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Empowering EDTECH Platforms: A Study on the Role of Analytics and AI in Decision-Making

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Abstract

Analytics and AI innovations have the potential to help the decision-making processes and to bring more business opportunities for stakeholders.

This study explored how analytics and AI support decision-making in EdTech platforms. The interest in research on how artificial intelligence (AI) can be applied in the Education sector has grown significantly in the past decade.

Using a comprehensive literature review, document analysis, and search analysis, the study emphasized the growing attention to analytics and AI-related topics in public companies' annual fillings. Also, the study explored the types of decisions in EdTech platforms that can benefit from analytics and AI implementations. There is a broad range of decisions that can benefit from analytics and AI: personalized learning paths, early notifications or student dropout prediction are only a few of the possibilities that analytics and AI implementations can provide to EdTech platforms.

The originality of this article consists of a review of the unique combination of stakeholders and decision types that can benefit from analytics and AI along with the general trend of the analytics and AI-related concepts in the official communications of the US public companies.

This research contributes to a better understanding of how analytics and AI technologies can help the EdTech platforms provide better learning experiences to the students and better insights to decision-makers on educational offerings.

Keywords: Edtech platform, analytics, artificial intelligence, decision

1 INTRODUCTION

EdTech platforms (short for Educational Technology) have shown significant development in recent years regarding the range of services and content offered and the market segments served. An EdTech platform refers to any type of technology or software that facilitates the creation, delivery, or management of learning and educational experiences. These platforms can serve various purposes in the educational context, providing support for learning and teaching, administration, collaboration, and communication, as well as for the development and distribution of educational content. Wiki, e-learning, open educational resources (OER), blogs, learning management systems (LMS), and massive open online courseware (MOOC) are all examples of EdTech. In simpler terms, EdTech is considered "the use of digital technologies in and around the education system" [1].

Analytics is defined as "extensive use of data, statistical and quantitative analysis, explanatory and predictive models, and fact-based management to drive decisions and actions" (Davenport and Harris, 2017). We can differentiate between descriptive, predictive, and prescriptive analytics.

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Analytics and AI have begun to make their mark on strategic decisions within the context of EdTech platforms. Although the educational technology sector presents substantial competition, the example of companies like Duolingo underscores the significant impact of advanced technology, content, brand, image, and user data in securing a lasting competitive advantage [2]. Furthermore, Skillsoft has also used big data and AI to make its technology-based learning solutions more useful. Personalization of learning content and recommendations for each customer is done by looking at a lot of data, including how learning assets are used, as well as survey data and direct email response patterns. Through sophisticated personalization of both content and recommendations, Skillsoft has achieved a substantial improvement in user engagement [3].

At this confluence, analytics and AI have the potential to shape and redefine company perspectives by extracting vital insights from collected data, thus enabling informed and strategically founded decisions.

Gartner, in its annual report on top strategic technologies [4], defined applied observability as “the applied use of observable data in a highly orchestrated and integrated approach across business functions, applications, and infrastructure and operations teams”. This trending technology “works from the data emitted by an organization, using AI to analyze and make recommendations, which allow an enterprise to make faster and more accurate future decisions” [4]. This is consistent with their previous reports, for example, in 2018 when they stated, "the ability to use AI to enhance decision making, reinvent business models and ecosystems, and remake the customer experience will drive the payoff for digital initiatives through 2025" [5].

This article seeks to explore the impact of analytics and AI in dynamizing EdTech platforms, with special attention paid to the decision-making process. In a context where technological advances enable EdTech companies to respond agilely to market changes and gain a deep understanding of their clientele, new business models and notable efficiency in internal processes are highlighted. As AI systems continue to evolve and data usage grows more prevalent, a better understanding of their effects, including on education and training, is required. The significant rise in the use of AI necessitates that educators and students have a fundamental understanding of AI and data usage to interact positively, critically, and ethically with this technology and maximize its potential [6]. In this context, the following research questions are proposed for analysis:

RQ1: How does the implementation of analytics influence an EdTech platform?
RQ2: How does the implementation of AI elements influence an EdTech platform?

The novelty of the paper is the exploration of analytics and AI technologies as tools to enhance decision-making in EdTech companies. The topicality of the paper resides in the purpose of this research, namely, to gain an overview of the impact of analytics and AI in the decision-making process.

