2017	The Effects of Financial Education: Evidence from Finnish Lower Secondary Schools	Finland
i03	Koh	2016	Approaches to teaching financial literacy: Evidence-based practices in Singapore schools	Singapore
i04	Reis & Almeida	2016	The use of mobile devices to support daily routines of teens with Down syndrome: A case study	Portugal

Table 3. Selected papers for IC1

In this criterion the papers present ways of using applications developed by third parties, with the purpose of developing the initial steps of financial literacy in children, teenagers through videos and cataloged readings (i02, i03) and also by games (i03), to peoples with down syndrome through mobile applications for use in daily routines (i04), and for teacher training through readings and spreadsheets (i01). None of the works related to this group makes use of gamification or tools with artificial intelligence, and although Koh (i03) deals with gamification at certain moments of the text the given examples are related to games and simulations not to gamified applications.

For the inclusion criterion 2 (IC2) were selected papers with a focus approach to

the technique for financial literacy software such as artificial intelligence using artificial neural networks (ANN), support vector machines (SVM), as well as intelligent tutors systems and expert systems presented in table 4.

ID	Authors	Year	Title	Country
i05	Huang	2007	A Financial Literacy Simulation Model using Neural Networks: Case Study	Australia
i06	Huang	2008	Application of Support Vector Machines in Financial Literacy Modelling	Australia
i07	Tawfik	2009	Analysing financial literacy determinants with computational intelligence models	Australia

Table 4. Selected papers for IC2

The three papers selected are related to reports of the same research, it is a survey of financial profile and lifestyle of young students between 16 and 24 years old from responses to a questionnaire and an artificial neural network (ANN) are trained from the answers to these questions. By the analysis of error factor and learning rates the presented model returns the approximate classification of the respondents (i05, i06, i07).

In the inclusion criterion 3 (IC3), the works are related to software developed by authors and these software are already completed and presented for use in initial financial education as can be seen in table 5.

ID	Authors	Year	Title	Country
i08	Cavalcante	2017	"Edu no Planeta das Galinhas": Development process of a game about financial education for children	Brazil
i09	Chambers & Shufflebottom	2010a	"Innovation in inclusion" - a financial m-learning game: Part one	UK
i10	Chambers & Shufflebottom	2010b	"Innovation in inclusion" - a financial m-learning game: Part two	UK
i11	Chen et al	2010	My-investment: Simulation games to help primary students learn financial management	Taiwan
i12	Giridher et al	2009	Mobile applications for informal economies	Senegal
i13	Kumar et al	2013	Banking 101: Mobile-izing financial inclusion in an emerging India	India
i14	Raducu et al	2017	Innovation in Financial Education: ULe-Bank	Spain
i15	Samonte et al	2017	KASHING: A financial literacy microlecture app	Philippines
i16	Wu et al	2012	Primary students' financial learning within a pet-nurturing game environment	Taiwan
i17	Zhu	2011	Teaching OOP with Financial Literacy	United States
i18	Zhu & Shen	2012	A game based, financial literacy oriented approach to improving programming education	United States

Table 5. Selected papers for IC3

For financial education of school-aged children, basically, mobile games

focusing on animals were used to illustrate the teachings in a ludic way (i08, i11, i16). For university students the approach given is more technical, the teachings were passed mixed in classes of Java object oriented programming where the intention is to create the applications knowing the requirements related to concepts of Savings, debt management and investment (i17, i18) and in another university from the development of a web application for banking simulation (i14). For adults there are several approaches, ranging from focusing on low literacy with the concern of creating mobile applications with audio visual resources and little or no text (i12, i13) and games (i09, i10, i14, i15).

In four of the works (i09, i10, i11, i16) the structure of the games is based on decisions of consumption, using the mechanics of finding a job in the virtual environment in order to make money and to make expenses in places like markets or even in casinos.

Table 6 shows a detailed analysis of the approaches used by all the filtered works, however since the concept of gamification is the use of game components in other environments (Werbach and Hunter, 2016), the games did not have the gamification components evaluated for being outside of this scope (i08, i09, i10, i11, i14, i17, i19). Some papers did not comment on the development platforms or the operating systems where they were used (i05, i06, i07, i11, i17).

ID	Software approach	Plataform	AI Techniques	Gamification Techniques	Target Audience
i01	App	PC\ (Spreadsheets), Web	None	None	Adults (teachers)
i02	App	Web	None	None	Teens, Adults (15-18 years old)
i03	App, Game	Web, Mobile	None	None	Teens, Adults
i04	App	Mobile	None	None	Teens (16 years old)
i05	App	---	Neural Networks	None	Teens, Adults (16-24 years old)
i06	App	---	Neural Networks and Support Vector Machines	None	Teens, Adults (16-24 years old)
i07	App	---	Neural Networks and Support Vector Machines	None	Teens, Adults (16-24 years old)
i08	Game	Mobile\ Various OSs (Unity)	None	---	Children
i09	Game	Mobile\ OSs with Flash Lite 2 support	None	---	Teens (13-15 years old)
i10	Game	Mobile\ OSs with Flash Lite 2 support	None	---	Teens (13-15 years old)
i11	Game	---	None	---	Children
i12	App	Mobile\ Various OSs (J2ME)	None	None	Adults (Womem)
i13	Game	Mobile\ OSs with Flash Lite 2 support	None	---	Adults
i14	App	Web\ Google App Engine	None	None	Adults
i15	App	Mobile\ Android	None	Points and Leaderboard	Any



i16	Game	---	None	---	Children
i17	App	PC\Various OSs (Java)	None	None	Adults
i18	Game	Mobile\ (Android and Windows), Web, Game Console (XBOX)	None	---	Adults

Table 6. Summary of the approaches, platforms, techniques and target audience of each paper

With the data in table 6 it is possible to summarize the indicators related to the software approach, which were separated here between games and applications, target platforms classified between Mobile, PC, Web and Game Console (games for more than one platform were counted in all that they were intended), use of gamification techniques and artificial intelligence and target audience (Children, Teens, Adults) as can be seen in Figure 6.

