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Artificial intelligence adaptive learning tools: the teaching of English in focus

Plataformas de aprendizagem adaptativa com base na Inteligência Artificial: o ensino da língua inglesa em foco

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Abstract: This paper explores the field of Artificial Intelligence applied to Education, focusing on the English Language Teaching. It outlines concepts and uses of Artificial Intelligence, and appraises the functionalities of adaptive tools, bringing evaluative feedback on their use by American school teachers, and highlighting the importance of additional research on the matter. It was observed that the tools are valid media options to complement teaching, especially concerning adaptive learning. They offer students more inclusive opportunities: they maximize learning by tailoring instruction to address students 'needs, and helping students become more responsible for their own schooling. As for teachers, their testimonials highlight the benefits of dedicating more class time to the students' most pressing weaker areas. Drawbacks might include the need to provide teachers with autonomy to override recommendations so as to help them find other ways to teach a skill that seems to be more effective for a specific student.

Keywords: Artificial Intelligence in Education (AIEd). English as a Foreign Language (EFL). Adaptative Learning Systems (ALS). The P21 Framework.

Resumo: Este artigo trata da Inteligência Artificial aplicada à Educação com foco no ensino da língua inglesa. Descreve os conceitos e usos da Inteligência Artificial e examina as funcionalidades das plataformas adaptativas, incluindo a avaliação de seu uso por professores estadunidenses da Escola Fundamental. Enfatiza, igualmente, a necessidade de pesquisas adicionais sobre o tema. A análise mostrou que as plataformas são opções válidas para complementar o ensino, especialmente na aprendizagem adaptativa. Elas oferecem oportunidades de inclusão, pois maximizam a aprendizagem de acordo com as necessidades dos alunos e os auxiliam a se tornarem mais autônomos. Já os professores salientam que podem dedicar mais tempo de aula aos tópicos de maior dificuldade entre os estudantes. Quanto às limitações, os docentes sentem que as plataformas deveriam proporcionar maior autonomia, para que pudessem substituir as recomendações automáticas dadas e encontrar outras formas de ensinar habilidades que considerassem mais efetiva para seus alunos.

Palavras-chave: Inteligência Artificial na Educação (AIEd). Inglês como Língua Estrangeira (EFL). Sistemas de Ensino Adaptativos (ALS). *Framework* P21.

Introduction

It is undeniably true that digital technologies have become an indispensable part of our everyday life and changed the way we look for information, communicate with each other, and behave. With recent technological advances in different productive workplaces, individuals have at their disposal a set of devices for their immediate use such as Virtual Reality in neurosurgery (3D Oculus Surgical Theater[3]), Augmented Reality (AR app Elements 4D designed to understand

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[3] It is used for simulating the surgery process of removing brain tumors.

atomic structures of chemical elements), and Artificial Intelligence (AI). In this paper, we will focus on AI for educational purposes (AIEd), more specifically for the English Language Teaching (ELT) field by describing techniques that can improve classroom performance and maximize personalized learning experiences.

As for Artificial Intelligence (AI) tools, it is known they are widely present in a variety of businesses, including banks, agriculture, social media, and streaming services. However, despite all its potential and demonstrated benefits, it is still underexplored in a substantial number of educational environments around the world. Like so many other subjects, the very nature of teaching - and learning - is acquiring new meanings as a result of constant changes in society. Historically speaking, technological advancements over a wide range of activities often resulted in not only new tools but also new educational roles and ways of teaching and learning.

More than a decade ago, an example of a modern framework for innovation in education (P21) was developed by a coalition, known as the Partnership for 21st Century Learning, of the US Department of Education, Apple, American Online Inc. (AOL), Microsoft, Cisco, and Student Assistance Program (SAP), and educational organizations such as the National Education Association (NEA). The P21 Framework, first published in 2006 and updated in 2015, is a model for incorporating 21st-century skills into learning that has been used by educational references like Holberton in San Francisco, Wildflower in Boston, and Portfolio in New York. The three schools have prepared students for an interdisciplinary world, connecting subjects in a meaningful way while developing fundamental XXI century skills.

Remake Learning (2016)[4], a network that promotes engaging, relevant, and equitable learning practices, points out that

> This framework was created to combine a set of competencies that emphasizes 21st Century Skills for students and supports teachers in teaching those skills. It uses core academic subjects as a vehicle for teaching life and career skills, learning and innovation skills, and information and media skills. These skills allow students to be better prepared for today's highly collaborative, innovation-focused workforce. For this reason, student outcomes in this framework are often described in terms of the future impact they will have for students when they seek employment (online).

These skills, which are part of the P21 Framework, are illustrated below: the student outcomes are represented by the arches of the rainbow whereas the support systems by the green boxes at the bottom.

Figure 1 – P21 Framework for 21st century learning
Source: Remaking Learning. (2016, April 29). *Demystifying learning frameworks*: the P21 Framework. Remaking Learning. https://remakelearning.org/blog/2016/04/29/demystifying-learning-frameworks--the-p21-framework/.

As for green arch "Life and Career Skills", we cite the World Economic Forum (2015), which stated that there are sixteen needed skills for today's job market. Among them are everyday skills related to information, media, and technology literacy competencies (critical thinking and problem solving, communication and collaboration), and character qualities in changing environments (curiosity, adaptability, leadership, initiative, persistence, and social-cultural awareness). The first four competencies concern how individuals approach complex challenges in life, and with AI, professionals of the future will be required to be more human than ever and think creatively to solve problems. Being able to communicate effectively

[4] https://remakelearning.org/

and work as a group are also fundamental life skills that apply to any context and are strongly influenced by emotional maturity, which must be developed from an early age in order to generate good professionals in the future. The last set of skills is already highly valued by companies that use it as criteria for hiring candidates because such skills display how the candidate deals with changes in organizations, a phenomenon that has grown at an unprecedented rate these days.

The World Economic Forum has also praised AIEd for enabling easy reproduction of promising models and sharing the best practices so that other teachers can gain insight into how and what students learn in real-time. The report mentioned the increase in teacher productivity, which gives them more free time to dedicate to activities other than grading and testing (2015, online).

As regards classroom, Underwood and Luckin (2011) affirm that AI techniques can improve class performance by delivering more inclusive and personalized learning experiences, and diagnosing basic achievement gaps through the automated correction of students' assignments. Addressing automatically identified achievement gaps would empower students to progress in class and further develop their learning skills. Also, natural language recognition algorithms would help allocate the teachers' time in the analysis of machine-generated insights regarding the students' needs and their professional development. AI-powered adaptive learning tools, featured as important developments in educational technology, offer the possibility of personalizing the student's journey with unique feedback to each online interaction.

