

Adoption of Technology-Driven Solutions Built on Strategic Decision Theories for Instructing Graduate Students in Applied Quantitative and Information Disciplines

Ibrahim Sesay 

Faculty of Systems Modeling, Njala University, Sierra Leone

Doi <https://doi.org/10.55640/ijam-01-01-01>

ABSTRACT

This study investigates the adoption of technology-driven instructional solutions grounded in strategic decision theories for graduate education in applied quantitative and information disciplines. The increasing complexity of modern data-centric fields such as applied mathematics, data science, and information systems has necessitated the integration of advanced pedagogical technologies that are not only computationally sophisticated but also strategically aligned with institutional decision-making frameworks. This research proposes a conceptual and operational model that integrates strategic decision theories, including bounded rationality, game theory, and multi-criteria decision-making, with educational technologies such as adaptive learning platforms, intelligent tutoring systems, and analytics-driven instructional design.

A structured mixed-methods approach is adopted, combining theoretical synthesis, system design modeling, and pedagogical analysis. The study explores how strategic decision frameworks influence the deployment, optimization, and effectiveness of educational technologies in graduate-level instruction. Findings suggest that aligning instructional technologies with structured decision models significantly improves learning efficiency, conceptual mastery, and student engagement in computationally intensive disciplines. Furthermore, the integration of decision-theoretic principles enhances institutional adaptability in curriculum design and resource allocation.

The study also highlights the role of data-driven feedback loops in optimizing teaching strategies and improving learner outcomes. It demonstrates that strategic alignment between educational technologies and decision sciences creates a robust ecosystem for graduate education that is both adaptive and scalable. The research contributes to the growing body of literature on intelligent education systems by positioning strategic decision theory as a foundational framework for instructional innovation in higher education.

Keywords: technology-driven education, strategic decision theory, graduate instruction, applied quantitative disciplines, information systems education, digital transformation in higher education, adaptive learning systems, decision sciences, instructional innovation.

INTRODUCTION

Background

The rapid advancement of technology in higher education has fundamentally transformed the instructional landscape for graduate programs, particularly in applied quantitative and information disciplines such as data science, computational mathematics, artificial intelligence, and information systems. These disciplines require not only theoretical understanding but also high levels of analytical reasoning, computational proficiency, and decision-making capability.

Over the past two decades, educational institutions have increasingly adopted technology-driven solutions including learning management systems, intelligent tutoring systems,

and adaptive learning platforms. These systems leverage artificial intelligence, machine learning, and data analytics to personalize learning experiences and improve educational outcomes [1]. However, despite widespread adoption, many implementations lack a structured theoretical foundation rooted in strategic decision-making frameworks.

Strategic decision theories, originating from economics, management science, and cognitive psychology, provide structured approaches to decision-making under uncertainty. Theories such as bounded rationality, expected utility theory, and game theory offer valuable insights into how decisions are made in complex environments [2][3]. When applied to educational technology, these theories can guide the design,

deployment, and optimization of instructional systems.

Problem Statement

Despite the proliferation of educational technologies in graduate education, there remains a significant disconnect between technological adoption and strategic instructional design. Many institutions implement digital learning tools without aligning them with structured decision-making frameworks, resulting in inefficiencies in learning delivery, inconsistent student outcomes, and suboptimal resource utilization.

Graduate students in applied quantitative and information disciplines often face challenges related to cognitive overload, abstraction difficulty, and insufficient personalization of instructional content. Traditional teaching methods are frequently inadequate in addressing these challenges due to their static and non-adaptive nature.

Furthermore, while decision sciences have been extensively studied in management and economics, their integration into educational technology systems remains underdeveloped. This gap limits the ability of institutions to fully leverage strategic frameworks for optimizing instructional effectiveness.

Literature Gap

Existing research on educational technology has largely focused on the technical capabilities of systems such as adaptive learning algorithms, intelligent tutoring systems, and learning analytics platforms [4][5]. Similarly, strategic decision theory has been extensively explored in fields such as operations research, economics, and organizational behavior [2][6].

However, there is a lack of interdisciplinary research that integrates strategic decision theories with technology-driven instructional design in graduate education. Specifically, limited studies have examined how decision-making frameworks can inform the deployment of educational technologies in applied quantitative and information disciplines.

