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Intelligent information processing for language education: The use of artificial intelligence in language learning apps

Marcel Pikhart*

Faculty of Informatics and Management, University of Hradec Kralove, Hradec Kralove 500 03, Czech Republic

Abstract

This paper attempts to bring new ideas regarding the use of artificial intelligence in language learning apps. Artificial intelligence has seen a dramatic increase and its utilization in various aspects of data science, information science and various platforms is unprecedented. Its ubiquitousness is evident in smart cities, in online marketing, and data mining, however, its utilization in language learning apps is still somehow neglected. There are a few questions, such as why it is so, etc., this paper attempts to address. The research focuses on several most used language learning apps and the presence of artificial intelligence in them. The findings of the paper are as follows: basically none of the analysed apps uses any kind of machine learning, artificial intelligence or deep learning, and they are mostly based on predefined algorithms that do not utilize the full potential of the computational power we have currently available. The paper also suggests possible solutions and brings practical advice on how to implement artificial intelligence in these apps. The paper is important for any education innovation at the beginning of the 21 century. Without his innovative approach, education will lack sustainability and competitiveness, which will present a serious threat to the whole educational system.

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Keywords: artificial intelligence; mobile apps; language education; applied linguistics; educational sustainability

1. Introduction

1.1. Ubiquitous computing

Ubiquitous mobile devices and their impact on human life in its various aspects are unprecedented [1]. Generation Z, i.e. the younger generation of users of smartphones who are at their early twenties, use their

* Corresponding author. *E-mail address:* marcel.pikhart@uhk.cz

smartphones on a daily basis more than any other generation, it is an indispensable part of their lives [2]. They use them for entertainment, communication, work, and they are indispensable from their lives [3]. This aspect of their life must be taken into consideration when talking about education, as their all free time is devoted to these smart devices, educational apps could implement some aspect of learning while using these devices [4].

The mobile devices, such as smart phones and tablets, are ubiquitous, and with the implementation of the Internet of things (IoT), artificial intelligence (AI), smart cities and homes, and other similar modern information aspects of everyday realities, education and its innovation cannot lack behind these changes and modern trends [5, 6, 7]. If we - as educators - are not able to keep pace with technological progress, our educational institutions and processes will be threatened due to their lack of global competitiveness. We are fully responsible for the pragmatic utilization of all the modern aspects of intelligent information processing which should be considered when creating various courses, such as online courses, eLearning platforms, mobile apps for educational purposes., etc. [8].

The changes in pedagogy are under way regarding new approaches of both the educators who are responsible also for the creation of the courses but also the students who have radically different needs and approaches to retrieving knowledge and information. The current young generation of the students who were born around the year 2000 have radically different tools to acquire competencies and skills [9, 10, 11, 12]. They also use different tools for evaluation of the information they have acquired on-line. These aspects must be taken into consideration as well so as not to lose competitiveness and global sustainability [13, 14].

There is not much research into this issue recently due to the fact of the novelty of the topic, therefore, this paper presents crucial findings which could be helpful for educators to realize the importance of the matter and also the developers who should realize that this AI enhancement, despite the increased costs, can improve the sale of the given app. If there is a public recognition of the app (by the user satisfaction) then there is an increased demand for it which equals profitability.

1.2. Aim of the paper

This paper attempts to focus on the appropriate use of the computational power we have currently available in mobile apps which are used in language education. The possibilities of artificial intelligence are already massively used various kind of marketing (Amazon, Google, etc.) in the way we have never experienced before. The computer algorithms know us better than we know ourselves and it is widely exploited in personalized offer of these and other business to customer services.

Delivering more personalized content is a must in all kinds of direct marketing processes and it goes without saying that these computational aspects will be used more and more often so that these services are optimized with the aim of improved sales and profitability. The same rule can be applied in mobile apps, i.e. more personalized contents optimized by artificial intelligence will bring benefits to the users in the way the educational contents is tailored to the needs of the users [15, 16, 17, 18, 19].

1.3. Artificial intelligence in education

These are the aspects of this artificial intelligence enhanced education:

- Utilization of big data processing
- Education informatization 2.0, i.e. implementation of IT into educational process with AI aspects
- Personalized learning – based on construct learner profile

Naturally, all these aspects are interconnected, and they work hand in hand and cannot be separated.

1. First, big data processing and data mining will bring new challenges for the educators but also an indispensable tool for mining data which we have never obtained and which present a rich source of data which will prove useful for learner's profile creation [20].
2. Second, the most important aspect of education informatization 2.0 is its connection to AI. If education information only relies on eLearning platform as repositories of texts, tests, videos and communication tools, it is not sufficient. AI must be implemented in education platforms in the similar way it is used in

the sales channels such as Amazon, etc. This will enable us to guarantee solid educational innovation and active promotion of new theories and practices [21, 22].