That said, we move forward to the principal aims of our study: i) offer the reader some reflection and facilitate discussion on the potential of AI-powered adaptive learning tools in the field of English Language Teaching; ii) explore the benefits of AI-powered adaptive tools to personalized learning in the EFL classroom; and iii) analyze two of the most relevant adaptive tools available based on faculty reports, more specifically, the functionality of My English Lab and SuccessMaker applied in regular (language) schools, and the tests used to measure improvement in light of the P21 Framework for 21st Century Learning.

This theoretically-oriented text falls into Artificial Intelligence in Education with a focus on English as a Foreign Language. Both the theoretical principles and spoken accounts presented by language educators, helped think through some of the most relevant tasks performed by AIEd, which will be referred to in the sections that follow. Firstly, we describe the main concepts and uses of AI to provide the reader with some information background; secondly, we outline the adaptive tools used in education with an eye to the ELT field, and discuss the potentialities of two software tools, bringing evaluative feedback on their use by school teachers; and thirdly, we draw some conclusions and highlight the importance of additional research on the matter.

1. Concepts and uses of AI

AI was used for the first time in 1956 during a workshop organized by John McCarthy at Dartmouth College. The main objective of the meeting was "The study (of Artificial Intelligence) is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be created to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans and improve themselves" (Russel & Norvig, 2010, p. 17).

McCarthy's hopes related to AI, i.e., that computers would be able to replicate human cognitive functions and think like humans have not been proven correct as the question remains whether machines will actually develop independent consciousness in the future. Marr (2018) ponders that "as research has progressed, scientists modified their expectations and concentrated their activities on building "models based on human reasoning, without the end goal of replicating complex human thinking".

Contemporary definitions of AI differ in various

ways given that the field is interdisciplinary and comprises the areas of Computer Science, Philosophy, Anthropology, Biology, Pedagogy, Psychology, Linguistics, Cognitive Science, Neuroscience, Statistics, and others. Some theorists consider AI as a specific set of skills of computers, e. g. Baker and Smith (2019, p. 10) define AI as "computers which perform cognitive tasks, usually associated with human minds, particularly learning and problem-solving". Others like Stone et al. (2016, p.4) see AI in a much broader context, as a Science: "AI is a science and a set of computational technologies that are inspired by—but typically operate quite differently from—the ways people use their nervous systems and bodies to sense, learn, reason, and take action". While AI-powered machines are not able to substitute humans, their ability to reproduce intelligent behavior derives from scientific knowledge of our own cognition.

In this paper, we were inspired by the definition of AI given by Luckin et al. (2016, p. 14) who define AI as "computer systems that have been designed to interact with the world through capabilities (for example, visual perception and speech. recognition) and intelligent behaviors (for example, assessing the available information and then taking the most sensible action to achieve a stated goal) that we would think of as essentially human". These computer systems, the authors suggest, include a wide range of technologies and methods, such as machine learning, adaptive learning, natural language processing, data mining, crowdsourcing, neural network or an algorithm.

Data processing is possible due to the existence of algorithms, which according to the Oxford Dictionary[5], are "a process or set of rules to be followed in calculations or other problem-solving operations, especially by a computer". These detailed series of instructions can be designed to recognize faces and speech, correct grammar or even suggest movies according to individual preferences. Such algorithms are used in the deep learning approach, an architecture inspired in the connections and neurons of the human brain, mimicking the neocortex. According to Hof (2013), what differentiates deep learning from Artificial Neural Networks (ANN) is the capacity of the former to process thousands of layers of data and having up to billions of parameters active at the same time. The input data can be anything digital, from text to sound or image, internally labeled and used by the trained algorithms that mathematically select and analyze patterns or predict possible outcomes.

When it comes to cognitive models, user modeling is paramount to the success of AI cognitive systems. It consists of building up and modifying an internal representation of the user in order to adapt to their specific needs. To put it simply, the system needs to be able to give the proper response at the right moment in the right way, according to previously established parameters. In the diagram below, we can see how the algorithms process information between cognitive models and return feedback to the user.

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5 https://en.oxforddictionaries.com/definition/algorithm

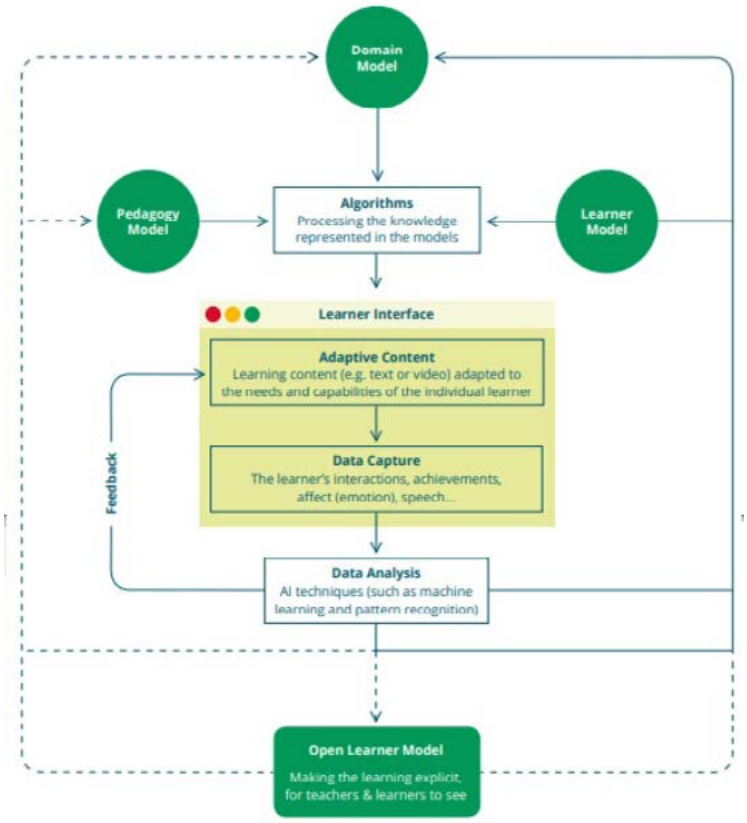
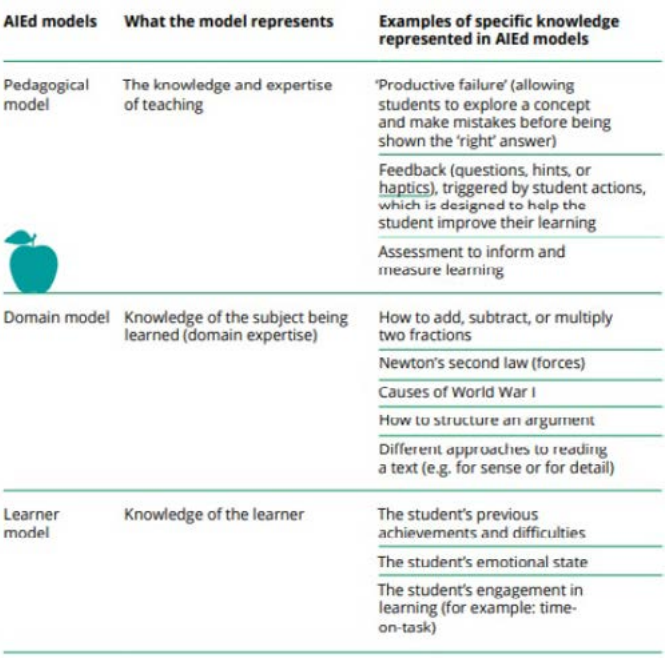


