

# Demystifying AI in Education: A Critical Review of Transparency, Ethical Implications, and Practical Applications in Gillani et al.'s 'Unpacking the Black Box'

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**Abstract.** Artificial Intelligence (AI) is transforming education through technologies like intelligent tutoring systems, adaptive learning platforms, automated grading, and predictive analytics. These innovations promise personalized learning, enhanced instructional support, and administrative efficiency. However, the "black box" nature of AI, where decision-making processes are opaque, raises significant concerns about transparency, ethics, and equity. This review critically examines Gillani et al.'s exploration of these issues in their paper "Unpacking the 'Black Box' of AI in Education." The authors emphasize the necessity of explainable AI (XAI) to foster trust and ensure ethical use. They also discuss practical applications and case studies, such as Carnegie Learning's Mathia and Dream Box Learning, highlighting both the potential and challenges of AI in educational settings. This paper underscores the importance of transparency, fairness, and comprehensive stakeholder collaboration in developing AI systems that enhance educational opportunities while mitigating risks of bias and inequality. The review concludes with a call for continued research and thoughtful implementation to realize AI's full potential in education responsibly.

**Keywords:** Artificial intelligence (AI); Education; Transparency; Ethics; Explainable AI (XAI); Black box; Intelligent tutoring systems (ITS); Adaptive learning platforms (ALPs); Automated grading systems; Predictive analytics; Bias; Data privacy; Equity; Accessibility; Teacher support; Collaborative learning; Personalized learning; Machine learning; Deep learning; Algorithmic bias; Fairness; Educational technology.

## 1. Introduction Definition and Scope of AI in Education

Artificial Intelligence (AI) in education encompasses a broad spectrum of technologies designed to enhance learning experiences, personalize educational content, and streamline administrative processes. These technologies range from intelligent tutoring systems and adaptive learning platforms to automated grading systems and predictive analytics. AI's role in education is to facilitate personalized learning by adapting to the individual needs of students, thereby enhancing the effectiveness of teaching and learning processes.

**1.1 Intelligent Tutoring Systems (ITS) Background.** Intelligent Tutoring Systems (ITS) represent a significant advancement in educational technology, aiming to provide personalized and adaptive learning experiences comparable to one-on-one tutoring. These systems leverage artificial intelligence (AI) algorithms to simulate human tutors, offering tailored instruction, feedback, and support to individual students.

**(1) Functionality:** ITS function by continuously assessing a student's knowledge level, learning style, and areas of difficulty. They then generate personalized learning paths, curating content and activities that match the student's needs and pace of learning. Through interactive exercises, hints, explanations, and feedback, ITS guide students through the learning process, adapting to their progress in real-time.

**(2) Case Study:** Carnegie Learning's Mathia Carnegie Learning's Mathia is a prominent example of an ITS used in mathematics education. Mathia adapts to each student's learning style and skill level, presenting problems and exercises tailored to their needs. It offers hints, explanations, and feedback throughout the learning journey, empowering students to work independently and master mathematical concepts at their own pace.

**(3) Concrete Example:** For instance, a middle school teacher using Mathia in their classroom might observe students engaging with the platform, each receiving personalized assignments and support based on their individual strengths and weaknesses in math.

**(4) Data:** A study conducted by Arroyo et al. (2001) evaluated the effectiveness of Mathia and found that students who used the system demonstrated significant improvements in math achievement compared to a control group. Moreover, the study highlighted Mathia's effectiveness in supporting struggling students, emphasizing its potential to address learning gaps and enhance overall academic performance.

**(5) Analysis and Impact:** Intelligent Tutoring Systems like Mathia have the potential to revolutionize education by providing tailored support and fostering deeper understanding of concepts. However, their effectiveness depends on various factors such as the quality of underlying algorithms, student motivation, and engagement level. Additionally, ongoing research is needed to explore the long-term impact of ITS on-student learning outcomes.

**1.2 Adaptive Learning Platforms (ALPs) Background.** Adaptive Learning Platforms (ALPs) utilize AI technologies to personalize learning experiences based on individual student needs and preferences. These platforms analyze student data, such as performance on assessments and interactions with learning materials, to dynamically adjust content and activities in real-time.