2 METHODOLOGY

Approach and Strategy

The authors used various methods to understand how analytics and AI are used in educational technology (EdTech) platforms. Following a diverse research approach, the study included website reviews, document analysis, comprehensive literature reviews and a search analysis.

Literature Review

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A detailed literature review was carried out to explore existing knowledge about using analytics and AI in various EdTech platforms. Numerous academic articles, research papers, and reports were carefully examined from well-regarded academic databases. The sources were picked based on how well they answered the study question, how recent they were, and how trustworthy the publication or institution was that put them out. After selecting the texts, they were critically analyzed to identify key themes and insights related to using AI and analytics in education.

Website and Document Analysis

Additionally, a review and analysis were conducted on the official websites (European Commission) and public documents of EdTech platforms and global technology research companies like Gartner, Inc. This review was not aimed at promoting any platform but was essential to furnish concrete examples illustrating the current applications of analytics and AI in the educational realm. Acknowledging that the platforms examined are only a snapshot of the extensive range of AI tools and applications available and utilized across various educational contexts is imperative.

Search Analysis

The study used the Electronic Data Gathering, Analysis, and Retrieval (EDGAR) database – an extensive resource from the U.S. Securities and Exchange Commission (SEC), in order to identify the number of annual filings (10-K report) that mentions in their content the various terms related to AI, ML or analytics. We have reviewed only the 10-K reports because these are audited documents that provide an overview of public companies' fiscal years. In order to offer a historical perspective of using these concepts in the annual reports, we have done this analysis for the past five years (Oct 14, 2018 - Oct 13, 2019, Oct 14, 2019 - Oct 13, 2020, Oct 14, 2020 - Oct 13, 2021, Oct 14, 2021 - Oct 13, 2022, Oct 14, 2022 - Oct 14, 2023).

3 LITERATURE REVIEW

The research regarding AI and education has recorded a constant growth in the last decade as illustrated in Figure 1 below. A query in Dimensions.ai based on ["artificial intelligence" AND Education] keywords has revealed a growing trend since 2014. The query has returned 16,340 publications. Also, in Web of Science, core collection database, the number of papers published related to the topics “Artificial Intelligence” and “Education” has been rising since 2008 [7].

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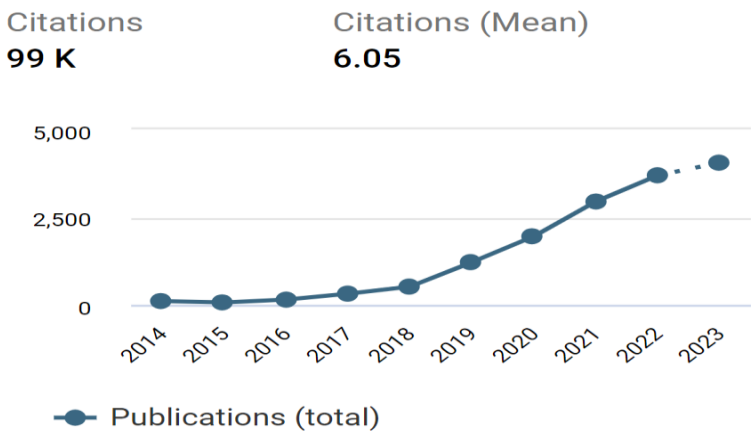

Figure 1 – The evolution of publications related to artificial intelligence and education. Source: Dimensions.ai, 2023

In Figure 1 above, the publications indexed in Dimensions.ai, related to AI and education topics, have produced 99000 citations with a value of citation mean of approximately 6 publications.

Table 1 below shows a significant increase in the number of publications every year since 2017. This is more than a ten-fold increase over the seven years and is an indication of a strong interest in research in these topics.

Table 1 - Publication Years

Years	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Number of publications	317	518	1216	1954	2945	3692	4051

Source: Dimensions.ai, 2023

Regarding the number of publications, Table 2 below shows the research categories with the most publications on AI and Education. Information and Computing Sciences is the category where most of the papers on AI and Education were published, according to Dimensions.ai. Education is the second most published category with 4716 publications.

Table 2- Top Research Categories for the topics the topics “Artificial Intelligence” and “Education”

Research Categories	**Number of publications**
Information and Computing Sciences	8836
Education	4716
Curriculum and Pedagogy	2169

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Education Systems	2148
Human-Center Computing	2092
Artificial Intelligence	2018
Biomedical and Clinical Sciences	1131
Data Management and Data Science	1034

Source: Dimensions.ai, 2023

Table 3 below shows the number of publication types with articles as the predominant type of publication with 7476 publications. This suggests that AI and Education have been attractive topics for worldwide researchers.