Figure 2 – Data processing in machine learning cognitive models
Source: Pearson. (2016, n.d.). *Decoding Adaptive Report*. Pearson.https://www.pearson.com/content/dam/one-dot-com/one-dot-com/uk/documents/educator/primary/Pearson-Decoding-Adaptive-Report.pdf

This groundbreaking technology allows us to program software to provide instantaneous feedback for tasks once the algorithm will have been trained with huge amounts of data and will be able to recognize the phonemes produced by the student, the grammar patterns used, their progress in a period of time and even the risk of school evasion, based on the level of engagement. Thankfully, AI offers the necessary means to analyze student performance over time and Big Data enables us to collect substantial amounts of data on which practices are working for each student in the classroom. Consequently, this data collection can be interpreted by the teacher and incorporated in the classroom to fill achievement gaps and improve results.

As we can see in the next figure, the AIEd domain model represents the content, the pedagogical model represents knowledge of teaching techniques and the learner model represents the cognitive system (the student). A simulation model of the student predicts what they will do next. Additionally, it can also be used to retrace the students' steps to explain the basis of their behavior.



AIEd models	What the model represents	Examples of specific knowledge represented in AIEd models
Pedagogical model	The knowledge and expertise of teaching	'Productive failure' (allowing students to explore a concept and make mistakes before being shown the 'right' answer)
		Feedback (questions, hints, or haptics), triggered by student actions, which is designed to help the student improve their learning
		Assessment to inform and measure learning
Domain model	Knowledge of the subject being learned (domain expertise)	How to add, subtract, or multiply two fractions
		Newton's second law (forces)
		Causes of World War I
		How to structure an argument
		Different approaches to reading a text (e.g. for sense or for detail)
Learner model	Knowledge of the learner	The student's previous achievements and difficulties
		The student's emotional state
		The student's engagement in learning (for example: time-on-task)

Figure 3 – AIEd models explained (Pearson, 2016)

The flow of data, starting with the capture and analysis of user's input to recognize patterns previously established in the pedagogy, domain and learner models, culminates in feedback to the user's performance and learning content adapted to the needs of the user. This model along with the 21st Century framework allowed us to discuss the possibilities of AIEd and the benefits EFL classrooms can receive from its features.

In the section that follows, we address this topic focusing on the ways AI have created efficient and flexible learning tools for education, especially language learning. It is known that these tools can help learners prepare for this swiftly changing reality, impacting on jobs and life in society as a whole.

2. AI-powered tools in education (AIEd) and language learning

As above indicated, AI-powered tools in education are seen as potentially beneficial to both students and teachers since they offer the opportunity to experience personalized, flexible, inclusive, and engaging learning. They also provide teachers and learners with the tools that allow them to respond to how it is being learned, and how the student feels rather than what is being learned. The tools help learners develop the knowledge and skills for a changing job market as well as assist teachers in creating more sophisticated and inspiring learning environments than would otherwise be possible (Luckin et al., 2016).

When using technology in class, teachers should not forget or overlook the human aspect of teaching. Therefore, in addition to pay attention to their students' feelings, some software allow teachers to add personal questions in the learning path. When correctly added, teachers can add questions such as "How do you feel doing this exercise?", "Are the questions difficult for you?", "How are you doing so far?", "What questions do you have about this topic?" Once some students are shy, typing their answer into a gadget (mainly in a gamified context) may allow them to feel more comfortable. Teachers can have instant access to these answers and, in face of negative answers, act to help their students. (LEMOV, 2018)

The field of AIEd, thus, fosters the development of adaptive learning aided by personalized, engaging tools. One of the many contributions of AIEd currently at use is the application of

educational data mining[6] techniques to check whether students are regularly attending class or handing in their assignments in order to identify the risk of school evasion. Another merit of AIEd is the possibility of offering effective simulated one-to-one tutoring in a class with 20 or 30 students, which allows the teacher to focus on social and creative tasks instead. In fact, intelligent tools can even contribute in group formation using its knowledge on each individual student to create probalanced groups with complementary knowledge and skills. The use of machine learning can also analyze and summarize group discussion so that the teacher knows when students are going off topic or failing to collaborate. The possibilities are endless.

According to Pearson (2016), AIEd tools present in model-based tutors can reproduce the cognitive and affective state of the learners, engage the student in learning experiences that involve active discussion, promote reflection and self-awareness and even use social simulation models that take into account the learners cultural and social norms.

Moreover, intelligent Virtual Reality (VR) applied to AIEd can also be fun: authentic immersive experiences such as historical role-playing games or a virtual visit to bottom of the ocean, which would probably never have been possible to students before, allow each student to interact with responsive environments in a simulated world and associate the language with an actual experience. Pearson (2016) states that an immersion in intelligent VR can improve educational outcomes as it enables students to experience and signify the world as they explore. Not to mention the benefits that role-playing brings to students with low self-confidence. Azevedo, Delgado and Silva (2017) present Google Expeditions as an interesting VR resource for the classroom, showing that teachers are not limited by the classroom walls. The app enables teachers to guide students through collections of 360° scenarios and 3D objects by pointing out national and international locations and artifacts. The authors first provided students with texts about the landmarks they would virtually visit to help them become linguistically and culturally familiar with them; the teachers would then select the same scenarios for students to visit using Google Expedition; finally, students were required to explore the places and take notes about the city they had seen by expressing their feelings and impressions with their classmates.

Fun and games aside, there is a highly promising field inside AIEd, the adaptive learning tools, mentioned earlier, dedicated to personalizing each student's experience. They consist of education technologies based on real-time interactions that provide the student with individual feedback and support, and can propel our knowledge on what learning experiences work best for each individual student, helping teachers reach great motivation and engagement rates in the classroom. Some students often lag behind their classmates because of achievement gaps: addressing such gaps can help them develop the skills they need to meet grade-level expectations.

Pearson (2016) affirms that the most difficult part of evaluating adaptive tools is to discover where exactly they truly adapt. There are usually three places where adapting usually happens: content, assessment and/or sequence. Some tools are adaptive in more than one way, as the ones we will examine below.

Regarding adaptive content, it responds to student interaction with feedback and hints based on specific input, offering additional materials so the user can review and give accurate answers in the future. These responses are provided over each piece of content aligned with a given skill. This feature is called scaffolding and consists in breaking content into smaller chunks until the student is able to put the parts together. The author states that adaptive content is more likely to keep students motivated and making progress than regular, non-adaptive content. In figure 4, we see an example of how scaffolding works with literacy.