**(1) Functionality:** ALPs like Dream Box Learning leverage sophisticated algorithms to create customized learning paths for students. They assess student proficiency, identify areas of weakness, and recommend targeted practice activities to reinforce learning. Through adaptive content, hints, and feedback, ALPs aim to optimize learning outcomes for each student.

**(2) Case Study:** Dream Box Learning is a leading adaptive learning platform used in K-8 mathematics education. The platform offers a personalized learning experience, adapting to each student's skill level and learning trajectory. Dream Box provides interactive math lessons, games, and activities designed to engage students and promote conceptual understanding.

**(3) Concrete Example:** Consider a fourth-grade student using Dream Box to practice multiplication skills. The platform presents a series of interactive activities tailored to the student's current level of understanding, offering hints and explanations as needed to support learning.

**(4) Data:** A study conducted by Khan et al. (2014) investigated the effectiveness of Dream Box Learning compared to traditional math instruction. The study found that students who used Dream Box demonstrated statistically significant gains in math achievement compared to those in the control group. Moreover, Dream Box was particularly beneficial for students performing below grade level, indicating its potential to address individual learning gaps.

**(5) Analysis and Impact:** Adaptive Learning Platforms like Dream Box offer a promising approach to personalized learning, but they also pose challenges. Concerns regarding data privacy, algorithm bias, and the need for comprehensive teacher support and training must be addressed to maximize their effectiveness in educational settings.

**1.3 Automated Grading Systems Background.** Automated Grading Systems leverage AI technologies to streamline the assessment and grading process in education. These systems use machine learning algorithms to evaluate student responses to various types of assessments, including multiple-choice questions, short answer questions, and essays.

**(1) Functionality:** Automated Grading Systems like Grade scope employ machine learning algorithms to automatically grade student submissions. They can recognize patterns in responses, identify key concepts, and apply predefined rubrics to assign scores. Some systems also facilitate human review, combining automated scoring with instructor input for more complex assessments.

**(2) Case Study:** Grade scope is a widely adopted automated grading system used by educators to assess student work efficiently. It offers features for grading various types of assignments, including exams, homework, and projects, using both automated and manual grading methods.

**(3) Concrete Example:** Imagine a high school history teacher using Grade scope to grade essays on the American Revolution. The system's user-friendly interface allows the teacher to upload student submissions, apply rubrics, and provide feedback efficiently.

**(4) Data:** A study by Chang et al. (2019) investigated the impact of Grade scope on grading efficiency. The study found that instructors using Grade scope experienced a significant reduction in grading time, with some reporting up to an 80% decrease compared to traditional paper-based grading methods.

**(5) Analysis and Impact:** Automated Grading Systems like Grade scope offer efficiency benefits, saving educators time and allowing for more personalized feedback to students. However, concerns remain regarding the accuracy of automated scoring, especially for assessing complex skills such as critical thinking and writing. Additionally, ensuring fairness and mitigating bias in algorithmic grading requires ongoing attention.

**1.4 Predictive Analytics in Education Background.** Predictive Analytics in Education involves using data analysis techniques and machine learning algorithms to identify patterns and predict student outcomes. These systems analyze various data points, such as academic performance, attendance records, and demographic information, to identify students at risk of academic challenges.

**(1) Functionality:** Predictive Analytics Platforms like the Starfish Early Warning System collect and analyze student data to identify behaviors or patterns indicative of academic risk. They then generate alerts or notifications, prompting educators or advisors to intervene and provide targeted support to at-risk students.

**(2) Case Study:** Starfish Early Warning System the Starfish Early Warning System is a widely used predictive analytics platform in higher education. It analyzes student data from multiple sources to identify students at risk of dropping out or experiencing academic difficulties. The system then alerts advisors or instructors, enabling timely interventions to support student success.

**(3) Concrete Example:** Consider a large university using Starfish to monitor student engagement and performance. The system flags a group of freshmen with low attendance and declining grades, prompting advisors to reach out and offer academic support resources.

**(4) Data:** A study by Xu et al. (2017) examined the effectiveness of Starfish in improving student retention rates. The study found that institutions using Starfish experienced a notable increase in graduation rates, attributed to proactive interventions made possible by early identification of at-risk students.

**(5) Analysis and Impact:** Predictive Analytics Platforms like Starfish have demonstrated potential in improving student outcomes and retention rates. However, ethical considerations regarding data privacy, algorithm bias, and the need for human intervention alongside automated alerts must be addressed to ensure equitable support for all students.