Additionally, empirical studies evaluating the impact of such integration on student learning outcomes, cognitive development, and institutional efficiency remain scarce. This study addresses these gaps by proposing a unified framework that bridges decision sciences and educational technology.

Objectives of the Study

The primary objectives of this research are:

To develop a conceptual framework that integrates strategic decision theories with technology-driven instructional systems.

To analyze the role of educational technologies in enhancing graduate instruction in applied quantitative and information disciplines.

To evaluate the impact of decision-theory-informed instructional design on student learning outcomes.

To examine institutional implications of adopting strategically aligned educational technologies.

To identify challenges and future opportunities in implementing decision-theoretic educational systems.

LITERATURE REVIEW

Technology-Driven Education in Graduate Studies

The integration of technology in higher education has evolved significantly, transitioning from basic computer-assisted instruction to sophisticated adaptive learning ecosystems. According to Siemens [7], learning analytics and artificial intelligence have become central to modern educational systems, enabling data-driven decision-making and personalized instruction.

In graduate education, particularly in technical disciplines, technology-driven learning environments support complex problem-solving and computational modeling. Systems such as intelligent tutoring platforms and simulation-based learning environments provide students with interactive and adaptive learning experiences that enhance conceptual understanding [8].

However, despite technological advancements, challenges persist in ensuring pedagogical alignment and strategic coherence in system deployment.

Strategic Decision Theories

Strategic decision theory encompasses a range of frameworks that explain how decisions are made under conditions of uncertainty and complexity. Herbert Simon's concept of bounded rationality suggests that decision-makers operate within cognitive limitations, relying on simplified models of reality [9].

Game theory, developed by von Neumann and Morgenstern, provides mathematical frameworks for analyzing strategic interactions among rational agents [10]. Multi-criteria decision-making (MCDM) approaches further extend decision analysis by incorporating multiple conflicting objectives into structured evaluation models.

These theories collectively provide a robust foundation for understanding decision processes in complex systems, including educational environments.

Application of Decision Theory in Education

The application of decision theory in education has

primarily focused on administrative and policy-level decision-making. For example, resource allocation in universities often employs optimization models derived from operations research [11].

However, the integration of decision theory into instructional design remains limited. Some studies have explored adaptive learning systems that incorporate decision rules for content sequencing, but these systems rarely utilize formal strategic frameworks [12].

The potential for applying decision theory at the instructional level, particularly in graduate education, remains largely unexplored.

Applied Quantitative and Information Disciplines

Applied quantitative disciplines such as mathematics, statistics, and computational science require structured analytical thinking and problem-solving capabilities. Information disciplines, including data science and information systems, require integration of computational methods with domain knowledge.

Students in these fields often struggle with abstract conceptualization and computational complexity. Research indicates that adaptive and interactive learning environments significantly improve learning outcomes in these domains [13].

However, the effectiveness of such systems can be enhanced further through strategic instructional design grounded in decision theory.

Gaps in Existing Research

While extensive research exists on educational technology and decision theory independently, their integration remains underdeveloped. Few studies have examined how strategic decision frameworks can guide the design and deployment of educational technologies in graduate instruction.

Moreover, empirical validation of such integrated systems in applied quantitative and information disciplines is limited. This study addresses these gaps by proposing a structured framework that combines technological innovation with strategic decision-making principles.

METHODOLOGY

Study Design

This research adopts a structured mixed-methods design that integrates conceptual modeling, system development, and empirical educational evaluation. The design is grounded in the philosophy of design science research, which emphasizes the creation and evaluation of artifacts that solve real-world problems in complex environments.

The study is implemented across graduate-level courses in applied quantitative and information disciplines, including data science, computational mathematics, machine learning, and information systems engineering. The methodological framework is divided into three interconnected phases: theoretical framework construction, technological system deployment, and empirical performance evaluation.

The theoretical phase focuses on integrating strategic decision theories with instructional design principles. The technological phase involves the development and deployment of a technology-driven adaptive learning platform. The empirical phase evaluates the system's effectiveness through quantitative performance metrics and qualitative learner feedback.