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[6] The development and use of methods to analyze and interpret the 'big data' that comes from computer-based learning systems and from school, college, or university administrative and management system (PEARSON, p.24, 2016).

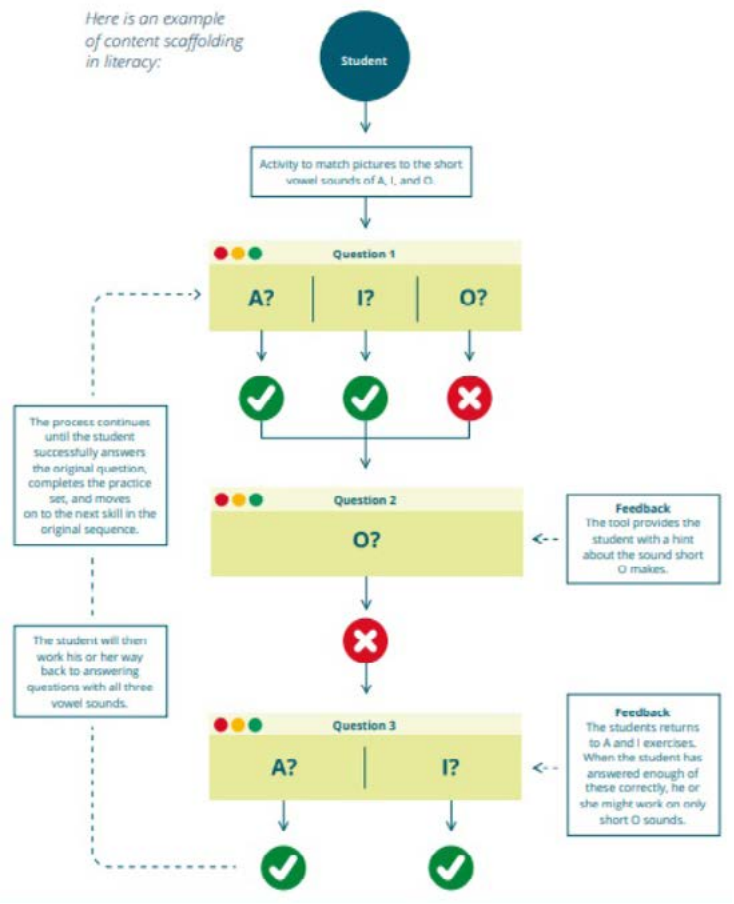

Figure 4 – Example of the scaffolding process in literacy
Pearson. (2016, n.d.). *Decoding Adaptive Report*. Pearson.https://www.pearson.com/content/dam/one-dot-com/one-dot-com/uk/documents/educator/primary/Pearson-Decoding-Adaptive-Report.pdf

As for adaptive assessment, Pearson (2016) claims that it consists of changing the level of the questions that are presented to the user based on their performance in the previous question, which helps teachers monitor student progress. In practical terms, it means that a student who answers correctly to an easy question will receive a more difficult one next. When tools with adaptive assessment are used as tests, the author explains that mathematical models are used to ensure that the test is adequate to measure students' academic success.

On the other hand, tools that have adaptive sequence differentiate themselves from other tools because they must collect real-time data and use it to change the sequence of what the user sees next, automatically adjusting the learning path. Objectively speaking, adaptive sequence is about collecting data, then analyzing the data and finally adjusting the content for the student with that data using algorithms and predictive analytics. We illustrate the process in the diagram below.

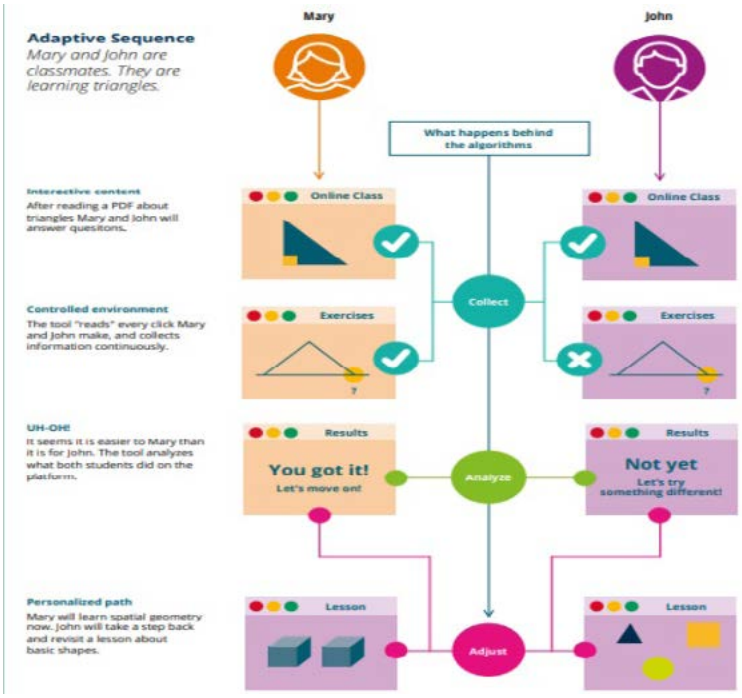

Figure 5 – Example of adaptive sequence
Pearson. (2016, n.d.). *Decoding Adaptive Report*. Pearson.https://www.pearson.com/content/dam/one-dot-com/one-dot-com/uk/documents/educator/primary/Pearson-Decoding-Adaptive-Report.pdf

As we can observe, the adaptive sequence process consists in asking questions after presenting the content and collecting student input. In the next stage, the algorithm analyses the students' interaction with the platform and later adjusts the path of each student according to their performance. A student who performed poorly, for example, will be guided to a review of the basic aspects that need to be improved.

Some of the data that adaptive sequence features collect are academic performance, the student's interests and the details of the learning process (how many attempts before the user answered correctly to a question or whether they used a dictionary). At any rate, Pearson (2016, p. 29) reminds us that "Tools that provide assessment, analyze the assessment data, and then assign a learning path but don't change the learning path until another assessment is administered are not adapting the sequence of the learning materials.

Similarly, Dougherty (in Wan, 2016) advises caution before making every student take these tests: "Try telling a five-year-old before you give them an adaptive assessment, that when [he or she] gets it right, it gets harder." Students—especially young ones—feel a certain measure of pride when they can solve test problems easily. Adaptive tests, which often focus on pinpointing weaknesses, can damage that motivation". This is one of the reasons why students need to be mentally prepared for adaptive assessments, according to Tricoche (in Wan, 2016). For her, "there's some growth mindset that has to be developed for students to be able to use these tests."

With that said – more reflection on assessment will be made later in the text - we proceed to depict the characteristics of two AI adaptive learning tools, MyEnglishLab and SuccessMaker.

3. MyEnglishLab (Pearson)

In this section, we present the main features of the adaptive tool Pearson's MyEnglishLab (MEL), and testimonials of English language teachers who have used it. We describe and analyse the tool, taking into consideration that it is adaptive in content and sequence.

