Adaptive Learning

Technology Snapshot

Second Front Systems (2F)
is a public benefit, venture-backed software company dedicated to fast-tracking government access to emerging technology for national security missions.

SECOND FRONT SYSTEMS

EXECUTIVE SUMMARY

Adaptive learning is a dynamic and innovative space. Due to advancements in artificial intelligence (AI) and machine learning (ML), adaptive learning has evolved from pre-programmed learning paths to understanding student learning and focusing on content recommendation through data aggregation. As a result, new platforms include supplemental programs to traditional learning methods—such as chatbots—as well as vertically-integrated, full-stack teaching platforms used at the school and enterprise levels.

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ABOUT

Atlas Fulcrum is Second Front System's subscription-based technology research and innovation scouting platform to help government users discover and engage Venture Capital (VC)-backed, commercially-developed technologies for national security missions. Specifically designed to access "dual-use" (commercial and government) technologies, Atlas Fulcrum is supported by a research team that combines deep understanding of national security mission requirements and US Government customers with VC best practices. This custom support is combined with best-of-breed commercial tools to enable users to more quickly and easily identify, assess, and access these technologies.

Second Front Systems, Inc. is a lightweight systems integrator and public benefit corporation committed to bringing emerging technology to bear on pressing national security missions. Second Front has operations in Washington, D.C. and San Francisco. More information can be found at secondfront.com.

ADAPTIVE LEARNING

PROMPT

The Defense Logistics Agency (DLA) seeks artificial intelligence and machine learning (AI/ML) approaches to adaptive learning in order to support a large number of skilled and unskilled users from agencies across the Department of Defense (DoD). In particular, DLA seeks to understand the current commercial leading-edge technologies that can provide learning on-demand and adjust to learners' needs in order to improve training outcomes.

PRIMARY FINDINGS

Adaptive learning seeks to tailor the learning experience to the skills and capabilities of the learner on an ongoing basis. Adaptive learning systems attempt to do this at scale with the commercial and educational goal of supporting more students without compromising the quality of the education. Until recently, most teaching platforms used decision trees which lead students through a pre-programmed learning path based on right and wrong answers (or if/then statements). These look like they adapt to the student, but it is still just a preset path and therefore highly limited in its adaptability.[1] This method of technology-enabled learning is considered a precursor to the newer, more cutting-edge methods of teaching that use data aggregation and machine learning to adjust what content is delivered, when, and at what speed. The goal is to use this data-centric approach to better take into account how students learn.[2]

Content recommendation is at the core of recent advances in adaptive learning technology rooted in machine learning (ML). Like all ML and many 'big data' implementations, adaptive learning ML models operate by ingesting large volumes of data in order to identify patterns and develop strategies.[3] Such algorithms are often embedded in Learning Experience Platforms (LEPs or LXPs). These platforms attempt to quickly surface higher quality and relevant content based on learned associations. These can incorporate a wider variety of media, including podcasts and articles, and often have a "Netflix-like" media library with recommendation algorithms.[4] As these features suggest, this space has benefited immensely from developments in other spaces where content recommendation is relevant, from retail to online media. An LEP can link into multiple different e-learning platforms—or content libraries—and surface the most relevant information for users. For example, a user could log into a single portal to access LinkedIn Learning for a class on

[1] Craig S. Smith. "The Machines Are Learning, and So Are the Students." *New York Times*. December 2019. https://www.nytimes.com/2019/12/18/education/artificial-intelligence-tutors-teachers.html.
[2] "5 Ways Education Is Adopting Artificial Intelligence." *CBInsights*. September 2020. https://app.cbinsights.com/research/education-artificial-intelligence/.
[3] Ibid.
[4] Brian Westfall. "What Is a Learning Experience Platform (LEP)?" *Capterra*. January 2020. https://blog.capterra.com/learning-experience-platform/.

Excel, a company's proprietary content library, podcasts relevant to a current project, and SkillSoft to learn about compliance issues.[5]

Content recommendation algorithms can take a few different forms according to Josh Bersin, a longtime industry analyst. One common approach simply highlights popular content. **Fuse** allows users to be segmented based on attributes like location and job title in order to ensure relevance. This can also involve skills assessments or mapping specific skills to job requirements. **Degreed** and **IBM's YourLearning** both take the latter approach, aggregating and curating content from major content libraries, seeking to map that content to specific job requirements. Degreed takes this a step further with its own internal skills assessment engine. Another form of content recommendation occurs through user engagement, whether it is setting clear parameters around interests or direct engagement with the platform of some kind.