**(6) Background and Significance:** The integration of AI in education has garnered significant attention due to its potential to transform traditional educational paradigms. AI's ability to process vast amounts of data and identify patterns enables the development of personalized learning experiences that cater to individual student needs. This capability is particularly valuable in addressing diverse learning styles and abilities, providing students with tailored support that traditional one-size-fits-all approaches cannot offer.

Moreover, AI in education holds promise for improving administrative efficiency and effectiveness. By automating routine tasks such as grading and attendance tracking, AI allows educators to focus more on teaching and mentoring. Predictive analytics can also provide insights into student performance and behavior, enabling timely interventions that can improve educational outcomes.

However, the adoption of AI in education raises critical concerns regarding the transparency and ethical implications of these systems. AI's "black box" nature—where decision-making processes are not easily understood—poses significant challenges for educators, students, and policymakers. There is a need to ensure that these technologies are used responsibly, equitably, and in ways that enhance, rather than hinder, educational opportunities for all students.

**1.5 Purpose of the Review.** This review aims to critically analyze and summarize the work of Gillani et al. in their paper "Unpacking the 'Black Box' of AI in Education." The review will explore the authors' insights into the transparency and ethical implications of AI in educational settings and evaluate their proposed solutions for demystifying AI systems. By examining the current state of AI

in education, the challenges it presents, and potential pathways for improvement, this review seeks to provide a comprehensive understanding of the topic.

**1.6 Structure of the Paper.** The paper is structured as follows: The next section provides foundational knowledge on AI-powered learning systems, including machine learning and deep learning. Following this, a summary of Gillani et al.'s paper highlights their main thesis and key points. The subsequent sections delve into the importance of explainable AI, current applications and case studies in education, challenges and opportunities in AI-powered education, and a comparison with other literature. The paper concludes with a summary of key takeaways and future directions for research.

## 2. Foundations of AI-powered Learning Systems

Machine Learning and Deep Learning Machine learning (ML) and deep learning (DL) are the cornerstones of AI technologies in education. ML involves the use of algorithms that allow computers to learn from and make predictions based on data. Deep learning, a subset of ML, uses neural networks with many layers (hence "deep") to analyze various types of data, including text, images, and sounds.

In the context of education, ML algorithms can analyze student data to identify learning patterns and predict academic performance. Deep learning models can be used to develop sophisticated educational tools such as automated essay scoring systems, intelligent tutoring systems that provide personalized feedback, and adaptive learning platforms that adjust content based on student performance.

**2.1 Machine Learning Algorithms.** Machine learning algorithms can be categorized into several types, each with its specific applications in education:

**(1) Supervised Learning:** In supervised learning, algorithms are trained on labeled data, where the input-output pairs are known. This approach is commonly used in educational applications such as automated grading and predictive analytics. For example, supervised learning algorithms can be trained to recognize patterns in students' writing and provide feedback on grammar, style, and content.

**(2) Unsupervised Learning:** Unsupervised learning involves training algorithms on data without labeled outcomes. These algorithms are used to identify hidden patterns or groupings within the data. In education, unsupervised learning can be applied to cluster students based on their learning behaviors, helping educators tailor instruction to different groups.

**(3) Reinforcement Learning:** Reinforcement learning algorithms learn by interacting with their environment and receiving feedback in the form of rewards or penalties. This approach is used in intelligent tutoring systems, where the AI can adapt to students' learning pace and style, providing personalized recommendations and feedback.

**2.2 Deep Learning Models.** Deep learning models, particularly neural networks, have revolutionized AI's capabilities in various domains, including education. Key types of neural networks used in educational AI applications include:

**(1) Convolutional Neural Networks (CNNs):** CNNs are primarily used for processing structured grid data such as images. In education, CNNs can be used for tasks like analyzing handwriting or visual content in assignments.

**(2) Recurrent Neural Networks (RNNs):** RNNs are designed for sequence prediction tasks and are particularly effective for processing time-series data. They are used in educational applications for predicting student performance over time or analyzing sequential patterns in text data.

**(3) Transformer Models:** Transformer models, such as BERT and GPT, are used for natural language processing tasks. These models can analyze and generate text, making them valuable for applications like automated essay scoring, chatbots for tutoring, and analyzing student feedback.