MyEnglishLab[7] is an online platform designed to offer a complete English course with text, audio, video and voice-recorder all in one place. The tool offers practical exercises of the content in a way similar to a dynamic, interactive workbook with tasks for integrated skills. It offers instantaneous feedback based on the student's answer on each task, including text production, interpretation, audio and video comprehension and speaking.

MEL can be used by self-taught students, regular and language schools. Regarding format, MEL is a website-based platform that can be accessed from any browser on computers or mobile devices. Likewise, the tool provides live feedback and offers teachers the possibility of exporting a variety of reports about individual students and whole classrooms. Concerning implementation, it also offers either in loco training for the school staff or online tutorials and manuals to support the transition. In the picture below, we can see how feedback is provided to the student.

%	Student submission	MyEnglishLab response	MyEnglishLab coaching feedback
14.73	knew	INCORRECT	Look for *ten years*. Does it refer to a specific event in the past or one that lasts up to the present moment?
11.23	have knew	INCORRECT	Make sure you use the correct form of the verb. What is the past participle form of *know*?
9.30	had been	INCORRECT	This is past perfect tense. Make sure you use the correct form of the auxiliary verb *have*.
8.48	have been	INCORRECT	Make sure you use the correct form of the verb *have*. Which form do we use with the pronoun *she*?
7.20	know	INCORRECT	This is present simple tense. Look at *for ten years*. Which tense can we use with it?

Figure 6 – MyEnglishLab input and feedback
Pearson. (2016, n.d.). *Decoding Adaptive Report*. Pearson.https://www.pearson.com/content/dam/one-dot-com/one-dot-com/uk/documents/educator/primary/Pearson-Decoding-Adaptive-Report.pdf

Interestingly, the feedback on grammar given by the tool concentrates on a more constructive way of assessing students, i.e., it avoids simply presenting students with correct answers or a list of rules to learn; instead, encourages them to 'discover' the rules through an inductive problem-solving approach.

The tool provides a number of features to improve the class' course curriculum without the constraints of using only the publisher's books. Aside from the online activities, teachers can assess students each step of the way. There is a record for each activity the student completed, the Grade Book, where teachers can analyze their strengths and weaknesses. It can be configured to display individual information or the group as a whole.

The online platform also provides teachers with insights about common mistakes students make in the Common Error Report. That way, teachers can adapt their next class to address these shared difficulties and reinforce the content, changing the approach accordingly. Using such reports allows teachers to dedicate more class time to the students' most pressing needs, targeting the weaker areas.

Both the reading and writing sections can be used with any other English course, not only Pearson's. Each of these sections offers a four-level program, from beginner to upper intermediate, which can be adapted to the students' context, offering them a meaningful communicative experience. Each activity is built into a lesson plan that can be adapted according to the student's needs.

MEL can be used both as a homework platform

[7] Additional information can be retrieved at < https://www.pearson.com/english/myenglishlab/how-it-works.html>

for extra practice as well as part of a blended classroom - on tablets, computers and even connected to the interactive whiteboard. It spares the teacher the hassle of manual correction of exercises and allows students with different paces to be productive and engaged with the subject. That way, early finishers will always have room to grow and slower students do not feel pressured to finish fast just to keep up with the group. With a portfolio of over 80 thousand exercises available, there is always something to keep students active; however, it is worth highlighting that it is hard to keep those who finish the activities earlier than others occupied and engaged in class while having to give additional assistance to those who need it. To give early finishers "more of the same" is not the best option as believed by Francis & Gould (2013). They suggest providing students with higher level extension tasks (same content but more demanding); this could be a very useful strategy, but it is important to examine if students do not feel they are being "punished" for being higher leveled. In this case, we recommend either keeping extra problem-solving exercises available in the portfolio or asking these students to help needy classmates so that they keep engaged in meaningful tasks. We understand, however, there is not a single formula that fits each and every classroom: only by using diverse strategies with our students, and asking for their feedback will we be able to identify the ones that best shape our students' needs and aspirations.

MEL also offers class management resources so that teachers and students can communicate in the safe environment of an online messaging tool, use to-do lists, get email notifications and homework assignments. Teachers can add students to a group, view their progress and export the data at any time without asking Information Technology (IT) technicians for help.

According to Kochannek and Ripley (2014), the Al Nahda School for Girls, in the United Arab Emirates, reported a very satisfactory experience with the tool. The English language teacher Bridin Harnett gave feedback in the name of the school and described almost utopic scenery: students remained interested in the platform even during the last class of the day, before the weekend. Using the NorthStar coursebook and MEL, she declared that students had the opportunity to apply daily life skills while learning English in a meaningful way. Bridin stated that motivation was a key factor to the success of the English classes as well. The frequent practice, assessment and feedback kept students in control of their own learning journey, making them feel they were making progress and, therefore, motivating them to advance. Due to the creation of an engaging, autonomous English learning environment, students felt more comfortable to face their mistakes and grew more confident about their English skills.

Regarding her personal experience as a teacher using the tool, Ms. Harnett added "the vocabulary exercises with automatic scoring and feedback are very motivational for students. For one weak student, after repeated practice, she achieved a score of 97%. She was so excited and so delighted - she felt really empowered!" (Kochannek and Ripley, 2014, p. 19).

The Let's Go English Institute community also had a positive experience with MEL. As the principal in this private language school in Argentina, Viviana Valenti selected the MEL platform as a way of making students more interested in practicing English. Using Pearson Choices book on the online platform, Valenti perceived notable results in less than a year. To test the hypothesis of growth in student engagement in an online environment, she conducted a comparative experiment: she split students in two groups and assigned both with the same exercises from the Choices workbook, half in print and half on MyEnglishLab. Valenti observed that students who interacted with the online platform were far more engaged and focused in the tasks than students who used the paper workbook. One of the main benefits of using the online platform was the engagement and commitment that the students demonstrated towards the activities. They also seemed to appreciate the autonomy provided by the blended learning model and the custom feedback received from both the machine and the teacher. The platform allowed Valenti to devote some time to answer the students' questions and work on their metacognitive skills

as well (Kochannek and Ripley, 2014, p. 19).

MEL also aims to eliminate the grading and learning gap. Allowing students to move at their own pace according to their level of difficulty shows great promise as slow-paced students are given the necessary practice opportunities and attention to address their difficulties. Valenti saw great benefit in the way feedback is offered to students:

> There is a lag time between completing an activity in the print workbook and receiving a grade and there is limited opportunity to provide feedback. MyEnglishLab provides an instant score and, more importantly, instant feedback when students need it so they can reflect on incorrect items. Additionally teachers can spend more time offering feedback on work the computer cannot automatically grade (Kochannek and Ripley, p. 20, 2014).