Chatbots are a common implementation of this type of learning technology that both improves engagement and allows students to set the pace for learning. They have emerged as a popular implementation of artificial intelligence (AI)-powered learning assistance due to their lower costs for both the technology itself and ability to integrate into learning platforms as opposed to launching fully-equipped adaptive learning platforms. The technology is defined as a "text-or voice-based interface that lets users execute certain actions and retrieve information using language."[6]

One study conducted by the University of Murica in Spain found that an AI-based chatbot rolled out across its campuses was able to correctly answer student questions over 91% of the time. While not perfect accuracy, such a feature allowed for the university to aid students on-demand and without the help of instructors due to its easy rollout as a supplement to the main, in-person learning system. Researchers found this feature also increased student motivation. The benefits of academic chatbots have gained popularity as evidenced by other universities beginning to implement them, including Staffordshire University in the United Kingdom and Georgia Tech in the United States.[7]

The commercial sector has also taken interest in designing chatbots for educational and commercial use. **Chatfuel** is a no-code chatbot that can answer questions, retrieve content, and collect feedback but is focused on the Facebook ecosystem. **Rasa** is an open-source chatbot that works across many channels (including websites and social media) and can interact with a wide range of database types. The chatbot delivers lessons in a conversational style in order to keep students engaged, in addition to personalizing learning based on student performance.[8]

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[5] Josh Bersin. "Learning in the Flow of Work: Arriving Now." *Josh Bersin*. November 2018. https://joshbersin.com/2018/11/learning-in-the-flow-of-work-arriving-now/.
[6] "Lessons From the Failed Chatbot Revolution - 7 Industries Where the Tech Is Making a Comeback." *CBInsights*. January 2021. https://app.cbinsights.com/research/report/most-successful-chatbots/.
[7] Lasse Rouhianinen. "How AI and Data Could Personalize Higher Education." *Harvard Business Review*. October 2019. https://hbr.org/2019/10/how-ai-and-data-could-personalize-higher-education.
[8] "Lessons From the Failed Chatbot Revolution."

As highlighted by the still looming inaccuracies in the University of Murica study, chatbots have not been as successful as initially hoped; funding interest in them peaked in 2016 and has steadily declined since. That said, chatbots still provide value in time-intensive settings where they can automate specific and repetitive tasks. Such cases with technical, defined, and limited vocabulary are also most likely to see successful chatbot deployment.[9] Such sectors could include medicine and the military, which both rely on the consistent use of stringent, standardized vocabularies.

Ultimately, content recommendation and adaptive learning more generally require a significant time investment upfront to develop a full curriculum and map it to learning objectives. This ensures content is available and interconnected with the appropriate use cases.[10] AI/ML systems also require training through data collection to improve recommendations over time, and the speed of that process is heavily dependent on the systems user base and utilization.[11] Learning objectives must be carefully defined, and careful consideration of how to support those objectives must be a part of implementing any learning platform, requiring long-term planning.[12] As such, these systems are most likely to be effective for introductory or fact-focused materials.[13]

TRENDS IN PLATFORM LEARNING

Learning via platform has received significant market attention for several reasons, not least among them the emergence of smartphone applications that support continuous learning, such as language skills. The emergence of major content libraries, massive open online courses (MOOCs), and teaching platforms such as Khan Academy have also helped drive this trend in commercial applications, further supported by trends in remote work and learning. This segment has therefore seen significant market-incentivized development, resulting in a series of important trends, including:

- **Learning Analytics**—predictive analytics used to personalize education at a higher organizational level, such as a company or school. The data analytics platform **BrightBytes** improves learning by creating actionable insights from personalized information collected from an individual organization.

[9] Ibid.
[10] Patsy Moskal, Don Carter, and Dale Johnson. "7 Things You Should Know About Adaptive Learning." *Educause.* January 2017. https://library.educause.edu/resources/2017/1/7-things-you-should-know-about-adaptive-learning.
[11] Ibid.
[12] Luc Lutin. "Superlearning." *Deloitte Insights.* June 2020. https://www2.deloitte.com/us/en/insights/focus/technology-and-the-future-of-work/reskilling-the-workforce.html/#endnote-sup-5.
[13] Moskal, Carter, and Johnson.

