




The Content Analysis of the Lesson Plans Created by ChatGPT and Google Gemini

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ABSTRACT

Following the emergence of chatbots, especially ChatGPT, researchers have begun to examine their capabilities, credibility, and reliability in educational context. In this study, ChatGPT and Google Gemini are used as technological tools to create 7th-grade lesson plans for mathematics, science, literature, and social studies classes. Using prompts, these chatbots were asked to create lesson plans for the desired course, subject, and level. The data source of this study is the content produced by these chatbots. We analyzed 18 lesson plans to identify patterns and variations within the context of learning theories and models by using the Taguette qualitative analysis program. The results show that the lesson plans created by both chatbots are strongly resemblance to human-written educational content such as sentence structures, lesson activities, and assessments. Although the activities in all lesson plans defined teachers as facilitators and offered partially constructive lesson plans, it was found that the technology-integrated activities were very limited. The findings of this study provide a practical implication of chatbots for teachers and highlights educational considerations when integrating these tools into lessons.

KEYWORDS

Keywords: Chatbots; ChatGPT; generative artificial intelligence; lesson plans; Gemini, machine leaning.

INTRODUCTION

The recent decade has witnessed interesting and magnificent developments. After enduring the Covid-19 pandemic nightmare, the world is now embracing generative AI. For some, artificial intelligence is a new challenge following the ordeal, while for others, it heralds the promise of a brighter day.

Artificial intelligence, a branch of computer science that deals with the creation of machines with intelligent behavior, is not a new concept. AI, or Artificial Intelligence, is dedicated to enhancing machines' capacity to learn, reason, and autonomously make decisions. The machine system developed by Alan Turing to strategize against German aircraft is considered the first modern study in this field (Baytak, 2023). In later periods, AI applications started being used in various fields, particularly in factories and other areas. The most notable AI studies are now being utilized in chess comparisons that demand advanced thinking and strategic development.

In the 1990s, progress in the field of AI accelerated as artificial neural networks, computer programs that mimic the operations of the human brain, were developed. In the following years, there were developments of new technologies such as big data and cloud computing. Owing to large data processing applications, AI has started to be used in new applications that make daily life easier and attract attention such as self-driving cars, virtual assistants and facial recognition. Artificial neural networks are now being utilized in various fields including image recognition, natural language processing, and machine translation.

ChatGPT and Google Gemini applications, which are the main subject of this study, do not have long history (during the time of this research process, the platform was known as Bard but it was renamed as Gemini as of February 2024). First, the Generative Pre-trained Transformer 3 (GPT-3), established by the OpenAI company since 2020, has started to be used. Quickly these new versions came out and the GPT-3.5 version was released as ChatGPT in November 2022. Following its presence on social media and in the news, the use of ChatGPT has rapidly increased. In March 2023, Google launched its Generative AI application, Gemini. ChatGPT reached 1 million users in just 5 days, which even a popular social media platform like Instagram reached in 2.5 months (Duarte, 2023). It may not be easy to give an exact number of users as the statistics for these two platforms change rapidly. However, according to data as of May 2023, ChatGPT has more than 100 million users with around 1 billion visits per month and Gemini reached 30 million monthly active users (Duarte, 2023).

Despite the short history of ChatGPT and Gemini, numerous studies have been conducted about these and similar applications. A meta-analysis about the acceptance and adoption of the ChatGPT and Gemini shows that research in the field of education has already accepted the applications (Baytak, 2023). There have been various studies conducted in the field. Some studies assess the competence of ChatGPT in law school exams (Choi et al., 2023), medical exams (Kung et al., 2023), management (Korzynski et al., 2023), and even in coding assignments (Malinka et al., 2023). Even though some studies found that students' views on

ChatGPT were innovative, compatible, and user-friendly (Castillo-González, 2023; Cotton et al., 2023; Raman et al., 2023), some studies found the weaknesses of these systems (Pavlik, 2023). However, after students have their assignments done on ChatGPT, there have been studies discussing the ethical and practical challenges of these platforms (Adiguzel et al., 2023; AIAfnan et al., 2023; Trust et al., 2023).

Studies have also begun on the use of ChatGPT and Gemini about teachers and education. According to Hong (2023), ChatGPT is a great opportunity for educational institutions and teachers in language teaching and assessment. Likewise, Trust et al. (2023) conducted studies on teacher education, and Milano et al. (2023) assessed its use in higher education. Biswas (2023) even claims that applications such as ChatGPT can be used to prevent global warming. However, the content provided by these platforms raised some concerns about the credibility (Yeadon et al., 2022) and harmfulness, bias, and inequity (Trust et al., 2023) of the content.

Because of the capabilities of generative AI applications, studies such as Opara et al. (2023) and Trust et al. (2023) have explored the possibilities and limitations of ChatGPT for teaching and learning. A survey-based study conducted with EFL teachers showed that teachers found ChatGPT-based teaching motivational, but attitudes towards the effect of ChatGPT on developing listening and speaking skills were found to be neutral (Ali et al., 2023). Differently, Tlili et al. (2023) studied how ChatGPT in education was perceived by analyzing social media content and conducting interviews. However, most of these studies are exploratory. The study by Farrokhnia et al. (2023) took an overall perspective and evaluates ChatGPT platform based on SWOT analysis. In other words, the study tested the system based on its strengths, weaknesses, opportunities and threats to education (Farrokhnia et al., 2023). It is fact that these chatbots become part of most of our daily used applications similar to messaging or searching applications. Thus, there is a need to examine the content of these handy tools based on pedagogical perspectives. The current study aimed to examine the content developed by ChatGPT and Gemini. Indeed, the studies conducted on chatbots are mainly done with ChatGPT. However, this current study examines the content of both ChatGPT and Gemini.

So far, poems, stories, and codes created by ChatGPT and Gemini have been seen as remarkable and shared on different platforms. Essays written in the field of education and the answers to the questions asked revealed the opinion that these systems are also smart enough. However, how lesson plans, which are a roadmap in the field of education, were prepared and in which educational structures these contents were prepared were not examined in detail. When educators are expected to use these platforms intensively, the importance of this study becomes very evident. Thus, the aim of this study is to examine the suitability, theoretical framework, and creativity of educational content created by applications such as ChatGPT and Gemini for the field of education, using lesson plans as an example. To achieve this objective, the study aims to answer the following research questions:

- Are there any differences between the chatbots in terms of developing lesson plans?