Yet, another interesting study was conducted by the same scholars in secondary schools in Poland, whose purpose was to compare the performance of students who used MEL and the scores of students nationally. They used two national exams (Matura and Gimnazium) and took the opportunity to interview teachers about their experience with the online tool. As we can see in the graphic below, students who used MEL outperformed the scores of the national average.

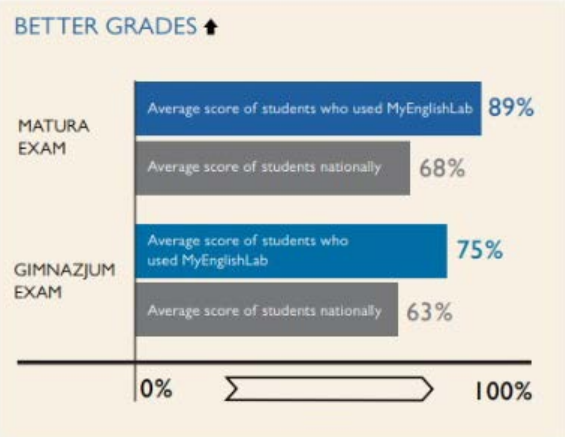

Figure 7 – Student performance in the national exams (Kochannek and Ripley, 2014).
Kochannek, C. & Ripley, N. (2014, July n.d.). Pearson *Efficacy Results Report*. Pearson. https://support.pearsonelt.com/content/dam/professional/english/knowledge-help/KB_Images/Efficacy%20Report%20Secondary_final_online.pdf

Furthermore, about 60% of the teachers claimed to have an easier time using the tool in comparison with regular printed workbooks due to greater student commitment. Students not only showed more engagement with the media but also felt motivated by the instant feedback, as reported by 70% of the teachers. They seemed satisfied with the platform: nearly 90% of them feel less consumed by student homework because of the platform and assigned MEL exercises as part of the course credit. Eighty per cent (80%) noticed that they had more time to focus on developing the students' communication skills and would recommend the tool to other fellows.

By using software that collects data through artificial intelligence, teachers are able to track the students' progress easier than assessing class work on paper or through applications that do not use artificial intelligence. According to Boudett et al. (2020), using tools that automatically collect data allows teacher to access these information and use automated parameters (for instance, Excel formulas) to understand amount of assertiveness and mistakes and tasks in which students have struggled. The game Quizizz, for example, gives the teachers a spreadsheet with data about mistakes and hits, time spent in each question, question(s) that were more commonly answered incorrectly, and questions that were easily – and quickly – answered. By having an automated spreadsheet with these pieces of information, teachers are able to optimize their times instead of analyzing results one by one and inserting the data into a table or document that needs human interpretation.

4. SuccessMaker (Savvas Learning Company).

SM aims to promote reading success for young students at all levels of proficiency. The courseware delivers adaptive reading intervention in a gamified interface, personalizing the students' path according to their responses. Savvas Learning Company takes into account that diverse students have different needs and backgrounds, therefore technology should reach out to them

in an individualized way. It was developed for regular school students from kindergarten to the final years of middle school, offering mathematics and reading subjects.

SM proposes a structured, comprehensive curriculum in a flexible and interactive way. Interactions generate reports full of insightful information on the learners so that teachers can use to address achievement gaps more successfully when needed. The key features of SM are, among others, the chance to decide where to begin instruction, the diagnosis of learning evidence, the offer of appropriate content and management of struggle, and the assessment of mastered content. We can see below the process flow of learner's accomplishment (or lack of it) in the lessons.

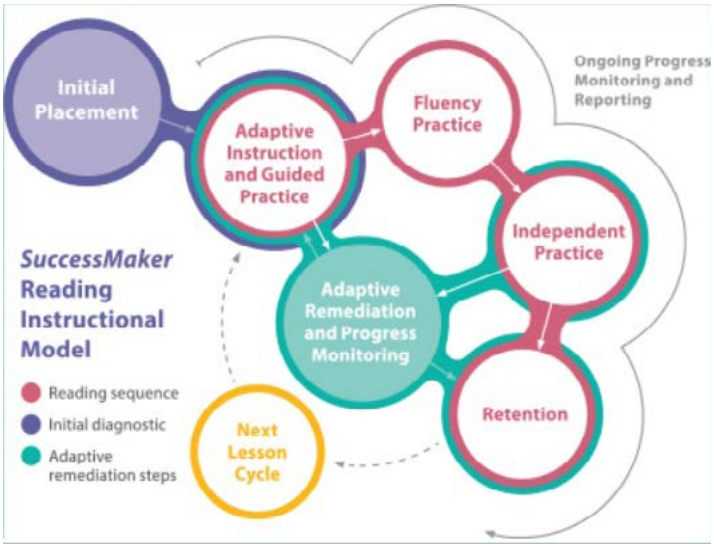

Figure 8 – SM instructional model
Source: Pearson. (2015, n.d.). *SuccessMaker in Farmington Public Schools*. Pearson. https://assets.pearsonglobalschools.com/asset_mgr/current/201526/SuccessMaker_Farmington-Public-Schools.pdf

As we can see, the tool places the student into the course content according to their demonstrated knowledge on the subject. Then, the student receives their first adaptive lessons and guidance to move on to the next step, which is fluency practice. Following, there is the independent practice of the content, which will lead to retention assessment. User interaction is monitored at all times and students may be led to adaptive remediation of achievement gaps at any stage of the lesson. When the student successfully completes a given content cycle, they will be allocated to the next lesson cycle.

SM offers formative assessment to grade-level concepts and skills taking into consideration strengths as well as weaknesses of each student as they move through a personalized sequential path. The tool can delay or accelerate the learning cycle according to whether the student is likely to be frustrated or motivated by it. SM declares that learners benefit the most when using the platform for about 60 minutes a week, distributed in reduced sessions. In the figure below, we can see an example from the user interface of SM.

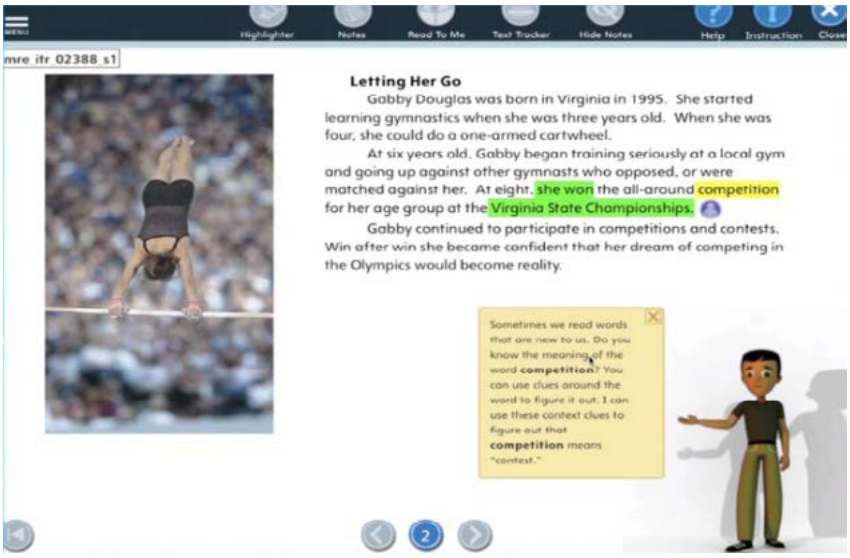

Figure 9 – SuccessMaker reading comprehension exercise
Source: Pearson. (2015, n.d.). *SuccessMaker in Farmington Public Schools*. Pearson. https://assets.pearsonglobalschools.com/asset_mgr/current/201526/SuccessMaker_Farmington-Public-Schools.pdf