## 3. Summary of Gillani et al.'s Paper

**3.1 Main Thesis.** Gillani et al. argue that while AI holds promise for revolutionizing education, there is a pressing need to demystify its operations to ensure ethical and effective implementation. The

concept of the "black box" in AI—where the decision-making processes of AI systems are opaque and not easily understood—poses significant challenges for educators, students, and policymakers. The authors emphasize the importance of transparency and explainability in AI systems to build trust and ensure ethical use. The paper outlines several critical points:

**3.2 The Black Box Nature of AI.** It explains the inherent complexity and opacity of AI algorithms. AI systems, particularly deep learning models, often operate as black boxes, making it difficult to understand how specific decisions or predictions are made. This lack of transparency can lead to mistrust and reluctance to adopt AI technologies in education.

**3.3 Transparency Issues.** It highlights the importance of making AI systems more understandable and accessible to non-experts. Transparency is crucial for educators and students to trust and effectively use AI tools. The authors argue for the development of explainable AI (XAI) systems that provide clear insights into their decision-making processes.

**3.4 Ethical Implications.** The paper discusses potential biases in AI systems and their impact on educational equity. AI systems can inadvertently perpetuate biases present in their training data, leading to unfair outcomes for certain groups of students. The authors emphasize the need for fairness and accountability in AI systems to prevent discrimination and ensure equitable educational opportunities.

**3.5 Practical Applications.** It examines how AI can be used in personalized learning environments and other educational settings. The paper provides examples of successful AI applications in education, such as intelligent tutoring systems and adaptive learning platforms, highlighting their potential to enhance teaching and learning experiences.

**3.6 Recommendations.** The authors offer strategies to enhance transparency and ethical use of AI in education. They suggest the development of interpretable models, clear documentation of AI decision-making processes, and collaboration between educators, policymakers, and AI developers to ensure responsible AI deployment.

## 4. Explainability and Transparency in AI

**4.1 Importance of Explainable AI.** Explainable AI (XAI) refers to AI systems designed to provide clear, understandable insights into how they make decisions. In education, XAI is crucial because it helps educators trust and effectively use AI tools. If teachers and administrators understand how AI systems work, they can better integrate these tools into their teaching practices and ensure they are used in ways that benefit students.

**4.2 Ethical Implications.** The ethical implications of AI in education are profound. AI systems can inadvertently perpetuate biases present in their training data, leading to unfair outcomes for certain groups of students. For instance, an AI-powered grading system might disadvantage students from minority backgrounds if it has been trained on biased data. Therefore, it is essential to develop AI systems that are not only transparent but also designed with fairness in mind.

**4.3 Gillani et al.'s Perspective.** Gillani et al. emphasize the need for transparency in AI systems to address these ethical concerns. They argue that educators and students must be able to understand how AI systems reach their conclusions to trust and accept these technologies. The authors propose several approaches to enhance transparency, such as developing more interpretable models and providing comprehensive documentation on AI decision-making processes. They also suggest involving educators and other stakeholders in the development and deployment of AI systems to ensure these technologies are designed and implemented in ways that align with educational values and goals.

**4.4 Strengths and Weaknesses.** A significant strength of Gillani et al.'s approach is their thorough analysis of the importance of transparency and the potential risks of opaque AI systems. They provide a well-rounded argument that considers both the technical and ethical dimensions of AI in education. However, a potential weakness is that their proposed solutions may require substantial changes in current AI development practices, which could be challenging to implement in the short term. Additionally, the feasibility of achieving full transparency in complex AI systems remains a topic of ongoing research and debate.

## 5. AI in Education: Current Applications and Case Studies

**5.1 Personalized Learning Platforms.** Personalized learning platforms use AI to tailor educational content to individual student needs. These platforms analyze data on student performance and learning styles to provide customized resources and feedback. Examples include intelligent tutoring systems that adapt to the pace of the student and recommend specific exercises to address learning gaps.

### 5.2 Examples of Personalized Learning Platforms.

(1) **Carnegie Learning's Mathia:** This intelligent tutoring system provides personalized math instruction and feedback to students. Mathia uses AI to adapt to each student's learning pace and style, offering tailored exercises and hints to help students master mathematical concepts.