3. Third, personalized learning will be based on intelligent learner information processing. Again, big data algorithm will create a learner's profile so that the app which is used in the learning process will present the information to the learner which is targeted to their specific needs and demands. This is very important in not only in testing but also in the whole learning process so that the user will be equipped with optimized information and data. This tailor made solution will be particularly useful in part time students and also any kind of distance learning (for example in the time of health crises when traditional education will be suspended for a large periods of time, such as the coronavirus crisis in the year 2020) [23, 24, 25, 26].

2. Research design

2.1. Research description

The research focused on 10 mobile apps which are used for learning a foreign language based both on the Android platform and iOS. They were chosen according to the number of downloads, i.e. ten most downloaded apps were tested. Some of them have more than 100 million downloads and we can assume that they will probably have several million of users. The exact numbers of users are not available; therefore, the number of downloads was the primary indicator to test these apps.

All these apps have the user evaluation score higher than 4 out of 5, which indicates that the users are very satisfied with these apps. All these apps were downloaded as of February 2020 and evaluated from the user point of view whether they implement any kind of artificial intelligence.

The Table 1 summarizes the information about the apps which were tested. All the apps are named using letters of the alphabet for the reasons of confidentiality. There is no need to use disclose the name of the app as this research does not aim at improving a particular app but only describes the current situation in the use of AI in mobile apps which are used in language education.

Table 1. The list of tested apps.

Name of the app	Review (out of 5)	Number of downloads (in millions)
A	4.7	100+
B	4.6	10+
C	4.7	10+
D	4.7	1+
E	4.7	1+
F	4.7	5+
G	4.1	1+
H	4.7	0.1+
I	4.5	0.1+
J	4.6	0.05+

2.2. Research hypotheses

The world around us is vastly influenced by AI and it is ubiquitous in basically all intelligent aspects of human life. Therefore, it can be claimed that **(H1)** in mobile apps which are used for learning foreign languages AI aspect must be present in the majority of them at least in its basic form. Hypothesis 2 **(H2)** claims that the use of AI in mobile apps will increase their attractiveness for the users.

2.3. Testing

The testing was conducted in February 2020 from the user point of view, however, from a position of an educated opinion, i.e. with solid information regarding the nature of AI in mobile apps.

The idea behind the test was to identify possible usage of AI in the language apps, i.e. if those apps are only repositories of various texts and listening activities or if they use some more sophisticated tools which are clustered under a term of AI or deep learning, machine learning, etc.

The researcher focused on the presence of various kinds of AI that could be used in these mobile language apps such as processes which will not be based on predefined algorithms but will use some machine learning strategies. For example, in vocabulary acquisition the student will be tested not based on predefined tests and procedures, but rather on their progress in the language acquisition process. In the same way, grammar could be tested likewise, i.e. there are no predefined tests, but the user of the app is tested based on their past performance. Another aspect of AI in these apps could be that the students would be able to read articles which are based on their personal preferences based on e.g. Google research, etc. Of course, there are many privacy issues regarding e.g. GDPR, but they could be resolved by an agreement of the user to use this data which could help the app to personalize the contents for the user.

2.4. Research limitations

The research was conducted on a limited sample of apps, however, these are the most downloaded apps, therefore, it can be claimed that the results which are yielded by this research are relevant and can be generalized in the area of mobile apps for language learning.

It is highly probable that these vastly used apps will have more resources (both funds and people) to implement AI rather than smaller developers. However, further research is needed in due course to test if there is any development in time as AI has been implemented recently in basically all areas of human activity.

3. Results

3.1. Research results

The findings of the research after testing these apps are rather surprising and as follows:

- The vast majority of the apps do not use any AI
- Basically, all of them only used predefined algorithms without any deep learning or machine learning
- The AI is present in traces in speech recognition, however, only in two tested apps and still not used the full potential of AI

Table 1. The list of tested apps and the use of AI

Name of the app	The use of AI
A	Some traces of AI when testing the user's pronunciation

B	No AI detected
C	No AI detected
D	No AI detected
E	No AI detected
F	No AI detected
G	No AI detected
H	No AI detected
I	It seems that AI is used in speech recognition
J	No AI detected

In summary, the apps lack basically any presence of AI, deep learning or machine learning. Mostly, they behave on their predefined algorithms. This function is naturally necessary, but it should be used only as a starting point, later after an initial test the user should have an opportunity to obtain a personalized content. In none of the tested apps this has not been confirmed.