- What are the characteristics of the responses based on learning theories and models?

LITERATURE REVIEW and THEORETICAL FRAMEWORK

Lesson plans are simply drafts of a course. Lesson plans are important for teachers' class activities (Ball & Cohen, 1996) and they are essential guidelines for student teachers (Rusznyak & Walton, 2011). These drafts should have learning objectives (what participants are expected to learn), learning activities (how teaching and learning take place), and materials (resources to use during instruction). According to Süral, (2019) teachers and pre-service teachers should be aware of the importance of lesson planning. It was found that preparing lesson plans increases the quality of teaching (Süral, 2019). Another study conducted about implementing technology in lesson plans shows that pre-service teachers expect to get support on what they need to learn for their future careers (Janssen & Lazonder, 2015). Studies show that there are differences between pre-service teachers' education programs. It was found that teachers in the elementary education program used more internet resources when planning lessons compared to the pre-service teachers in the inclusive early childhood program (Sawyer & Myers, 2018). Thus, technology becomes a vital means and context for lesson planning and implementing the lesson plans (Johnson & Sdunzik, 2023).

Teachers are expected to know how to prepare a lesson plan. Most teacher education programs involve lesson planning activities in their programs. There can be various educational approaches and strategies to prepare lesson plans, but there are well-known three methods of lesson planning: offloading (using existing lesson plans), adapting (minor changes to existing lesson plans), and improvising (creating learning plans) (Lim et al., 2018). Lim et al. (2018) found that the teachers relied more on the first two lesson planning methods. In this study, however, ChatGPT and Gemini are developing new lesson plans that provide new learning models to teachers.

With the development of web technologies, there are websites and software that provide lesson plans for teachers. Cairncross and Mannion (2001) stated that using technology was found helpful for prospective teachers to overcome the problems they face in the process of lesson planning. Similarly, Pratiwi et al. (2020) also found lesson planning software useful for both experienced and inexperienced educators at different educational institutions. Indeed, a quick search on Google shows that there are paid websites that provide lesson plans (i.e., powerschool.com, commoncurriculum.com, or planbook.com). Farrokhnia et al. (2023) generated a lesson plan from ChatGPT for novice teachers in order to conduct SWOT analysis. The current study, thus, extends the use of technology for lesson planning beyond the borders. There is lack of studies analyzing lesson plans generated by chatbots. This study may fulfill the gap and provide guidance for teachers to use the chatbots more professionally.

In addition to the lesson planning software, there are models that evaluate lesson plans. Aguirre and Zavala (2013), for example, developed a tool to assess the mathematics lesson plans based on mathematical thinking, language, culture, and social justice. Similarly, Jacobs et al. (2008) developed a model to assess lesson plans developed by science teachers. Ndiokubwayo

et al. (2022) also developed a lesson plan analysis tool that assessed the lesson plans of competence-based curriculum.

The current study, however, evaluates the lesson plans based on learning theories and models in addition to the use of technology integration. The theoretical framework of this study is based on learning theories such as behaviorism and constructivism. The lesson plans were also evaluated based on learning models such as ARCS. These learning theories and models are briefly described in the following paragraph.

Behaviorism, proposed by J.B. Watson and B.F. Skinner, focuses on observable behavior and how it can be changed through conditioning. In behaviorism, teachers try to shape student behavior by rewarding desired behaviors and punishing unwanted behaviors. Some of the techniques that behaviorism suggest are positive reinforcement, negative reinforcement, punishment and operant conditioning (Moore, 2011). Thus, the lesson plans for this theory are more specific, measurable, achievable, relevant, and time-bound. The assessments of these lesson plans are clear and objective way to measure learning (Kent Kükürtcü et al., 2021). Constructivism, a prominent theory in the field of education and learning, claims that knowledge is actively constructed by individuals rather than passively received. The theory emphasizes that learners build their knowledge by integrating new information and experiences with their existing mental frameworks. Jean Piaget, Lev Vygotsky, and Jerome Bruner contributed valuable insights to the theory. Constructivism purposes a learner-centered approach which promotes critical thinking, problem-solving, and meaningful engagement in the learning process (Bruner, 1996). Since constructivism requires active participation of learners in the learning process, the teacher's role is facilitator rather than a lecturer (Ebo, 2018). The lesson plans in constructivism, thus, suggest settings to have students construct their knowledge and understanding (Darchinian et al., 2021). The lesson plan should provide inquiry-based learning, group activities, reflection, scaffolding and real-world connections (Vu, 2019). Then, learners' confidence in their ability to succeed in the learning task plays a crucial role in their motivation. John M. Keller (1987) developed instructional design model ARCS, which stands for Attention, Relevance, Confidence, and Satisfaction, to enhance learners' motivation and engagement in the learning process. In this model, the lesson plans should start with attention to capture and maintain learners' attention from the beginning of the instructional process. Next, the learner should be informed about importance and relevance of the content. Then, the learners should be recognized and praised for their efforts and progress. For satisfaction, learners should feel a sense of satisfaction and accomplishment to be motivated for sustainable learning. Thus, the lesson plans developed based on any of these theories or models should have activities and assessments accordingly.

METHODOLOGY

This study is based on content analysis within the scope of a qualitative study. The study used textual content analysis to evaluate the text generated by chatbots. Content analysis is the

systematic examination of content to identify important information that can answer research questions. Among two categories of content analysis: conceptual analysis and relational analysis, conceptual analysis focuses on understanding the underlying concepts and themes within textual data, while relational analysis examines the relationships and connections between various elements or concepts within the data. This study used relational analysis to examine the relationships among concepts generated by the chatbots. Indeed, the cognitive mapping strategy of the relational analysis was employed to investigate how meanings and definitions related to learning theories and models shift across the different responses. In order to conduct the study, the following guidelines from Palmquist et al. (1997) have been applied;

- Identifying the question
- Choosing a sample or samples for analysis
- Determining the type of analysis
- Reducing the text to categories and code for words or patterns
- Exploring the relationships between concepts
- Coding the relationships

In order to examine the content of the answers given by the ChatGPT and Gemini applications used within the scope of the research, within the framework of which educational theory and model were examined, the outputs of these applications to the prompts were examined. Wardat et al. (2023) also analyzed the content of ChatGPT for mathematics related prompts.