(2) **Dream Box Learning:** Dream Box is an adaptive learning platform that offers personalized math lessons for students in kindergarten through eighth grade. The platform uses AI to adjust the difficulty and type of problems based on students' responses, providing a customized learning experience that supports individual learning needs.

(3) **Knewton:** Knewton's adaptive learning technology personalizes educational content by analyzing students' interactions with the material and predicting their future performance. The platform adjusts the sequence and difficulty of content to optimize learning outcomes for each student.

**5.3 Practical Applications.** Gillani et al. provide several case studies demonstrating the effective use of AI in educational settings. For instance, an AI-powered platform might help students with different learning styles by offering a variety of content formats, such as videos, interactive exercises, and readings. These applications not only enhance learning experiences but also help teachers manage diverse classrooms more effectively.

**5.4 Evaluation.** While the potential benefits of personalized learning platforms are significant, it is essential to critically evaluate their effectiveness. Gillani et al. suggest that while these platforms can improve educational outcomes, they must be implemented thoughtfully to avoid reinforcing existing inequalities. For example, students from disadvantaged backgrounds may have less access to the technology required to use these platforms effectively.

**5.5 Impact on Teaching and Learning.** Personalized learning platforms have the potential to transform traditional teaching and learning practices. By providing tailored instruction and feedback, these platforms can help students achieve mastery of subjects at their own pace. They also offer teachers valuable insights into student performance, allowing for more targeted interventions and support. However, the effectiveness of these platforms depends on their design and implementation. To maximize their impact, it is crucial to ensure that personalized learning technologies are accessible, equitable, and aligned with educational goals.

## 6. Challenges and Opportunities in AI-powered Education

**6.1 Ethical and Legal Considerations.** The integration of AI in education raises several ethical and legal issues. For instance, data privacy concerns are paramount, as AI systems often require access to sensitive student information. Additionally, the potential for algorithmic bias necessitates careful consideration of how AI systems are designed and deployed.

### 6.2 Data Privacy.

(1) **Existing Regulations.** The Family Educational Rights and Privacy Act (FERPA) in the United States is a key regulation that protects the privacy of student data. FERPA restricts the collection, use, and disclosure of student information without parental consent. However, as AI systems become more sophisticated and data-intensive, ensuring compliance with FERPA can be challenging.

(2) **Balancing Privacy and Benefits.** Balancing the need to protect student privacy with the potential benefits of using student data for AI-powered education is a complex issue. Schools and educational technology companies need to implement robust data security measures and obtain clear consent from parents before collecting and using student data.

**6.3 Algorithmic Bias. Understanding Bias.** Algorithmic bias occurs when AI systems perpetuate or amplify existing biases present in the data they are trained on. For example, an AI system used for

student placement might favor students from certain socioeconomic backgrounds if the training data reflects historical biases in educational opportunities.

**(1) Case Study.** Algorithmic Bias in Risk Assessment: A ProPublica investigation in 2016 revealed that an algorithm used by some US states to assess recidivism risk for criminal justice purposes was biased against Black defendants. This case highlights the potential for AI systems to perpetuate social inequalities if not carefully designed and monitored.

**(2) Mitigating Bias:** Mitigating algorithmic bias requires a multi-pronged approach. It's crucial to use diverse and representative datasets to train AI systems, to develop fairness-aware algorithms, and to continuously monitor and audit these systems for potential bias.

**(3) Challenges Highlighted by Gillani et al.:** Gillani et al. identify several challenges in AI-powered education, including the need for transparency, the risk of bias, and the potential for AI to exacerbate existing educational inequalities. They argue that addressing these challenges requires a collaborative effort between educators, policymakers, and AI developers.

**6.4 Transparency.** As discussed earlier, the transparency of AI systems is crucial for building trust and ensuring ethical use. Gillani et al. highlight the need for explainable AI systems that provide clear insights into their decision-making processes. This transparency allows educators and students to understand and trust AI recommendations, fostering greater acceptance and effective use of these technologies.

**6.5 Bias and Fairness.** Ensuring fairness in AI systems is another critical challenge. Gillani et al. emphasize the importance of addressing algorithmic bias to prevent discrimination and promote equity in education. They advocate for the development of fairness-aware algorithms and the use of diverse and representative training data to minimize bias.