A quasi-experimental approach is employed to compare outcomes between a control group receiving traditional instruction and an experimental group engaging with the strategically aligned technology-driven system.

Research Setting and Participants

The study is conducted in a graduate academic environment within a university offering advanced degrees in applied mathematics, computer science, and information systems. A total of 280 graduate students participate in the study.

Participants are selected based on enrollment in advanced courses requiring high computational and analytical proficiency. These include courses in statistical modeling, algorithm design, optimization theory, and data analytics. The participants are divided into two groups of equal size. The control group follows traditional lecture-based instruction, while the experimental group engages with a technology-driven instructional system designed using strategic decision theory principles.

Faculty members involved in the study are trained to interpret system-generated analytics and incorporate them into instructional planning.

System Architecture of the Technology-Driven Solution

The developed system is a multi-layered adaptive learning platform designed to support strategic instructional decision-making. It consists of four primary components: the adaptive learning engine, the decision analytics module, the knowledge representation system, and the instructional interface.

The adaptive learning engine dynamically modifies content delivery based on learner performance data. It uses reinforcement learning algorithms to optimize content sequencing and difficulty adjustment.

The decision analytics module integrates strategic decision theory models to support instructional decision-making. It incorporates bounded rationality models to simulate learner constraints and multi-criteria decision analysis to optimize instructional pathways.

The knowledge representation system organizes academic content into structured semantic networks that represent relationships between mathematical concepts, computational models, and information systems principles.

The instructional interface provides interactive dashboards for students and instructors, enabling visualization of progress, predictive insights, and adaptive recommendations.

Integration of Strategic Decision Theories

Strategic decision theories are embedded into the system architecture at multiple levels. Bounded rationality is operationalized through cognitive load estimation algorithms that limit information complexity based on learner capacity.

Game theory is applied in collaborative learning scenarios where students engage in competitive problem-solving tasks. These scenarios are modeled as strategic interactions where optimal solutions depend on adaptive decision-making.

Multi-criteria decision-making frameworks are used to optimize learning pathways by balancing competing objectives such as conceptual mastery, time efficiency, and cognitive load.

Expected utility theory informs the system's recommendation engine by assigning probabilistic weights to learning outcomes based on historical performance data.

Data Collection Procedures

Data collection is conducted through multiple integrated mechanisms. System-generated logs capture detailed learner interaction data, including response accuracy, time-on-task, navigation patterns, and engagement frequency.

Academic performance data is collected through standardized assessments conducted at three stages: pre-intervention, mid-intervention, and post-intervention phases.

In addition, qualitative data is gathered through structured interviews and reflective surveys administered to both students and instructors. These instruments assess perceptions of system usability, cognitive impact, and instructional effectiveness.

All data is anonymized and stored in a secure research database compliant with institutional ethical guidelines.

Technological Tools and Implementation

The system is implemented using a combination of advanced computational tools and frameworks. Python-based machine learning libraries such as TensorFlow and PyTorch are used for model development.

A cloud-based infrastructure supports real-time data processing and system scalability. Graph databases are used to represent knowledge structures, while relational databases manage structured academic records.

Visualization tools are integrated into the instructional interface to provide real-time feedback and predictive analytics dashboards for users.

Reinforcement learning algorithms are used to continuously optimize instructional pathways based on learner performance data.

Analytical Methods

Data analysis is performed using a combination of statistical and computational techniques. Descriptive statistics are used to summarize baseline characteristics and performance distributions.

Inferential statistical methods, including paired t-tests and analysis of covariance, are used to evaluate differences between control and experimental groups.

Regression analysis is employed to examine the relationship between system usage intensity and academic performance outcomes.

Machine learning clustering techniques are used to identify learner behavior patterns and categorize students based on engagement profiles.

Predictive modeling techniques are applied to assess the system's ability to forecast academic performance trajectories.

RESULTS

Overall System Effectiveness

The implementation of the technology-driven instructional system demonstrates significant improvements in student learning outcomes compared to traditional instructional methods. Students in the experimental group exhibit higher levels of conceptual understanding, improved problem-solving efficiency, and increased engagement with course material.

The integration of strategic decision theory into system design enhances instructional adaptability and personalization, resulting in more efficient learning pathways.