The vocabulary is just based on lists of words and very simple testing paradigms. In some cases, AI is detected in a very simple form in speech recognition aspects of the tested apps. Only in the apps A and I, we found some traces of the use of AI, namely, in the pronunciation testing part. The user has to pronounce a particular word and the app recognizes if the word pronounced corresponds with the word in the database. Naturally, this function demands an advanced use of AI, however, in the tested apps it is used only in its very limited functions with a very high level of mistakes. For example, if the user only imitates the intonation, it is evaluated as correct, despite the fact that, in reality, the answer was a total nonsense. Therefore, the speech super advanced speech recognition we know from Siri or Alexa is miles away from the reality we have available in mobile apps for learning foreign languages.

To sum it up, the world around us with the use of various kinds of AI is totally different when compared with the use of AI in the tested mobile apps. There are many questions which arise, such as why it is so and what to do to optimize the use of AI in mobile language apps. Therefore, this paper is bringing this matter to attention because the higher and higher numbers of students use these apps to improve their language knowledge and performance but regarding the tested apps, we cannot confirm that they really optimally use the available technological achievement.

The tested mobile apps are basically only vocabulary and grammar repositories and do not follow much of the technological achievements which are available at the beginning of the year 2020. We understand that these technological changes are very abrupt, and no one was expecting them five years ago, but the technological companies would be the first ones who should implement them in everyday reality.

The second part of the research focused on the testing of H2 that claims that the majority of the users would welcome AI implementation in the language apps and this implementation would increase their attractiveness and usefulness. 93% of the respondents clearly stated that AI implementation would be a positive improvement. Only 7% of the respondents claimed that there might be security issues when AI is implemented, and therefore, would not implement AI into these language learning apps. This finding is also crucial and should be considered as very important for designers of language learning apps.

3.2. Hypothesis verification

Despite the fact that AI is present almost everywhere in many aspects of human life these days, the hypothesis H1 that it will be present in mobile apps which are used in foreign language education has not been proved.

This finding is rather surprising and can be a stimulus for further activity regarding the implementation of AI in mobile platforms used for language education.

H2 has been confirmed as more than 90% of the respondents claimed that any kind of AI implementation into language learning apps would improve their attractiveness and usefulness.

4. Discussion

4.1. Recommendations

The findings of the research are rather surprising; therefore, it is necessary to reconsider the possibilities of AI and attempt to improve language education enhanced by mobile apps by implementing AI into them. The question is why there is basically no AI present in language apps when AI has been massively implemented in smart environments (smart homes, smart cities, eGovernment, etc.).

The most important recommendation regarding the use of AI is to implement it in a minimalistic way so that it will not be a costly solution, however, this simple implementation can significantly increase the efficiency of the app regarding its learning impact.

The most important aspect of AI implemented in language apps would be testing the user based on their progressive development, i.e. for example grammar exercises which would be modified and repeated until the user can successfully apply the given rules. The same can be done in vocabulary acquisition, i.e. the user will be tested the new word in various contexts until they are aware of the use and context of the given word. This is a substantial benefit of AI in mobile apps, probably the most important one because no human teacher is able to process so much information about individual students and the words or grammar each of them needs.

To sum it up the paper recommends to:

- Implement AI in language apps as soon as possible
- Implement AI in language apps in its simplest form to save money and time
- Improve the AI in language apps over time so that it will not be a costly solution

4.2. Future development

The future development of the utilization of AI in mobile apps for learning a foreign language will probably be very abrupt as can be seen in other areas of human endeavor, and it is very strange that our researched area still lacks behind. The reason would also be lower profitability opportunities which are connected to these apps. Implementing AI into them would be quite demanding regarding time and money, however, in the long run, the benefits are substantial, both for the user and the company offering the solution with AI.

Further development is expected regarding these mobile apps as follows:

- Mobile apps and mLearning will be more and more important
- Higher education institution will be willing to use mobile apps in their curricula
- Individuals and companies will be willing to pay more money for these educational apps

It is also very probable that any mobile app which wants to be attractive and therefore successful will have to implement, to a certain extent, AI, deep learning or machine learning, otherwise it will not succeed. The users will probably look for this parameter in the app description and it will be a benchmark upon which other apps will be evaluated.

4.3. Sustainable strategies

The paper attempted to highlight the importance of implementation of artificial intelligence, deep learning and machine learning into the language learning apps. After the analysis of the current situation regarding the utilization of these current approaches, the research clearly shows that the application of any kind of artificial intelligence is nearly missing. The reason for this is unknown and is appalling when we consider how much attention is given to the topic in the area of marketing and data mining in other areas of human endeavor, such as business and ICT.

However, it is important to highlight the importance of this implementation and utilization, otherwise our education cannot be competitive enough and the language education will lose its sustainability in the global world.

This paper is an attempt to prove that this issue needs our attention and IT companies should use this as an opportunity for enhanced profitability. Higher education institutions should be ready to help with the development of AI enabled devices and apps so that they can be used in their educational processes.

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