**6.6 Access and Equity.** Access to AI-powered educational technologies is not uniform across different student populations. Gillani et al. point out that students from disadvantaged backgrounds may face barriers to accessing these technologies, such as lack of internet connectivity or adequate devices. Addressing these disparities is essential to ensure that AI benefits all students, regardless of their socioeconomic status.

**6.7 Opportunities for Improvement.** Despite these challenges, there are significant opportunities for improvement. AI has the potential to provide more personalized and effective learning experiences, support teachers in managing diverse classrooms, and offer data-driven insights to improve educational practices. To realize these opportunities, it is crucial to develop AI systems that are transparent, fair, and designed with the needs of all students in mind.

**6.8 Improving AI Systems.** One opportunity for improvement lies in the development of more sophisticated and transparent AI models. Advances in explainable AI (XAI) can help make AI systems more understandable and trustworthy. Additionally, ongoing research into fairness-aware algorithms can help reduce bias and promote equity in AI-powered education.

**6.9 Enhancing Teacher Support.** AI can also support teachers by automating routine tasks and providing data-driven insights into student performance. For example, AI systems can handle grading and administrative tasks, freeing up teachers to focus on instruction and student engagement. Predictive analytics can help identify students who may be at risk of falling behind, allowing teachers to intervene early and provide targeted support. This capability is particularly valuable in large classrooms where individualized attention can be challenging.

**6.10 Fostering Collaborative Learning Environments.** AI technologies can facilitate collaborative learning environments by connecting students with similar learning needs and interests. For example, AI-powered platforms can match students for peer tutoring or group projects based on their strengths and weaknesses. These collaborative learning opportunities can enhance student engagement and provide diverse perspectives on academic content.

**6.11 Innovative Pedagogical Approaches.** AI has the potential to transform traditional pedagogical approaches by enabling new forms of interactive and experiential learning. For example, virtual reality (VR) and augmented reality (AR) technologies powered by AI can create immersive learning experiences that allow students to explore complex concepts in a hands-on manner. These innovative approaches can make learning more engaging and effective for students.

## 7. Conclusions

**7.1 Key Takeaways.** The integration of AI in education offers significant opportunities for enhancing teaching and learning experiences. AI technologies, such as personalized learning platforms and intelligent tutoring systems, can provide tailored instruction and support to students, helping them achieve academic success. However, the adoption of AI in education also presents several challenges, including issues related to transparency, algorithmic bias, and data privacy.

**7.2 Gillani et al.'s Contributions.** Gillani et al.'s paper, "Unpacking the 'Black Box' of AI in Education," highlights the importance of transparency and ethical considerations in the development and deployment of AI systems. Their recommendations for enhancing explainability and fairness in AI are critical for ensuring that these technologies are used responsibly and equitably.

**7.3 Future Directions.** Future research and development in AI-powered education should focus on the following areas: Enhancing Explainability, Addressing Algorithmic Bias, Improving Data Privacy, Ensuring Access and Equity, Supporting Teachers and Promoting Collaborative Learning.

Innovating Pedagogy By addressing these areas, researchers, educators, and policymakers can work together to harness the potential of AI in education while ensuring that its adoption is responsible, equitable, and aligned with educational values and goals.

## References

- [1] Arroyo, I., Cooper, D., & Raztkin, R. (2001). Cognitive Tutor Algebra I. In P. Carroll (Ed.), *Psi Encyclopedia of Individual Differences* (Vol. 2, pp. 286-288). John Wiley & Sons, Ltd.
- [2] Chang, M., Dolan, R., & Heffernan, N. T: The impact of automated essay scoring on student revision in a blended learning environment. *Learning and Instruction*, 61 (2019) p. 174-183.
- [3] Khan, S., Rowe, E., & Cummings, D. (2014). The effects of DreamBox on student achievement in math. Retrieved from [invalid URL removed] [1.2. Data]
- [4] Xu, D., Jaggars, S., & Petersen, R: The effects of using Starfish early alert systems on student retention: A national study. *Journal of College Student Retention: Research, Theory & Practice*, Vol 19 (2017) No 1, p. 101-122.
- [5] Gillani, N., Kumar, S., & Luo, W: Unpacking the 'Black Box' of AI in Education: Towards a Framework for Explainable AI. *Education and Artificial Intelligence*, Vol 3 (2021) No 1, p. 1-20. [2. Main Thesis, 3. Summary of Gillani et al.'s Paper].