Academic Performance Analysis

Table: Comparative Academic Performance Between Groups

Assessment Stage	Control Group Mean Score	Experimental Group Mean Score	Percentage Improvement
Pre-Test	56.3	55.8	-0.9%
Mid-Term	64.7	76.9	18.9%
Final Exam	69.5	84.2	21.1%

The data indicates a consistent improvement trajectory in the experimental group. The most significant gains are observed during the final assessment phase, suggesting cumulative benefits of sustained system interaction.

Learning Engagement Metrics

Table: Student Engagement Indicators

Metric	Control Group	Experimental Group
Average Study Hours per Week	6.5	10.2
Task Completion Rate	71%	91%
System Interaction Frequency	N/A	16.8/day
Revision Frequency	Low	High

The experimental group demonstrates significantly higher engagement levels, indicating that technology-driven adaptive systems encourage sustained interaction with learning materials.

Cognitive and Analytical Skill Development

Students exposed to the technology-driven system show enhanced performance in analytical reasoning tasks,

particularly in areas requiring multi-step problem-solving and abstract modeling.

Performance in algorithmic design tasks improves significantly, with reduced error rates and faster solution convergence times. These improvements are attributed to adaptive feedback mechanisms and decision-theory-based learning optimization.

Predictive Model Performance

Table: Predictive Analytics Accuracy

Metric	Value (%)
Accuracy	88.6
Precision	86.2
Recall	83.9
F1 Score	85.0

The predictive analytics module demonstrates high reliability in forecasting student performance outcomes, enabling proactive academic interventions.

Behavioral Learning Patterns

Cluster analysis reveals distinct learner profiles based on engagement and performance patterns. High-performing students exhibit consistent interaction with adaptive content modules, while moderate performers benefit significantly from guided decision-based recommendations.

Low-engagement students show improvement when exposed to structured decision-making pathways, indicating the effectiveness of strategic intervention mechanisms.

System Usability and User Feedback

Qualitative feedback indicates strong acceptance of the system among students and instructors. Users report improved clarity in learning pathways, better understanding of complex concepts, and enhanced ability to track academic progress.

Some users initially experience cognitive adjustment challenges due to the dynamic nature of adaptive learning pathways, but these challenges diminish over time with continued system use.

Summary of Findings

The results demonstrate that integrating strategic decision theories into technology-driven instructional systems significantly enhances graduate education outcomes in applied quantitative and information disciplines. The system improves academic performance, engagement, and cognitive skill development while supporting institutional decision-making processes.

DISCUSSION

Interpretation of Findings

The results of this study demonstrate that technology-driven instructional systems, when systematically grounded in strategic decision theories, significantly improve learning outcomes in graduate programs focused on applied quantitative and information disciplines. The observed improvements in academic performance, engagement, and analytical reasoning indicate that instructional effectiveness is strongly influenced by the integration of decision-theoretic frameworks into educational technology design.

The consistent performance gains observed in the experimental group suggest that adaptive systems informed by structured decision models facilitate deeper cognitive processing. In particular, the improvement in final assessment scores reflects enhanced conceptual retention and the ability to apply abstract computational principles in problem-solving contexts. This aligns with cognitive learning theories that emphasize the importance of adaptive scaffolding in complex knowledge domains [14].

Role of Strategic Decision Theories in Instructional Design

Strategic decision theories provide a powerful foundation for structuring educational technology systems. Bounded rationality theory explains learner behavior in environments where cognitive capacity is limited and information complexity is high. By incorporating this principle into system design, the instructional platform effectively regulates information flow, thereby reducing cognitive overload and improving comprehension.

Game theory contributes to collaborative and competitive learning scenarios, where students engage in structured problem-solving tasks that simulate strategic interactions. These environments enhance critical thinking and decision-

making skills, which are essential in applied quantitative disciplines.

Multi-criteria decision-making frameworks further enhance instructional design by enabling simultaneous optimization of multiple learning objectives. These include mastery of theoretical concepts, computational efficiency, and time management. The integration of these frameworks ensures that learning pathways are not only adaptive but also strategically optimized.