Students interact with a gamified interface that allows them to create and personalize their own character as they progress in the platform. In the figure above, the reading exercise is about a non-fictional gymnast and her experience with competitions. The activity was preceded by a vocabulary activity to ensure that they would be able to understand the text. Then each student chose a virtual coach to guide them in this first step of the cycle. The coach highlights clues in the text to support learners in the subsequent interpretation questions. If a student did not answer a question correctly, SM brought them back to the text and helped them learn the correct answer.

Additionally, SM defines itself as an interactive online course to supplement reading. The platform places students according to eight criteria: concepts of print, comprehension, fluency, phonics, phonemic awareness, vocabulary, grammar and spelling. Like MEL, SM provides reports on how every student and the group are performing so that the teacher can monitor and adjust lessons accordingly.

A Pearson (2015) study case from Farmington, Michigan, conducted between 2010 and 2014 demonstrated the potential of SM to reduce the gap in the Michigan Educational Assessment Program (MEAP). During that time, the percentage of English Language Learners (ELL) achieving proficiency grew over 11%, which is higher than the state average growth of about 9%. The school's non-ELL improved only 1% in the same period, but only ELL had access to the SM platform.

The Farmington ELL students, the study says, enjoyed the non-fictional content and did better when there were videos or pictures involved. One of the teachers, Ms. Masri, stated that "they love the program and the SM characters. It is fun for them. They work individually at their own pace and are excited about their independent work. It is a great tool". The use of SM also allowed the school to monitor the students' work and compare their progress through the years and the school staff demonstrated interest in keeping up with the progress of the students. Another teacher, Ms. Clever, also showed her satisfaction with the results of the tool:

> I can drill into areas of difficulty and share the data with classroom teachers to identify areas where students are doing well and areas in which they need to do additional intervention work. SuccessMaker is linked to standards, and you can tie it back to direct instruction with the students (Pearson, 2015, p. 20).

Another school, the Baldwin Elementary School in Georgia, had a positive experience with SM.

Despite the expected decrease in performance that usually takes place during the first months of implementation, Baldwin Elementary experienced an increase of 10% in reading and mathematics scores during their first year with the tool, in 2012. Hispanic students reached even higher score improvement with an increase of 17%. The fact that Hispanic students represent 63% of the total number makes this accomplishment even more remarkable.

Pearson's (2014) case study in Baldwin demonstrated that the school community also faced socioeconomic challenges. Fifty-one percent (51%) of the kindergarten students were limited English proficient and, consequently, needed support to close learning gaps and catch up for the following years. The school Principal Vicki Wade celebrated the improvement of the students, especially in a group that was particularly deficient:

> Of the 14 students in the class, 71% showed a gain of more than .4 years in reading with no student showing less than a .33 years gain. In math, the data indicate that 64% of students showed growth gains of more than .5 years and 36% showed instructional levels above grade 1.

Generally speaking, the school's district score gap in the Criterion-Referenced Competency Tests decreased by 53% after the implementation of SM. Compared to the state scores, the gap decreased in about 45% only in the first year. The efforts of Baldwin Elementary combined with the use of SM granted them at least 5 years of growth in reading for 81% of the students from grades 1 to 5. Kindergarten students also improved substantially, with about .5 years of growth for 57% of the students in 3.5 months of using SM.

5. AI adaptive learning tools'potential and pitfalls: final remarks

> "Are there 43 quintillion ways of doing adaptive learning? Perhaps; I have no idea. But I know you're not going to get one of those things correct if you design the technology top-down and pay less attention to who your stakeholders are" (Larusson, in Wan, 2016)

As referred to in the introductory section, the aims of this paper were: i) offer the reader some reflection and facilitate discussion on the potential of AI-powered adaptive learning tools in the field of English Language Teaching; ii) explore the benefits of AI-powered adaptive tools to personalized learning in the EFL classroom; and iii) analyze two of the most relevant adaptive tools available based on faculty reports, more specifically, the functionality of My English Lab and SuccessMaker applied in regular (language) schools, and the tests used to measure improvement in light of the P21 Framework for 21st Century Learning.

Our opinion corroborates the said testimonials about the AI-powered adaptive tools: although we have not yet carried out systematic research at the institutions we are affiliated to, we have used a number of technological tools at various levels of instruction, endorsing the benefits they bring to classroom and encourage colleagues to apply them in their educational settings. Yet, a regular school in Brazil, *Colégio Israelita Brasileiro* (CIB), has adopted a 21st century focused methodology. The school used to follow a 3.0 system, but understood that due to the evolution of education towards education 4.0, limiting itself to a 3.0 system would not be coherent with the 21st century needs. Therefore, in 2019 the school changed its approach to CIB21 by valuing 21st century skills, and incorporating new methodology and pedagogical software for the promotion of critical thinking, self-learning, technology-guided learning, and social and communicative skills.

Needless to say, application of digital devices and software require mindset shifts: we cannot use them the same way we did or even do in more traditional curriculum. According to Jacobs (2010, p 17) "curriculum should not only focus on the tools necessary to develop reasoned and logical construction of new knowledge in our various fields of study, but also should cultivate a culture that nurtures creativity in all of our learners". She continues "this point seems particularly important as the institutions are so difficult to change [...] thinkers should be valued as we begin drafting creative designs for our curriculum and our schools". In this sense, the 21st century skills, such as creativity, become

meaningful to learners and ensure their genuine development. These skills, however, should be translated into meticulous classroom applications and be connected to the assessment types and to the curriculum content (Jacobs, 2010).

Her words substantiate the principles of the P21 Framework and the World Economic Forum (2015), which express concern about how individuals approach complex challenges in life, being able to think creatively to solve problems. In this sense, Pink (2006, p. 2) pays particular attention to right-brained thinkers, who will be the main actors of collective futures, in the quotation below:

> We are entering a new age. It is an age animated by a different form of thinking and a new approach to life – one that prizes aptitudes that I call "high concept" and "high touch". High concepts involves the capacity to detect patterns and opportunities, to create artistic and emotional beauty, to craft a satisfying narrative, and to combine seemingly unrelated ideas into something new. High touch involves the ability to empathize with others, to understand the subtleties of human interaction, to find joy in one's self and to elicit it in others, and to stretch beyond the quotidian in pursuit of purpose and meaning.