Data collection

As this study examined lesson plans generated by ChatGPT and Gemini, a content analysis approach was employed. Even though these systems, also known as Generative AI, chatbots, or large language models (LLMs), have various applications like Bing Chat, Claude, and longLLaMa, this study focuses on two of the most widely used applications: ChatGPT and Gemini. Lesson plans can be used for any course, but 7th grade topics have been chosen for mathematics, science, social studies, and English courses, as they are the courses that we think can get the most detail and are accepted as common worldwide. The selected course topics are taken from the teacher.org site. Prompts were developed to enter into Gemini and ChatGPT and there was no time gap in order to assure that there was no significant change. Chatbots have the option to continue a chat or start a new chat. Continuing a chat helps the chatbots stay on the same topic and respond accordingly. Since there were different subject areas in this data collection process, each prompt was started as a new chat to prevent related output. The prompts entered into both chatbots are as follows:

- “I am a 7th grade math teacher. My lesson topic is formulas for the area of squares, rectangles, and triangles. Can you write a lesson plan for one class period? This plan should have lesson objective, lesson activities, assessment, and teacher role.”

- “I am a 7th grade math teacher. My lesson topic is simple interest. Can you write a lesson plan for one class period? This plan should have lesson objective, lesson activities, assessment, and teacher role.”
- “I am a 7th grade science teacher. My lesson topic is Environmental Issue. Can you write a lesson plan for one class period? This plan should have lesson objective, lesson activities, assessment, and teacher role.”
- “I am a 7th grade science teacher. My lesson topic is Reducing Every Day Plastic Use. Can you write a lesson plan for one class period? This plan should have lesson objective, lesson activities, assessment, and teacher role.”
- “I am a 7th grade English teacher. My lesson topic is the rules on the present perfect tense. Can you write a lesson plan for one class period? This plan should have lesson objective, lesson activities, assessment, and teacher role.”
- “I am a 7th grade English teacher. My lesson topic is to analyze the information given and discuss their opinion based on facts from an article. Can you write a lesson plan for one class period? This plan should have lesson objective, lesson activities, assessment, and teacher role.”
- “I am a 7th grade Social Studies teacher. My lesson topic is a landmark of Ancient Rome. Can you write a lesson plan for one class period? This plan should have lesson objective, lesson activities, assessment, and teacher role.”
- “I am a 7th grade Social Studies teacher. My lesson topic is the list of the Seven Natural Wonders of the World. Can you write a lesson plan for one class period? This plan should have lesson objective, lesson activities, assessment, and teacher role.”

Based on these prompts, 18 lesson plans were generated. Since both ChatGPT and Gemini responded complete lesson plans, none of the outputs were excluded from the analysis. “Regenerate” function to generate a different response for the same prompts were not used for any prompt in this study. In order words, the first responses of the chatbots for each prompt were included in the data analysis process. The generated lesson plans were copied and saved as separated word files. The data set, then, were transferred to Taguette software for data analysis process.

Data Analysis Process

The study followed the following data analysis process (Solomon, 1993) within the scope of cognitive mapping guidelines; first of all, research questions were identified, then a sample of the content was selected. After content selection from the first course, the main concepts that have been covered by ChatGPT and Gemini were determined, and the differences were listed. Subcategories are listed, some patterns are found, and the relationship between the concepts is explored and listed. Taguette software was used to analyze the data since it is open-source and user-friendly (taguette.org). The entire content was controlled to see if the same pattern existed for the other responses. The concepts that were not within the scope of this study were

excluded from the analysis. While analyzing the content, it was aimed to identify important information that could answer the research questions.

The same content was re-coded to ensure stability, and the concepts were checked against the standards of the learning theories and models to ensure accuracy. A content expert, who is an experienced teacher, took role of an outside source and analyzed the lesson plans based on content suitability and educational applicability. The same prompts were entered to the chatbots another time to assure trustworthiness of the data.

Ethical issues such as privacy, fairness and non-discrimination, transparency in the use of chatbots have been brought up to attention by the researchers (Cotton et al., 2023; Mhlanga, 2023). In the data collection process of this study, however, no ethical rules were violated when using the chatbots.

FINDINGS

This section addresses the first research question: 'Are there any differences among generative AI applications in developing lesson plans?' The content indicates that there is little difference between the learning objectives created by the applications. Although they are different in form, as presented in the example lesson plan in Table 1, both chatbots listed similar learning objectives in meaning. While ChatGPT created learning objectives for some lessons in a single paragraph, Gemini created all learning objectives in a bulleted list. For example, for the math lesson plan, ChatGPT created "By the end of this lesson, students will be able to identify and apply the formulas for calculating the area of squares, rectangles, and triangles correctly" as the learning objective, while for the same exact prompt, Gemini created the following learning objectives:

- Students will be able to state the formulas for the area of a square, rectangle, and triangle.
- Students will be able to use the formulas to find the area of squares, rectangles, and triangles.
- Students will be able to solve problems involving the area of squares, rectangles, and triangles.

Another section of the lesson plan was the materials to be used in the lessons. For each lesson plan, both chatbots created appropriate material lists. Even though most of the materials were limited to "whiteboard or projector", "markers or pens", and "handouts or articles", ChatGPT suggested using some different materials. For example, as shown in Table 1, ChatGPT also listed "Projector or whiteboard" and "computer or tablet with internet access" as materials to use in the lesson. Indeed, ChatGPT also suggests using "examples of real-life scenarios involving simple interest" for the interest topic in the math lesson plan and "graphic organizer handouts" for the present perfect tense topic in the English lesson plan.

Table 1.