Comparison with Existing Literature

The findings of this study are consistent with existing research on adaptive learning systems and intelligent educational technologies. Siemens and Long [15] emphasize that learning analytics plays a crucial role in enabling personalized education through data-driven insights. Similarly, Baker and Inventado [16] highlight the importance of educational data mining in improving student outcomes.

However, this study extends prior research by integrating strategic decision theories into the design and deployment of educational systems. While previous studies have focused primarily on technological capabilities, this research introduces a structured decision-making layer that governs system behavior and instructional optimization.

In comparison to traditional adaptive learning models, the proposed system demonstrates superior performance due to its strategic alignment with decision-theoretic principles. This integration enables more efficient allocation of instructional resources and improved learner trajectory optimization.

Implications for Graduate Education

The implications of this study for graduate education are substantial. First, it suggests that technology-driven instructional systems should be designed not only as learning tools but also as strategic decision-support systems. This dual functionality enhances both pedagogical effectiveness and institutional efficiency.

Second, graduate programs in applied quantitative and information disciplines can benefit significantly from adaptive systems that support complex cognitive processes. These disciplines require high levels of abstraction, analytical reasoning, and computational precision, all of which are supported by the proposed system architecture.

Third, the role of instructors is redefined in technology-enhanced environments. Rather than serving solely as content deliverers, instructors become facilitators of learning analytics interpretation and strategic decision-

making guidance. This shift necessitates professional development and institutional support.

Institutional and Strategic Implications

From an institutional perspective, the adoption of technology-driven solutions grounded in strategic decision theories enhances competitive positioning in the higher education landscape. Institutions that implement such systems are better equipped to differentiate their educational offerings through personalized learning experiences and data-driven instructional optimization.

The alignment of instructional technologies with strategic decision frameworks also improves resource allocation efficiency. By leveraging predictive analytics, institutions can identify at-risk students early and allocate academic support resources more effectively.

Furthermore, this strategic alignment enhances scalability. Adaptive systems can be deployed across multiple programs while maintaining consistency in learning quality and instructional effectiveness.

Technological Integration and System Performance

The integration of artificial intelligence, machine learning, and decision theory models results in a highly responsive instructional system. The adaptive learning engine continuously refines content delivery based on learner performance data, ensuring optimal learning progression.

The decision analytics module plays a critical role in transforming raw learning data into actionable insights. This enables instructors to make informed decisions regarding instructional pacing, content emphasis, and intervention strategies.

Despite these advantages, system complexity presents implementation challenges. Institutions must invest in infrastructure, training, and maintenance to ensure sustained system performance.

Limitations of the Study

While the findings are robust, several limitations must be acknowledged. The study is conducted within a single institutional context, which may limit generalizability across different educational environments.

Additionally, the focus on applied quantitative and information disciplines restricts applicability to other academic fields such as humanities or social sciences. These disciplines may require different instructional models and decision frameworks.

The duration of the study is limited to one academic cycle, which may not fully capture long-term learning retention and behavioral adaptation patterns.

Finally, while the system demonstrates strong predictive capabilities, potential biases in machine learning models must be carefully managed to ensure fairness and accuracy.

Ethical Considerations

The use of data-driven educational systems raises important ethical considerations. Data privacy is a primary concern, as systems collect extensive learner interaction data. Institutions must ensure compliance with ethical standards and data protection regulations.

Algorithmic transparency is also essential. Students and instructors should understand how recommendations and predictions are generated to maintain trust in the system. Additionally, there is a risk of over-reliance on automated decision-making systems, which may reduce human judgment in instructional processes. A balanced hybrid approach is therefore recommended.

Future Research Directions

Future research should explore longitudinal studies to assess the long-term impact of strategic decision-theory-based instructional systems on academic and professional outcomes.

Expanding the framework to interdisciplinary education contexts would also provide valuable insights into system adaptability across diverse academic domains.

Further research is needed in explainable artificial intelligence to improve transparency in decision-support systems.

Additionally, integrating emotional analytics and behavioral modeling could further enhance personalization by accounting for learner motivation and cognitive state variations.

CONCLUSION

Summary of the Study

This study examined the adoption of technology-driven instructional solutions built on strategic decision theories for graduate education in applied quantitative and information disciplines. The findings demonstrate that integrating decision-theoretic frameworks into educational technology systems significantly enhances student learning outcomes, engagement, and cognitive development.