Hence, considering that education is walking towards a movement called Education 4.0, preparing students for a future market is a fundamental requirement of schools. One of the premises of the 4.0 education is the fact that schools should prepare students to deal with technology (artificial intelligence, robots, etc.) that will – most likely – be part of their future jobs. Even though we cannot predict what kind of jobs will be available when students leave school, there are several studies that prove that some kinds of technologies will be available in a near future. McKinsey Digital (2016) predicts that about 60% of all jobs could have – potentially – at least one third of their activities automated by technological tools. Even if students end up having a job that demand more modern devices, preparing them to understand and deal with them is not only about their future as professionals, but about their daily lives in the years to come.

Also, it is important to note that the English Teaching field – or the teaching of any language – is dependable on the teaching of culture be either the "big C culture" or the "little c culture": this means, thus, that it is largely connected to artistic beauty and interaction. The former refers to what is visible, which include arts, holidays, literature, food and customs whereas the latter is a more invisible type of culture and are associated with a region, group of people and language. Some examples of this kind of culture include communication styles, cultural norms, verbal and non-verbal language symbols, behavior, and myths, among others. Using technology in language teaching classes to discover and explore virtually new places in the world and their culture is particularly advantageous to students in unfavorable social conditions. By sharing best practices, AI tools, thus, play a fundamental role in this burgeoning high-tech century since it fosters more affordable and inclusive learning spaces for underserved student communities.

Therefore, we acknowledge the significant contribution AI-powered adaptive tools make to educational settings and particularly to the English language classroom. Given the fact that adaptive tools can maximize and personalize learning, they provide opportunities for students to become autonomous and co-responsible for the quality of their education. They also contribute to deconstruct recurrent educational practices combined with the use of technology, since many educational institutions still limit their use to automation and consumption, that is, they only replace experiences and learning from analog to digital (Magana, 2017). Having the potential to contribute to more engaging and meaningful learning experiences, we understand that educational institutions around the world can profit from AI-powered adaptive tools. Additionally, the myriad of tools available for course integration and design makes AIEd accessible at a variety of levels and for different schools' needs worldwide.

Concerning MyEnglishLab and SuccessMaker, we understand they are valid media options for a variety of useful EFL activities to complement EFL learning. Offering students more inclusive learning

opportunities while keeping them motivated using media that is natural to their generation shows them that the tools care about providing them interesting and effective lessons. In particular, they foster a new way of looking at teaching that maximizes the learning of digital generations, who perform multiple tasks, tend to be creative, like challenges and find meaning in learning through experimenting.

It is also important to highlight that some technological tools are available in different languages, allowing students to expand their vocabulary by using the apps. Even though some of them may not be straightforwardly user-friendly, digital literacy is part of the learning process. Teachers do not have to use or require students to use the software by themselves. In order to ensure an optimized use, teachers may teach students how to use the software and may even run some tryouts before adopting a tool. Similar to using a notebook to take notes for the first time, students become familiar with new technological tools as they use them.

However, adaptive tools need improvement in quite particular aspects. According to the testimonials of school teachers in the United States, limitations like lack of flexibility, autonomy, and human interaction with the technology provided. In short, some of the weaknesses they mention (EdSurge; Pearson, 2016):

- Tools do not take into account the reality of the school systems, one in which students progress according to their age groups and grades, and another one in which learners receive differentiating instruction. Teachers urge developers to build tools that both incorporate grade-level standards and allow them the power to assign content as they see fit.
- Adaptive tools are being overused. Students are being detracted from the social aspects of learning, especially in language teaching classes where listening, speaking skills as well as collaboration play a critical role in language acquisition.
- Prescriptive teaching: Data itself should not prescribe how students should learn; teachers end up losing potentially skillful learners if their learning is just seen in technology terms.
- Teachers and students should be part of the advisory board to discuss the design of every educational tool to avoid systems of oppression, for example.
- Teachers would like to be more autonomous regards tool recommendations for students. They wish to review the content used by the students, so that they know exactly what learners have done and be able to provide intervention and use other ways to teach a skill, if necessary.
- Teachers wish to have the chance to disagree with a skill being assigned and change it. Or, they might want to adjust the level of mastery to around 80% for an important course concept, since they tools do not allow them to change or challenge the way the tool analyses the student's performance or suggests new content.

Another aspect that needs consideration is that adaptive tools should be integrated with appropriate pedagogical models and an infrastructure for change at system level. For instance, if a teacher uses an inflexible curriculum pacing, incorporating a tool with an adaptive sequence will most likely be unsuccessful. It means that an adaptive tool, in order to be successful, should be implemented if the school aligns with how the tool was designed to be used. In other words, the learning environment should support, among other things, students working at their own pace; students working on different content and skills that might be above or below the grade-level expectations; students working on skills in a unique order or different to the skills being taught in the classroom at the same time.

A final quick comment to be made about the shortcomings adaptive technologies have is the lack of training and support to teachers in terms of offering them the necessary instruction on how to analyze data and integrate tools within the classroom (Figure 10). EdSurge and Pearson (2016, p.13) states in their report that "By providing

a common language, we hope that edtech companies will be able to communicate their value more clearly, so that educators understand the impact each tool can have. Most importantly, we hope this research will move the field toward better decisions and better product design, better professional development for teachers, better implementations, and better outcomes for learners".

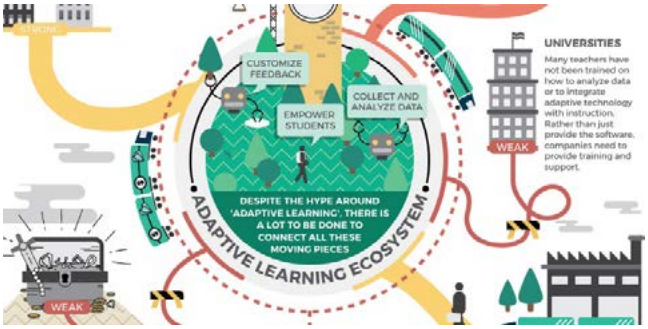

Figure 10 – More about adaptive learning
Source: Wan, T. (2016, n.d.). *Adaptive learning's potential and pitfalls*. EdSurge. https://www.edsurge.com/news/2016-02-08-adaptive-learning-s-potential-and-pitfalls

Aware of the limitations of this study, and the multitude of possible approaches to the subject, we invite fellow academics to further research on the field of AIEd, especially in the ELF scenarios. Teaching a language alone is a complex endeavor and introducing AI to it certainly presents its challenges. Nonetheless, offering a type of tailor-made learning experience to students while providing teachers with feedback data to continue improving their techniques and assist students' progress is worth the trouble. Limitations do exist, but we understand that adaptive tools are likely to be improved especially in terms of content and assessment flexibility to stakeholders in the short run.

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