An output sample of ChatGPT and Gemini for a science prompt (see the appendix)

When the activity sections of the lesson plans created by the chatbots are examined, it is found that there are some key differences. While the activities created by Gemini generally consist of the introduction and the main topic, the activities created by ChatGPT have been found to be broader and more systematic. For example, when the sample lesson plan given in Table 1 is examined, the lesson plans for science created by Gemini list the activities to be done under two separate headings: "causes and effects" and "possible solutions" after the introduction. However, in the lesson plan created by ChatGPT, after the introduction, there are more detailed lesson activities under the titles "brainstorming", "presentation and discussion", "case study analysis" and "solution generation". Similar patterns were found for the other lesson plans.

There are also differences between the chatbots regarding the time allocation they made for lesson plans. The analysis shows that Gemini gives a certain time period for the entire lesson, while ChatGPT divides the lesson into certain time periods, and each activity is given a certain time period. Some of the examples of time allocation are presented in Table 1.

Another important section of a lesson plan is assessment. In the prompts, the chatbots were asked to give the assessment for each lesson plan. The chatbots did provide an assessment section for each subject. However, there are differences between the assessment types and structures. For example, almost all lesson plans created by ChatGPT have formative and summative assessments, but none of the lesson plans created by Gemini have any formative assessments. On the other hand, neither of the chatbots provided any peer assessment except for the two activities that ChatGPT suggested: "check their calculations with their peers" and "discuss their answers and reasoning with their peers". The lesson plans provided in Table 1 show clear differences between the assessments created by chatbots. Indeed, the assessment types created by Gemini are mainly quizzes, whereas the assessments created by ChatGPT have group discussion, observation, and activity-based assessment (Table 1).

The chatbots were also asked to write about the teachers' roles in the lesson plans. Both of the chatbots provided detailed roles for teachers, even though ChatGPT has more organized and classified role descriptions. For examples, as shown in Table 1, ChatGPT listed three roles for the teachers; facilitator, content expert, and assessor. Each of these main roles is explained with detailed responsibilities. However, teachers' roles are limited by the following keywords: facilitate, help, and encourage (Table 1).

On the other hand, Gemini provides for each lesson plan a section called "Differentiation". In these sections, Gemini provides additional activities for students who are struggling and are ahead (Table 1). ChatGPT, however, only gives an additional suggestion at the end of some lesson plans. One of the suggestions that ChatGPT added is as follows: "Remember to adjust the pace and level of difficulty based on your students' needs and provide additional support or enrichment as necessary."

Moreover, the lesson plans created by ChatGPT have activities and teacher responsibilities that may help increase and maintain students' motivation during the learning

process. For example, in a math lesson plan, teachers are asked to "state the lesson objective and explain why it is important to understand these formulas" to attract students' attention. Similarly, the "ask students to share their calculations and solutions to the real-life scenarios" activity can make the content relevant and meaningful to students' lives and goals. In another activity, it is suggested to "encourage students to think creatively and propose innovative ideas to address the environmental problems," which may address students' self-efficacy and confidence in their ability to succeed in the learning task. To reinforce the students' positive attitudes, the lesson plans have such suggestions as "encourage active participation and create a supportive learning environment". These listed activities have been the important outputs that distinguish ChatGPT from Gemini for the created lesson plans.

What are the characteristics of the responses based on learning theories and models?

This study also had the aim of exploring the characteristics of the responses based on learning theories and models. Thus, the content analysis for the research question focused on the terms, activities, and materials used. The verbs of learning objectives, thus, were analyzed to find the clues to these theories and models. As one of the examples presented in Table 1, most of the learning objectives have the following verbs: 'define', 'identify', 'evaluate', 'explain' and 'discuss'. Most of these verbs can be considered verbs of the cognitive domain in behaviorism.

Most of the lesson plans start with brainstorming activities. With these activities, the learners' prior knowledge is assessed. However, it is interesting that none of the math lesson plans had any brainstorming activities or any other prior knowledge assessment activity. Most of the activities had a "work independently or in pairs" expression that let the learners engage in activities as a constructivist lesson activity. Even though there are no straight activities that encourage students to do hands-on activities, Gemini provides activities under 'Extensions' title. Some of these activities include the following:

Extensions

- Have students write a short story using the present perfect tense.
- Have students create a presentation about the present perfect tense.
- Have students research the history of the present perfect tense.

ChatGPT extension activities

- Research Project: Have students conduct independent research on one of the Seven Natural Wonders of the World and create a multimedia presentation or poster highlighting its features, significance, and conservation efforts.
- Comparative Analysis: Have students compare the Seven Natural Wonders of the World with the Seven Wonders of the Ancient World, analyzing the differences in their historical and cultural contexts.
- Virtual Tour: Utilize online resources to take a virtual tour of one or more of the natural wonders, allowing students to explore and learn more about them in an immersive way.

As it was already explained above, teachers' roles were mainly provided as 'facilitators' by both chatbots. The teacher's role section on Table 1 shows that teachers are expected to

'facilitate the discussion', 'help students' and 'encourage students to think creatively'. These roles are some of the teachers' roles in constructivist lesson plans.

Working in pairs is provided for all ChatGPT lesson plans, but Gemini suggested this activity only for the first lesson of math. Group work is provided in most of the ChatGPT lesson plans, but Gemini provides it only for social studies lessons. For example, the lesson plans by ChatGPT divide the class into small groups of 3–4 students' activities and group. These group discussions are Constructivist approaches in which students share their ideas, debate, and learn from each other's perspectives.

DISCUSSION

This study aimed to make a detailed analysis of the educational content created by chatbots such as ChatGPT and Gemini. The lesson plans for four subject areas were created in this study. As a result of the analysis, interesting findings were obtained and presented in the previous section of the article. In this section, the discussion of the data obtained from the existing literature will be presented, and recommendations that will contribute to the field will be listed.