Table 3 – Number of publications per publication type

Publication Type	**Number of Publications**
Article	7476
Chapter	4512
Proceeding	1987
Edited Book	1384
Preprint	807
Monograph	174

Source: Dimensions.ai, 2023

An examination of the academic literature shows that the topic of AI and education has been investigated from different perspectives, and the impact of analytics and AI on EdTech platforms have been insufficiently explored. As data accessibility increases, new data-driven business models have emerged. Although a rising number of EdTech companies are delivering data-driven pedagogical solutions, some authors [8] argue that only a limited number of businesses fully harness the potential of AI and analytics to provide personalized educational experiences.

In a comprehensive analysis, [9] have examined the major research themes and historical trends from 2000 to 2019 and have identified four major paradigm shifts in accordance with the changing role of AI technology in education (Virtual Reality, student profiling models and learning analytics). Furthermore, [10] has shown the benefit of process mining on Coursera MOOC data and revealed that the way students watch videos as well as the interval between successive watched videos have a direct impact on their performance.

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The role of machine learning models in identifying students at risk of failing was extensively investigated in the academic literature by [11], [12], [13], [14], [15], [16], or [17].

AI-driven personalization in education has the potential to revolutionize the learning process and improve student performance. Adaptive learning systems may make learning environments more efficient, attractive, and inclusive by using AI technology to customize teaching [18].

4 RESULTS

Analytics and AI use cases

Table 4 illustrates in a simplified way how analytics and AI can be used inside an EdTech platform across different roles and decision types. The AI technologies help learners to customize learning experiences, automate choices, and enhance various platform functionalities.

Also, the analytics techniques can extract valuable insights from the multi-modal data. Analytics and AI in EdTech could improve the decision-making pertaining to different organizational roles. By collecting and analyzing data such as learners' performance, learners' engagement levels, etc., the digital platforms can provide its stakeholders with valuable or actionable insights. This information can then be used in decisions in various educational contexts such as instructional design, assessment method, student evaluation, educational content selection, curriculum selection, and even budget allocation as it has been illustrated in Table 4 below.

Table 4 - Decisions Facilitated by Analytics and AI in an EdTech Platform for Different Role Types (a simplified model)

Role	Content Personalization	User Engagement	Assessment & Grading
Learner/Student	-Personalized learning paths -AI-driven content curation	-Personalized notifications	- AI-driven self-assessment tools
Educator /Instructional Designer	-Curriculum adaptation - Content relevance analysis	-Interactive content suggestions - Communication enhancement	-Automated feedback on assignments - Identifying learning gaps
Manager /Administrator	- Course offering decisions	- Community & forum management - User support prioritization	- Analyzing overall performance

Source: Authors representation

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While some decision types or roles may be missing from the above table (such as platform developer or cybersecurity specialist), it is essential to note that ongoing advances in AI and analytics continue to expand the boundaries of possibilities, and collaborative decision-making processes are crucial in a multi-role environment specific to EdTech platforms.

For learners:

- Personalized Learning Path: Recommendation Systems can customize learning paths based on learners' behaviour and preferences. Instead of a one-size-fits-all lesson, the learners/students can get a learning experience tailored just for them.
- Personalized notifications: The learners can get personalized notifications. Predictive Analytics, which analyzes past behaviour to predict when a student might disengage, and Natural Language Processing (NLP) for interactive and engaging chatbots.
- AI-driven self-assessment tools include adaptive questioning, tailored feedback or progress tracking. The learner can get instant feedback on practice questions or mock tests.

For Educators/Instructors:

- Curriculum adaptation and content relevancy analysis: Educators can employ AI to analyse the efficacy of different components within the curriculum, thereby identifying areas that may require change. AI can maintain the currency and relevance of information by aligning it with contemporary industry norms and societal shifts.
- Interactive content suggestions, AI can provide interactive educational materials such as quizzes, considering the levels of involvement exhibited by learners. Interaction tracking techniques, sentiment analysis or recommendation systems can enhance communication by providing insights into students' sentiments or concerns, enabling educators to address them proactively.
- Automated feedback on assignments, identifying learning gaps: AI has the capability to streamline the process of providing feedback on assignments through the assessment of responses based on predetermined criteria. Additionally, this technology has the capability to identify and emphasize certain areas in which numerous learners are encountering difficulties, so enabling educators to effectively target and correct shared learning deficiencies. This can be achieved through automated grading algorithms, NLP, and clustering algorithms for identifying common mistakes.