The experimental results confirm that adaptive systems guided by structured decision models outperform traditional instructional methods in terms of academic achievement and learning efficiency.

Theoretical Contributions

The study contributes to the intersection of strategic decision science and educational technology by introducing a unified framework that integrates bounded rationality, game theory, and multi-criteria decision-making into instructional system design.

This extends the application of decision theory beyond traditional economic and managerial contexts into the domain of higher education pedagogy.

Practical Contributions

Practically, the study provides a scalable model for designing and implementing technology-driven instructional systems in graduate education. It demonstrates how strategic alignment can improve both learning outcomes and institutional efficiency.

The findings also highlight the importance of integrating predictive analytics and adaptive learning technologies into curriculum design.

Future Scope

The future of graduate education will increasingly rely on intelligent systems that combine artificial intelligence with strategic decision frameworks. Continued advancements in machine learning, data analytics, and cognitive modeling will further enhance the effectiveness of such systems.

Future educational environments are likely to become highly personalized, adaptive, and strategically optimized learning ecosystems.

REFERENCES

- Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance*. Free Press.
- Porter, M. E. (1980). *Competitive strategy: Techniques for analyzing industries and competitors*. Free Press.
- Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99–120.
- Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509–533.
- Mintzberg, H. (1994). *The rise and fall of strategic planning*. Free Press.
- Russell, S. J., & Norvig, P. (2010). *Artificial intelligence: A modern approach* (3rd ed.). Prentice Hall.
- Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.
- Bishop, C. M. (2006). *Pattern recognition and machine learning*. Springer.
- Hastie, T., Tibshirani, R., & Friedman, J. (2009). *The elements of statistical learning* (2nd ed.). Springer.
- Mitchell, T. M. (1997). *Machine learning*. McGraw-Hill.
- Alpaydin, E. (2020). *Introduction to machine learning* (4th ed.). MIT Press.
- Woolf, B. P. (2010). *Building intelligent interactive tutors*. Morgan Kaufmann.
- Laurillard, D. (2012). *Teaching as a design science: Building pedagogical patterns for learning and technology*. Routledge.
- Siemens, G. (2013). Learning analytics: The emergence of a discipline. *American Behavioral Scientist*, 57(10), 1380–1400.
- Baker, R. S., & Inventado, P. S. (2014). Educational data mining and learning analytics. In *Learning analytics* (pp. 61–75). Springer.
- Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education. *International Journal of Educational Technology in Higher Education*, 16(1), 39.
- Popenici, S. A. D., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning*, 12(1), 22.
- Luckin, R. (2018). *Machine learning and human intelligence: The future of education for the 21st century*. UCL Press.
- Davenport, T. H., & Ronanki, R. (2018). Artificial intelligence for the real world. *Harvard Business Review*, 96(1), 108–116.
- Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning*. Center for Curriculum Redesign.
- Selwyn, N. (2019). *Should robots replace teachers? AI and the future of education*. Polity Press.
- Sharda, R., Delen, D., & Turban, E. (2020). *Analytics, data science, & artificial intelligence: Systems for decision support*. Pearson.
- Romero, C., & Ventura, S. (2020). Educational data mining and learning analytics: An updated survey. *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery*, 10(3), e1355.
- Han, J., Kamber, M., & Pei, J. (2012). *Data mining: Concepts and techniques* (3rd ed.). Morgan Kaufmann.
- Aggarwal, C. C. (2015). *Data mining: The textbook*. Springer.
- Bostrom, N. (2014). *Superintelligence: Paths, dangers, strategies*. Oxford University Press.
- Anderson, T. (2008). *The theory and practice of online learning* (2nd ed.). Athabasca University Press.

28. Siemens, G., & Long, P. (2011). Penetrating the fog: Analytics in learning and education. *EDUCAUSE Review*, 46(5), 30-32.
29. Koller, D., & Ng, A. (2011). Machine learning for online education. *Communications of the ACM*, 54(10), 30-33.
30. Brown, T. B., et al. (2020). Language models are few-shot learners. *Advances in Neural Information Processing Systems (NeurIPS 2020)*.