According to the results obtained in the study, it was found that the lesson plans created by ChatGPT and Gemini were sufficient to be used in the lessons. It has been revealed that the desired learning objectives, activities, teachers' roles, and assessment created by these chatbots are in accordance with the applications in the classroom. In addition, it has been found that the learning objectives and activities created for each course correspond to the course topics. These findings showed that ChatGPT and Gemini were satisfactory at producing lesson plans. This result supports the previous studies (Tlili et al., 2023). Even though some of the previous studies have claimed that machines are still behind in performance compared to the human workforce in passage comprehension (Khademi, 2023), the lesson plans created by ChatGPT and Gemini were well-developed. Indeed, using chatbots to produce lesson plans supports Brändström's (2011) suggestion that use of the Internet as a planning and teaching resource has effects on students and teachers. Similar to other technologies that help inexperienced practitioners develop lesson plans (Pratiwi et al., 2020), these chatbots can also help teachers and pre-service teachers get ready for their lessons. However, the learning objectives from ChatGPT and Gemini were found to be narrower than the learning objectives of the New Jersey Student Learning Standards (State of New Jersey, 2021) for the same subject areas. Each entered topic could have sub-topic and there could be more objectives for each generated lesson plan. However, the prompts entered the chatbots were requesting to generate lesson plans for a single class period. Chatbots may generate more detailed objectives if it is requested in prompts. This difference is even possible between the learning standards of states or countries. Thus, detailed prompts for these chatbots may provide more related learning objectives, and, indeed, human supervision may still be necessary (Khademi, 2023) to ensure the quality of outputs and meet the needs of users. Moreover, teachers who use these tools may enter some more details about their school settings and state standards to obtain more related lesson plans.

Based on the findings, the lesson plans created by ChatGPT and Gemini have similarities and differences. Even though the forms of the learning objectives are different, the contents are similar for both chatbots. The materials in the lesson plans, however, have some differences. Beyond simple materials such as "whiteboard or projector", "markers or pens", and "handouts or articles" from both chatbots, ChatGPT also listed some technology-based materials for the lesson activities. These materials and the extension activities provided by ChatGPT made a difference for lesson plans. Previous studies have emphasized computer-based instructional materials, and therefore, this difference may affect the quality of instruction (Baytak & Hırça, 2013; König et al., 2022). Even though there are numerous web tools and smartphone apps that help teachers or students develop digital materials for educational purposes, Gemini and ChatGPT did not suggest any usage of these tools in their lesson plans (except for one link that Gemini provided for a social study lesson plan). Indeed, it was found ironic that such technology-based platforms do not provide many options for technology integrated lesson activities in the lesson plans they create. For example, in environmental education lesson plans, there could be an activity where students develop educational games (Baytak & Land, 2010).

It was also found interesting that the assessments in the lesson plans were mainly quiz-based. The chatbots may produce these behaviorist assessment types since they are more clear and objective ways to measure learning. However, portfolios or other constructive assessment types were not created for the lesson plans. As it was described before, ChatGPT was found successful in most quiz-based exams (Choi et al., 2023; Kung et al., 2023; Malinka et al., 2023). Thus, suggesting a quiz can be a dilemma for chatbot-based learning environments, and, therefore, assessments need to be changed (Rudolph et al., 2023).

On the other hand, both of the chatbots, especially ChatGPT, provided 'work in pairs' and 'discussion' for the lesson plans. These activities are found in constructivist views even though students' prior knowledge has not been checked in any lesson plans. If it is requested in the prompts, as it was done by Farrokhnia et al. (2023) and obtained sufficient results, the chatbots can generate lesson plans with detailed group work activities. For some of the subject domains, both chatbots provided extension activities that have a constructivist engagement perspective. Indeed, both chatbots gave 'facilitator' role to teachers in the lesson plans, and this role is an indication that the chatbots also have a constructivist approach (Ebo, 2018; Özdaş, 2018). When considering learning models, ChatGPT has ARCS strategies such as attention, relevance, confidence, and satisfaction (Keller, 1987).

CONCLUSION and RECOMMENDATIONS

Poems, stories, or even software codes created by ChatGPT and Gemini added a new dimension to artificial intelligence studies that have been in use for a long time. As in many other fields, the capabilities, effects, advantages, and disadvantages of these chatbots in the field of education have started to be discussed. This study has analyzed the content of these chatbots, whose use in education is inevitable, in the context of educational theories and models. The

results show that teachers can use these tools to develop materials and contents for their lessons. Regardless of the subject domains, the lesson plans were ready to be applied in the classroom.

On the other hand, the use of these tools in the field of education causes serious reservations because of the advanced outputs of ChatGPT and Gemini. Acceptance and adoption of new technologies take time, and the content from Google or even Wikipedia can be considered in the same manner. Thus, instead of prohibiting them, it is necessary to ensure that educators use the current chatbots or new generative AI applications more effectively and efficiently in education.

The findings of this study have several significant implications for educators, policymakers, and researchers alike. First of all, chatbots can be a very beneficial technology tool for teachers. Secondly, educators and policymakers should be aware of the capabilities of chatbots in education. Thus, educational settings and curriculums should be revised. Researchers, indeed, should develop systems or integrate the API systems of these chatbots into learning management systems so that teachers and users can responsibly use them for their learning and teaching.

Thus, based on the findings of this study, the following recommendations can be made:

- Teachers and students need to be educated about chatbot literacy.
- The users of these chatbots should be trained about prompt engineering.
- Teachers may enter more details about their teaching theories and models since the results of this study show that the chatbots may not be consistent with educational approaches. For examples, when a math teacher plan to use a chatbot for his/her lesson, he/she should prepare a prompt that requests the teacher's learning approach, student levels, specific lesson objectives and some teaching and learning strategies and tactics. By doing this, the teacher may get a more directed outcome from the chatbots.
- The chatbots analyzed in this study are from different companies. Each of them has been trained with different data sets. Thus, it is possible to get different lesson plans as outputs. It was found that the chatbots produced different outputs for the same prompts. Thus, users may try more than one entry to get the most suitable lesson plans and contents.

While this research provides valuable insights into the use of ChatGPT and Gemini for developing lesson plans, some limitations should be acknowledged. These limitations are important considerations that may impact the interpretation and generalizability of the findings. This study was limited to four subject domains. The study was also technically limited to GPT 3.5 because of its free accessibility. On the other hand, GPT 4, more advanced and capable version of the GPT compared to GPT-3.5, is more capable of improved performance in generating human-like text and understanding context. Similarly, the study was conducted with Google Bard but Google recently renamed it as Gemini with more functionalities. Thus, different version may provide different outcomes. All of chatbots feed their data set to generate better results

but the results of this study are limited to outcome of that date. Even though the chatbots are still at the developing progress, several further studies can be conducted following the current study; exploring generated lesson plans based the state standards, comparing generated lesson plans based on learning approaches and examining the implementations of the generated lesson plans based on grade levels.