For Managers/Administrators:

- Course offering decisions, Tailoring learner journeys: Administrators can employ AI to scrutinize the demand for various courses or themes, enabling them to make well-informed decisions on the selection of courses to be offered. Furthermore, they can customize learners' paths by considering feedback and engagement indicators, guaranteeing the most effective learning experiences.
- Community & forum management, User support prioritization: AI can analyze community forums to uncover prevalent complaints or subjects currently gaining popularity. This technology enables administrators to take preemptive measures to address these issues. Additionally, it can assign priority to user assistance queries depending on their level of urgency or potential impact.

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Analyzing overall performance: With AI administrators can collect and evaluate performance data from different courses or groups of students, enabling the provision of valuable insights regarding the efficacy of the curriculum.

Search Analysis

The keyword search in EDGAR database has been performed based on the following criteria:

- Document word or phrase: <see the ones from the list below>
- Company name, ticker, CIK number or individual's name: Blank
- Filing types: 10-K
- Filed date range: Custom
- Principal Executive Offices: View All
- Filed from and to: A systematic yearly analysis starting from 2018-10-14 to 2023-10-14 (Oct 14, 2018 - Oct 13, 2019, Oct 14, 2019 - Oct 13, 2020, Oct 14, 2020 - Oct 13, 2021, Oct 14, 2021 - Oct 13, 2022, Oct 14, 2022 - Oct 14, 2023) with each year analyzed separately to identify the annual trends.

Keywords were chosen to align with the research objectives: understand the application, strategy, and outcomes related to AI and ML in the online educational domain. The utilized keyword combinations were:

1. "artificial intelligence" analytics instructor "online learning"
2. "artificial intelligence" analytics student "online learning"
3. "artificial intelligence" analytics student
4. "machine learning" analytics instructor student online learning
5. "machine learning" instructor student online learning
6. predict* instructor student online learning
7. instructor student online learning drop*out
8. student instructor platform
9. educational technology
10. machine learning online student
11. EdTech

The above terms were strategically grouped to encapsulate diverse dimensions of AI and ML in education, focusing on student-instructor dynamics, platform utilization, predictive analytics, and dropout rates, thereby providing a holistic view.

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Table 5 –The number of annual fillings returned by the query of word combinations 1 - 11

The combination of keywords	Oct 14 2018 - Oct 13 2019	Oct 14 2019 - Oct 13 2020	Oct 14 2020 - Oct 13 2021	Oct 14 2021 - Oct 13 2022	Oct 14 2022 - Oct 14 2023
Combination 1	3	5	11	10	15
Combination 2	6	9	11	15	16
Combination 3	23	46	54	91	95
Combination 4	2	2	3	9	9
Combination 5	3	3	4	12	12
Combination 6	24	18	33	38	36
Combination 7	1	1	4	5	3
Combination 8	24	19	34	42	43
Combination 9	1515	1543	2239	2680	2407
Combination 10	29	34	59	101	106
Combination 11	4	7	17	43	38

Source: https://www.sec.gov/edgar/search/ , 2023

Each row represents the number of 10-K filings retrieved by querying the EDGAR database with the entire string of keywords/phrases specified in the "The combination of keywords" column.

The word combination educational technology has the highest frequency and a growing trend among annual reports.

We have visually represented the data in Figure 2 for a subset of keyword combinations that includes “artificial intelligence” and “machine learning”.

The bar chart graph provides a comparative view of the evolving number of 10-K reports across different years and combinations of searched words and phrases. It indicates how the presence of these keywords included in 10-K reports, has shifted over time. For example, the combination of words ["artificial intelligence" analytics student] has had significant growth, especially between October 2020 and October 2022. Also, the combination of words ["machine learning" analytics instructor student online learning] experienced a substantial increase of 200% between October 2021 and October 2022. The combination of words ["artificial intelligence" analytics student "online learning"] has moderate and consistent growth. On the other hand, the keyword combinations "artificial intelligence" analytics instructor "online learning"] show certain inconsistencies with periods of growth followed by periods of decline.