- **Micro-lessons**—short lessons that are easily digestible and can be completed in short bursts. These are convenient for personalized, engaging, and flexible learning as the specificity of the lessons allows for easy program customization via AI applications.[14]

- **Repetitive Task Automation**—AI-based programs that automate repetitive tasks, such as basic user support, so that employees have more time to engage with complicated tasks. This trend has emerged as AI becomes increasingly skilled at automating these mundane tasks. This approach is common in classrooms. Such platforms include **Bakpax**, which reads student handwriting to auto-grade homework.[15]

- **Learning in the Workflow**—content pushed to the user's workflow in order to improve engagement, consistency, and efficiency.[16] In an office setting, this can include integrations with products like Slack, a Customer Relationship Management (CRM) platform like Salesforce, Microsoft Office365 or other systems to bring learning to the "time and place it would be most beneficial."[17] **Edcast** is known for this type of integration, but it is increasingly common across the industry. Some platforms also offer mobile, augmented reality/virtual reality (AR/VR), and even offline learning to support integration into workflows away from the computer.[18]

- **User-generated Content**—content published by people in the field meant to capture tacit knowledge—knowledge that is more difficult to convey in a manual or traditional learning environment.

- **Gamification**—the use of elements from games to increase engagement. Programs such as the popular language learning app **Duolingo** incorporate game design into learning via storytelling, levels, and challenges in order to promote engagement and help students better retain information.

THE ADAPTIVE LEARNING TECHNOLOGY STACK

Content recommendation and adaptive learning require at least a few components of a broader learning technology stack. Like many types of software, learning platforms have gone through several iterations in which products were more likely to be bundled together or each individual piece of the software stack was purchased separately. At this time, the market is moving

[14] Deb McMahon. "How Artificial Intelligence Can Boost Microlearning." *American Society of Association Executives.* September 2018. https://www.asaecenter.org/resources/articles/an_plus/2018/august/how-artificial-intelligence-can-boost-microlearning.

[15] Smith.

[16] Lutin.

[17] Westfall.

[18] Lutin.

increasingly from unbundled towards bundled software, and the distinctions between these segments are becoming blurred.[19] For example, **360Learning** attempts to cover many (but not all) of the segments below. A fully integrated approach, however, is not always available or necessary for a given use case.

- **Learning Experience Platform (LEP or LXP)**—designed to support adaptive learning through content recommendation and curation.
- **Learning Management System (LMS)**—administrative support for managing content and users.[20] This system can be a user interface, but it is increasingly seen as middleware that interacts with the backend data or the LEP.
- **Learning Records Store (LRS)**—a place to store training data. This can be deployed in support of an LEP, most of which do not store learning history data despite collecting it. By connecting an LEP to this data repository, for example, ML can be better deployed to surface content and learning insights.[21]
- **Content Discovery Tools**—make content discoverable initially. These are particularly important for organizations with a large backlog of content. For example, **Valamis** offers what it calls "intelligent knowledge discovery," which makes content *within* videos and documents discoverable. Other platforms, such as **Filtered**, use similar within video capabilities to automatically tag content so users can easily find what they need. Both of these companies have full learning platforms in their own rights. It is worth noting that Valamis worked with the National Aeronautical and Space Administration (NASA) to help create an ecosystem they term a "collaboratory," which combines innovation, learning, and developing teams across a wide variety of backgrounds to solve challenges in space.[22,23]
- **Content development tools**—focus on making course development simple and modular to reduce development time. **Xyleme** allows users to create a single learning module that can be used across multiple user groups and media types. Changes in one place will automatically update all presentations. One of the leading edge content development tools uses natural language processing to generate content from long-form documentation. A company called Volley became popular for this type of auto-generated content and testing, but it is now defunct.

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[19] Josh Bersin. "Learning Technology Evolves: Integrated Platforms Are Arriving." *Josh Bersin*. June 2019. https://joshbersin.com/2019/06/learning-technology-evolves-integrated-platforms-are-arriving/.
[20] Westfall.
[21] Josh Bersin. "Learning Experience Platform (LXP) Market Grows Up: Now Too Big to Ignore." *Josh Bersin*. March 2019. https://joshbersin.com/2019/03/learning-experience-platform-lxp-market-grows-up-now-too-big-to-ignore/.
[22] "Epic Problem Solving in a Global Learning Environment." *Valamis*. https://www.valamis.com/stories/nasa.
[23] Joe McKendrick. "Innovation, Connected: NASA Astronaut Wants to Fit 100,000 Engineers into a Garage." *Forbes*. October 2016. https://www.forbes.com/sites/joemckendrick/2016/10/07/innovation-connected-nasa-astronaut-wants-to-fit-100000-engineers-into-a-garage/.