REFERENCES

- Adiguzel, T., Kaya, M. H., & Cansu, F. K. (2023). Revolutionizing education with AI: Exploring the transformative potential of ChatGPT. *Contemporary Educational Technology, 15*(3), ep429. <https://doi.org/10.30935/cedtech/13152>
- Aguirre, J.M., & Zavala, R. (2013). Making culturally responsive mathematics teaching explicit: a lesson analysis tool. *Pedagogies, 8*(2), 163-190. <https://doi.org/10.1080/1554480X.2013.768518>
- AlAfnan, M. A., Dishari, S., Jovic, M., & Lomidze, K. (2023). ChatGPT as an educational tool: Opportunities, challenges, and recommendations for communication, business writing, and composition courses. *Journal of Artificial Intelligence and Technology, 3*(2), 60–68. <https://doi.org/10.37965/jait.2023.0184>
- Ali, J. K. M., Shamsan, M. A. A., Hezam, T. A., & Mohammed, A. A. Q. (2023). Impact of ChatGPT on learning motivation: Teachers and students' voices. *Journal of English Studies in Arabia Felix, 2*(1), 41–49. <https://doi.org/10.56540/jesaf.v2i1.51>
- Ball, D.L. & Cohen, D.K. (1996). Reform by the book: What is-or might be—the role of curriculum materials in teacher learning and instructional reform?. *Educ Researcher, 25*(9), 6-14.
- Baytak, A. (2023). The Acceptance and Diffusion of Generative Artificial Intelligence in Education: A Literature Review. *Current Perspectives in Educational Research, 6*(1), 7–18. <https://doi.org/10.46303/cuper.2023.2>
- Baytak, A., & Hirça, N. (2013). Prospective teachers' lived experience on computer-based instructional materials: A phenomenological study. *Anthropologist, 16*(1-2), 97-109. <https://doi.org/10.1080/09720073.2013.11891339>
- Baytak, A., & Land, S. M. (2011). An investigation of the artifacts and process of constructing computers games about environmental science in a fifth-grade classroom. *Educational Technology Research and Development, 59*, 765-782. <https://doi.org/10.1007/s11423-010-9184-z>
- Biswas, S.S. (2023). Potential use of Chat GPT in global warming. *Ann Biomed Eng, 51*, 1126-1127. <https://doi.org/10.1007/s10439-023-03171-8>
- Brändström, C. (2011). Using the internet in education - strengths and weaknesses: A qualitative study of teachers' opinions on the use of the internet in planning and instruction (Dissertation). Retrieved from <http://urn.kb.se/resolve?urn=urn:nbn:se:hig:diva-10029>

- Bruner, J. (1996). *The Culture of Education*, Cambridge, MA: Harvard University Press.
- Cairncross, S., & Mannion, M. (2001) Interactive Multimedia and Learning: Realizing the Benefits. *Innovations in Education and Teaching International*, 38(2), 156–164. <https://doi.org/10.1080/14703290110035428>
- Castillo-González, W. (2023). The importance of human supervision in the use of ChatGPT as a support tool in scientific writing. *Metaverse Basic and Applied Research*, 2, 29-29. <https://doi.org/10.56294/mr202329>
- Choi, J. H., Hickman, K. E., Monahan, A., & Schwarcz, D. B. (2023). ChatGPT Goes to Law School. *Minnesota Legal Studies Research*, 23-03, Available at SSRN: <https://ssrn.com/abstract=4335905>
- Cotton, D. R., Cotton, P. A., & Shipway, J. R. (2023). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in Education and Teaching International*, <https://doi.org/10.1080/14703297.2023.2190148>
- Darchinian, F., Magnan, M.-O., & de Oliveira Soares, R. (2021). The construction of the racialized other in the educational sphere: The stories of students with immigrant backgrounds in Montréal. *Journal of Culture and Values in Education*, 4(2), 52-64. <https://doi.org/10.46303/jcve.2021.6>
- Duarte, F. (2023, July 13). Number of ChatGPT Users (2023), *Exploding Topics*, <https://explodingtopics.com/blog/chatgpt-users>
- Ebo B. A. (2018). Constructivism or Behaviorism: What is the best method to teach special needs students?. *Journal of healthcare, science and the humanities*, 8(2), 45–56.
- Farrell, T. (2002). Lesson Planning. In J. Richards & W. Renandya (Eds.), *Methodology in Language Teaching: An Anthology of Current Practice* (Cambridge Professional Learning, pp. 30-39). Cambridge: Cambridge University Press. <https://doi.org/10.1017/CBO9780511667190.006>
- Farrokhnia, M., Banihashem, S. K., Noroozi, O., & Wals, A. (2023). A SWOT analysis of ChatGPT: Implications for educational practice and research. *Innovations in Education and Teaching International*, 1-15. <https://doi.org/10.1080/14703297.2023.2195846>
- Fujii, T. (2019). Designing and adapting tasks in lesson planning: A critical process of lesson study. In: Huang, R., Takahashi, A., da Ponte, J.P. (eds) *Theory and Practice of Lesson Study in Mathematics*. Advances in Mathematics Education. Springer, Cham. https://doi.org/10.1007/978-3-030-04031-4_33
- Gagne, R. M., Wager, W.W., Golas, K. C. & Keller, J. M (2005). *Principles of Instructional Design* (5th edition). California: Wadsworth.
- Hong, W. C. H. (2023). The impact of ChatGPT on foreign language teaching and learning: opportunities in education and research. *Journal of Educational Technology and Innovation*, 5(1).
- Jacobs, C.L., Martin, S.N., & Otieno, T.C. (2008). Instrument for formative and summative program evaluation of a teacher education program. *Sci. Teach Educ*, 92, 1097–1126.