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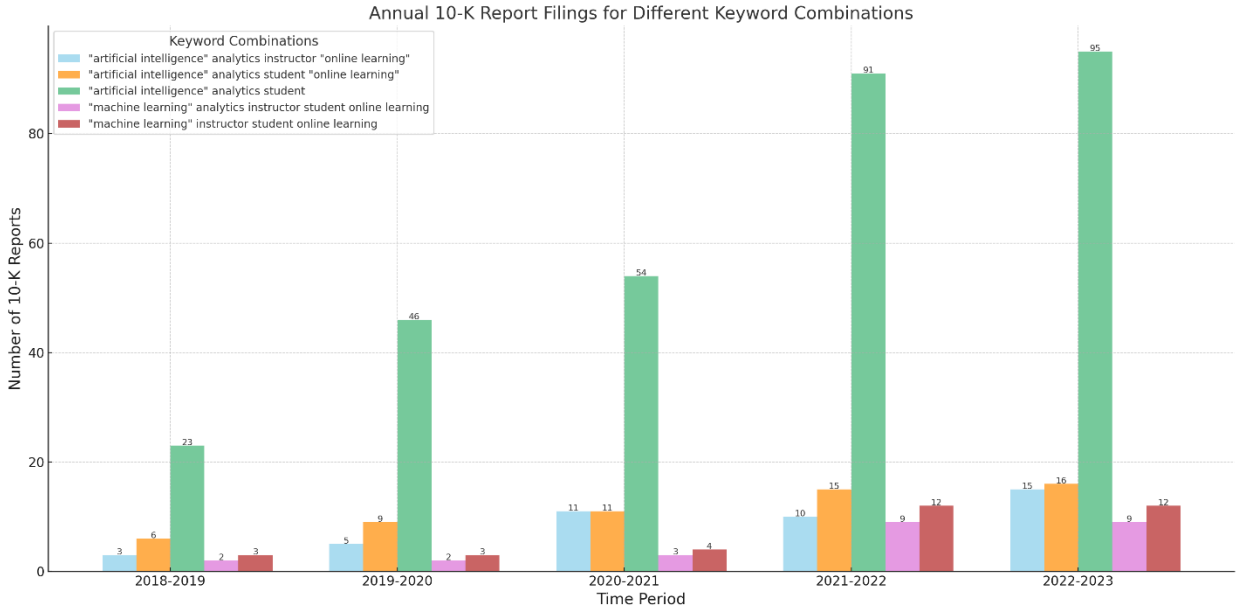
Figure 2 – the number of annual reports per year



Source: Authors 'own representation based on data https://www.sec.gov/edgar/search/ , 2023

The increasing trend for the above-mentioned keyword combinations may suggests growing relevance or mentions of terms related to AI, machine learning, and online learning in companies' annual reports. This might reflect an increasing awareness, consideration, or integration of these technologies in their strategies or operations.

Some keyword combinations have more stable and consistent growth, suggesting they might be more commonly used or relevant across various sectors or companies.

The variability in trends and growth rates may reflect changes in market dynamics, technological advancements, or company strategies and reporting shifts.

External factors, such as competition or the COVID-19 pandemic might have influenced the trends, especially considering the potential of accelerated adoption of digital technologies and online platforms during this period.

5 CONCLUSIONS

AI and analytics have risen as a catalyst, as demonstrated by the growing interest in research topics related to AI and education over the past decade. However, we still need to learn more about how AI and analytics can improve the learning experiences delivered by Edtech platforms. Many studies are contributing to a better understanding of how students interact with online content and how they can predict the students at risk of failure.

The evolution and shifts in AI use cases within digital educational environments have evolved through varied paradigms such as virtual reality, learning analytics, and student profiling models.

Using analytics and AI to personalize the learning process could make it better and more accessible for all students.

AI and analytics are often used in online learning platforms to help students, teachers, and administrators make decisions and improve their experiences. Analytics and AI can act like a combination of a personal tutor, an assistant, and a guide, making the learning, teaching, and managing processes more effective and tailored to individual needs.

Companies are discussing more and more in public about educational technology, analytics, AI, machine learning, and online learning. The term "educational technology" is used a lot and is becoming more popular among public companies, many of them operating in the education sector.

The popularity of different tech-related phrases in their annual reports changes over time. Some keywords and phrases (such as the ones related to analytics and AI) slowly become more popular while others increase much higher.

Technologies like AI become a more significant part of online learning, so it is essential to consider the quality of the teaching process and its fairness. Future studies should explore how Edtech companies talk about and use the technology to understand its role and impact in education.

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