- **Other Features**—collaborative tools, skills assessment and management, certification programs, mentoring, user-generated content, teacher-support, and other potentially relevant support within learning platforms.

ADDITIONAL FINDINGS

Although adaptive learning innovation has primarily targeted the education sector, DoD has also invested in technology to better train both servicemembers and civil servants. Notably, the Defense Advanced Research Projects Agency (DARPA) funded Silicon Valley-based **Acuitus** to train Navy information technology specialists. The company has fine tuned its teaching method by combining AI with psychology to create a "digital tutor" that significantly cuts down training timeframes.[24]

Other military-funded projects include a $1.6 million grant to the Georgia Tech Research Institute from the Office of Naval Research to progress Project SHARPI which looks to advance AI and ML in human performance and adaptation.[25] In line with improving soldier performance, Army Futures Command partnered with North Carolina State University's Center for Educational Informatics to develop AI programs that can assess team-level communication, in order to provide effective feedback, as well as create an AI "coach" that can critique soldier performance in synthetic training environments. This project will be funded via a $2 million cooperative agreement over three years.[26]

FORECAST AND CONCLUSION

As AI technology continues to advance and the commercial sector addresses the growing need for non-traditional learning solutions in the wake of COVID-19, adaptive learning has gained traction as a space for investment. In support of this idea, the Bill and Melinda Gates Foundation and the Chan Zuckerberg Initiative have even listed personalized learning as a major priority, moves that are forecast to result in hundreds of millions of dollars poured into the technology's advancement.[27]

To this end, the global adaptive learning market is likely to continue growing, with driving factors including the rising demand for e-learning solutions, personalized learning, and government

[24] Smith.
[25] "Improving Military Training with Machine Learning and AI." *Georgia Tech Research Institute.* June 2020. https://gtri.gatech.edu/newsroom/improving-military-training-machine-learning-and-ai.
[26] Matt Shipman. "How AI Will Help Train the Soldiers of the Future." *NC State University.* October 2019. https://news.ncsu.edu/2019/10/ai-training-future-soldiers/.
[27] Anya Kamenetz. "The Future of Learning? Well, It's Personal." *National Public Radio.* November 2018. https://www.npr.org/2018/11/16/657895964/the-future-of-learning-well-it-s-personal.

initiatives in the space.[28] Additionally, increased global competition in the space is likely, given the growing prominence of companies from economic powerhouses like China. To demonstrate, Shanghai-based **Squirrel AI Learning** has raised $44.9 million since its inception in 2014.[29] The demand for personalized, tech-enabled learning will only grow as education continues to evolve in response to current events and growing, commercially-available AI capabilities. In conclusion, while the technology has witnessed vast improvements over the past few decades, learning customization is expected to continue to evolve as the commercial market further diversifies.

POTENTIAL AREAS FOR FURTHER STUDY

- Provide a focused report or company list tailored to DLA's envisioned use case;
- Expand upon underlying technology such as data collection platforms;
- Gather information and insights into other government adaptive learning programs;
- Provide a deep dive into adaptive learning at the corporate level.

[28] "Adaptive Learning Market by Component." *Markets and Markets.* June 2020. https://www.marketsandmarkets.com/Market-Reports/adaptive-learning-market-257528889.
[29] "Squirrel AI Learning." *CBInsights.* https://app.cbinsights.com/profiles/c/8qk3j/overview.

METHODOLOGY

In producing this study, our research team reviewed industry reports, market research products, and trade-specific professional commentary. We also reviewed marketing materials produced by individual companies. Our team continuously monitors technology news and trade publications related to the subject of this study.

NOTABLE RESOURCES

Josh Bersin. "Learning Experience Platform (LXP) Market Grows Up: Now Too Big To Ignore." *Josh Bersin.* March 2019. https://joshbersin.com/2019/03/learning-experience-platform-lxp-market-grows-up-now-too-big-to-ignore/.

Lasse Rouhianinen. "How AI And Data Could Personalize Higher Education." *Harvard Business Review*. October 2019. https://hbr.org/2019/10/how-ai-and-data-could-personalize-higher-education.

Luc Lutin. "Superlearning." *Deloitte Insights*. June 2020. https://www2.deloitte.com/us/en/insights/focus/technology-and-the-future-of-work/reskilling-the-workforce.html/_#endnote-sup-5.

MORE INFORMATION

For more information about this report; our methodology, capabilities, and portfolio of offerings; the Atlas Fulcrum platform; or any other comments or inquiries, please contact us at research@secondfront.com.