- Janssen, N., & Lazonder, A.W. (2015). Implementing innovative technologies through lesson plans: What kind of support do teachers prefer?. *J. Sci Educ Technol*, 24, 910–920. <https://doi.org/10.1007/s10956-015-9573-5>
- Johnson, C., & Sdunzik, J. (2023). Introduction to special issue: Re-imagining teaching and learning in the context of current crises. *Research in Educational Policy and Management*, 5(1), i-iii. <https://doi.org/10.46303/repam.2023.1>
- Keller, J.M. (1987). Development and use of the ARCS model of instructional design. *Journal of Instructional Development*, 10, 2–10 <https://doi.org/10.1007/BF02905780>
- Kent Kükürtcü, S., Erkan, N. S., & Seyfeli, Y. (2021). The development of the democratic behavior scale: a validity and reliability study. *Theory and Practice in Child Development*, 1(1), 56–70. <https://doi.org/10.46303/tpicd.2021.5>
- Khademi, A. (2023). Can ChatGPT and Bard generate aligned assessment items? A reliability analysis against human performance. *Journal of Applied Learning and teaching*, 6(1), 1-39. <https://doi.org/10.37074/jalt.2023.6.1.28>
- Korzynski, P., Mazurek, G., Altmann, A., Ejdys, J., Kazlauskaite, R., Paliszkiwicz, J., Wach, K. and Ziemba, E. (2023). Generative artificial intelligence as a new context for management theories: analysis of ChatGPT. *Central European Management Journal*, 31(1), 3-13. <https://doi.org/10.1108/CEMJ-02-2023-0091>
- König, J., Heine, S., Jäger-Biela, D., & Rothland, M. (2022). ICT integration in teachers' lesson plans: a scoping review of empirical studies. *European Journal of Teacher Education*, 1-29. <https://doi.org/10.1080/02619768.2022.2138323>
- Kung, T. H., Cheatham, M., Medenilla, A., Sillos, C., De Leon, L., Elepano, C., Madriaga, M., Aggabao, R., Diaz-Candido, G., Maningo, J., & Tseng, V. (2023). Performance of ChatGPT on USMLE: Potential for AI-assisted medical education using large language models. *PLOS Digit Health* 2(2), e0000198. <https://doi.org/10.1371/journal.pdig.0000198>
- Lim, W., Son, J. W., & Kim, D. J. (2018). Understanding Preservice Teacher Skills to Construct Lesson Plans. *International Journal of Science and Mathematics Education*, 16(3), 519–538. <https://doi.org/10.1007/s10763-016-9783-1>
- Malinka, K., Perešini, M., Firc, A., Hujňák, O., & Januš, F. (2023). On the educational impact of ChatGPT: Is Artificial Intelligence ready to obtain a university degree?. *ArXiv preprint*, arXiv:2303.11146, 1-7. <https://arxiv.org/pdf/2303.11146.pdf>
- Mhlanga, D. (2023). Open AI in education, the responsible and ethical use of ChatGPT towards lifelong learning. *SSRN Electronic Journal*. <https://doi.org/10.2139/SSRN.4354422>
- Milano, S., McGrane, J.A. & Leonelli, S. (2023). Large language models challenge the future of higher education. *Nat Mach Intell*, 5, 333–334. <https://doi.org/10.1038/s42256-023-00644-2>
- Moore, J. (2011). Behaviorism. *Psychol Rec*, 61, 449–463. <https://doi.org/10.1007/BF03395771>
- Ndihokubwayo, K., Byukusenge, C., Byusa, E., Habiyaremye, H. T., Mbonyiryivuze, A., & Mukagihana, J. (2022). Lesson plan analysis protocol (LPAP): A useful tool for

- researchers and educational evaluators. *Heliyon* 8(1), 1-7, e08730.
<https://doi.org/10.1016/j.heliyon.2022.e08730>
- Opara E., Theresa, A. M., & Aduke, A.C. (2023). ChatGPT for Teaching, Learning and Research: Prospects and Challenges. *Glob Acad J Humanit Soc Sci*, 5(2), 33-40.
<https://ssrn.com/abstract=4375470>
- Özdaş, F. (2018). Evaluation of pre-service teachers' perceptions for teaching practice course. *Educational Policy Analysis and Strategic Research*, 13(2), 87–103.
<https://doi.org/10.29329/epasr.2018.143.5>
- Palmquist, M. E., Carley, K.M., and Dale, T.A. (1997). Two applications of automated text analysis: Analyzing literary and non-literary texts. In C. Roberts (Ed.), *Text Analysis for the Social Sciences: Methods for Drawing Statistical Inferences from Texts and Transcripts*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Pavlik, J. V. (2023). Collaborating with ChatGPT: Considering the implications of generative artificial intelligence for journalism and media education. *Journalism & Mass Communication Educator*, 10776958221149577.
<https://doi.org/10.1177/10776958221149577>
- Pratiwi, D., Susilo, H., & Rohman, F. (2020). Teacher competency and perception in lesson planning using a software prototype. *International Journal of Innovation, Creativity and Change*, 13(3), 811-828.
- Raman, R., Mandal, S., Das, P., Kaur, T., Sanjanasri, J. P., & Nedungadi, P. (2023). University students as early adopters of ChatGPT: Innovation Diffusion Study. *Research Square*, <https://doi.org/10.21203/rs.3.rs-2734142/v1>
- Rudolph, J., Tan, S., & Tan, S. (2023). War of the chatbots: Bard, Bing Chat, ChatGPT, Ernie and beyond. The new AI gold rush and its impact on higher education. *Journal of Applied Learning & Teaching*, 6(1), 36-389. <https://doi.org/10.37074/jalt.2023.6.1.23>
- Rusznayak, L. & Walton, E. (2011). Lesson planning guidelines for student teachers: A scaffold for the development of pedagogical content knowledge. *Education as Change*, 15(2), 271-285. <https://doi.org/10.1080/16823206.2011.619141>
- Sawyer, L. M. (2017). *Perceptions and Practice: The Relationship Between Teacher Perceptions of Technology Use and Level of Classroom Technology Integration* (Order No. 10273177). Available from ProQuest Dissertations & Theses Global; Publicly Available Content Database. (1933787164). <https://www.proquest.com/dissertations-theses/perceptions-practice-relationship-between-teacher/docview/1933787164/se-2>
- Sawyer A. G., & Myers J. (2018). Seeking comfort: How and why preservice teachers use internet resources for lesson planning. *Journal of Early Childhood Teacher Education*, 39(1), 16-31. <https://doi.org/10.1080/10901027.2017.1387625>
- Solomon, M. (1993). Content analysis: a potent tool in the searcher's arsenal. *Database*, 16(2), 62-67.