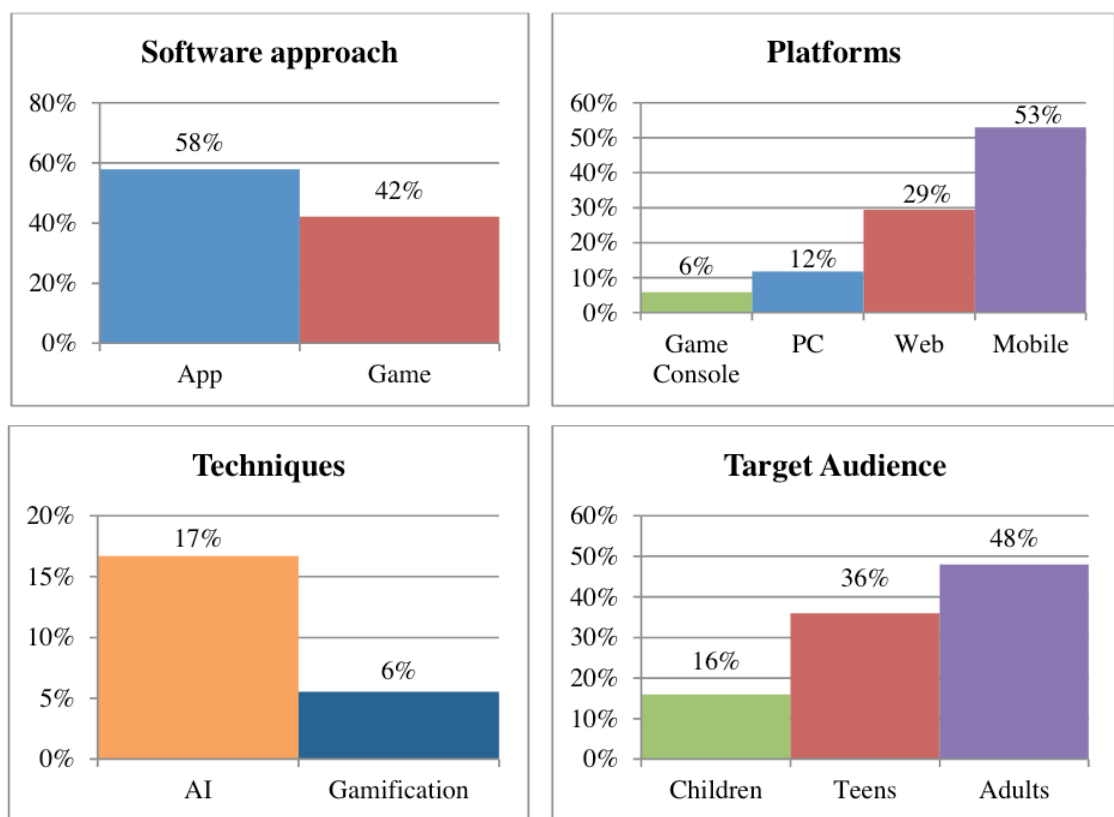


Figure 6. Indicators summarization

With this, it can be verified that of the 19 types of software presented in the selected papers 11 of them are applications, which shows a balance between the approach choices, which does not happen when analyzing the software platform, because 9 of the 17 platforms presented are mobile, equivalent to more than half of the choices of designers and developers, even if we evaluate only the group IC3, of the papers published by the developers themselves, this number rises to 7 of the 11 platforms presented and when analyzing only this group, the approaches also change, as the games are majority in choice (7 out of 11) leading mobile games to most of the choices in this group. Already gamification and AI techniques are little

used for this theme, since only 1 in 18 papers made the correct use of definitions and tools of gamification and the same happened with AI tools, 3 of the 18 papers made use, and being these 3 papers related to the same research, we noticed a lot of space for research in financial education that make use of these techniques, since terms like expert systems and intelligent tutors systems were not found among the returns of applied research strings. In the data related to the target public, it is noted that 84% of the studies focus on individuals over 12 years of age.

## CONCLUSION

Using the concepts of systematic reviews to create a protocol of research about software for initial financial literacy, this study uses all steps to its conception, and Prisma protocol to prevent biases and validate the findings. Using search strings previously selected to research about software of any kind and games (even though it is a software too received its own search string) that makes uses of techniques of artificial intelligence such as intelligent tutoring system and expert systems.

With this uses, would be possible to carry out a number of 81 studies about the theme (that includes not software studies), and after filtering it in tree classes of inclusion criteria and four sections of exclusion criteria (and removing repetitions) a number of 18 studies were selected and submitted to deep analysis.

Among the papers found with use of the search strings, 22% were about initial financial literacy software. These studies are used in Australia, Brazil, India, Finland, Philippines, Portugal, Senegal, Singapore, Spain, Taiwan, United Kingdom and United States. There was a balanced choice of applications and games (58% against 42% of use), and among the games evaluated, most are for mobile devices (75%). And in total of financial literacy solutions encountered, 84% of them are designed to be used by a target audience aged over 12 years old.

Given the combinations of the selected search strings, it was possible to notice the absence of applications of initial financial literacy that make use of expert systems or even of intelligent tutors systems. With this, as further work proposes the creation of experts systems capable of making use of user data in order to use their own money as punctuation and gamify their financial life.

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