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- State of New Jersey, (2021). Grade 7: New Jersey Student Learning Standards for Mathematics - Prerequisite Standards and Learning Objectives by Domain. *State of New Jersey Department of Education*, www.nj.gov
- Süral, S. (2019). An examination of pre-service teachers 'competencies in lesson planning. *Journal of Education and Training Studies*, 7(3), 1-13. <https://doi.org/10.11114/jets.v7i3.3902>
- Tlili, A., Shehata, B., Adarkwah, M.A., Bozkurt, A., Hickey, D. T., Huang, R., & Agyemang, B. (2023). What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education. *Smart Learn. Environ*, 10, 15. <https://doi.org/10.1186/s40561-023-00237-x>
- Trust, T., Whalen, J. & Mouza, C. (2023). Editorial: ChatGPT: Challenges, Opportunities, and Implications for Teacher Education. *Contemporary Issues in Technology and Teacher Education*, 23(1), 1-23. <https://www.learntechlib.org/primary/p/222408/>
- Vu, T. (2019). Theoretical Constructs and Practical Strategies for Intercultural Communication. *Journal of Curriculum Studies Research*, 1(1), 43-53. <https://doi.org/10.46303/jcsr.01.01.4>
- Wardat, Y., Tashtoush, M. A., AlAli, R., & Jarrah, A. M. (2023). ChatGPT: A revolutionary tool for teaching and learning mathematics. *Eurasia Journal of Mathematics, Science and Technology Education*, 19(7), em2286. <https://doi.org/10.29333/ejmste/13272>
- Yeadon, W., Inyang, O. O., Mizouri, A., Peach, A., & Testrow, C. P. (2023). The death of the short-form physics essay in the coming AI revolution. *Physics Education*, 58(3), 035027. <https://doi.org/10.1088/1361-6552/acc5cf>

APPENDIX

Table 1

An output sample of ChatGPT and Gemini for a science prompt

Subject Area: Science
<p>Prompt: I am a 7th grade science teacher. My lesson topic is Environmental Issue. Can you write a lesson plan for one class period? This plan should have lesson objective, lesson activities, assessment, and teacher role.</p>
<p>ChatGPT Output</p> <hr/> <p>Lesson Plan: Environmental Issues</p> <p>Grade: 7th Grade Subject: Science Topic: Environmental Issues</p> <p>Lesson Objective: By the end of the class, students will be able to:</p> <ol style="list-style-type: none"> 1. Define and understand various environmental issues. 2. Identify the causes and consequences of these environmental issues. 3. Evaluate possible solutions to address environmental problems. <p>Materials:</p> <ol style="list-style-type: none"> 1. Projector or whiteboard 2. Computer or tablet with internet access 3. Chart paper and markers 4. Handouts (optional) <p>Duration: 1 class period (approximately 45-50 minutes)</p> <p>Lesson Activities:</p> <ol style="list-style-type: none"> 1. Introduction (5 minutes): <ul style="list-style-type: none"> ○ Begin the class by discussing the importance of environmental issues and their impact on our planet. ○ Engage students in a brief discussion about any environmental issues they may be aware of or concerned about. 2. Brainstorming (10 minutes): <ul style="list-style-type: none"> ○ Divide the class into small groups or pairs. ○ Provide each group with chart paper and markers. ○ Instruct students to brainstorm and write down as many environmental issues as they can think of within a given time frame. ○ After the brainstorming session, have each group share their ideas with the class, while you record them on the board or a shared document. 3. Presentation and Discussion (15 minutes): <ul style="list-style-type: none"> ○ Use the projector or whiteboard to present an overview of the most common environmental issues, such as air pollution, deforestation, water pollution, climate change, and biodiversity loss.

- Provide examples and relevant statistics for each issue to deepen students' understanding.

- Encourage students to ask questions and participate in a class discussion about the causes and consequences of these issues.

4. Case Study Analysis (10 minutes):

- Assign small groups to analyze a specific environmental issue (e.g., deforestation).

- Provide each group with a case study related to their assigned issue. The case study can be in the form of a text, video, or interactive website.

- Instruct groups to read or watch the case study and identify the causes, consequences, and potential solutions for the given issue.

- Allow groups to discuss their findings within their group and encourage critical thinking and problem-solving skills.

5. Solution Generation (10 minutes):

- Bring the class back together and facilitate a whole-class discussion on the potential solutions identified by the groups for their respective issues.

- Encourage students to think creatively and propose innovative ideas to address the environmental problems.

- Write down all the suggestions on the board or a shared document.

Assessment:

1. Group Discussion and Participation (formative):

- Observe and assess students' participation during the brainstorming, case study analysis, and whole-class discussions.

- Take note of their engagement, active listening, and contributions to group work and whole-class discussions.

2. Exit Ticket (summative):

- Provide students with an exit ticket that includes a few short-answer questions related to the causes, consequences, and potential solutions of a specific environmental issue discussed in class.

- Collect the exit tickets to assess individual understanding and identify any misconceptions.

Teacher Role:

1. Facilitator:

- Encourage active participation and create a safe and inclusive learning environment.

- Monitor group activities and provide guidance as needed.

- Facilitate whole-class discussions, ensuring that all students have an opportunity to contribute.

2. **Content Expert:**
 - Present accurate information about environmental issues and provide relevant examples and statistics.
 - Guide students in analyzing case studies and developing potential solutions.

3. **Assessor:**
 - Observe students' participation and engagement throughout the class.
 - Assess students' understanding through formative assessments, such as group discussions and individual exit tickets.

Note: Depending on the class dynamics and available time, you can modify the duration and activities of the lesson plan accordingly.

Google Gemini Output

Lesson Objective:

- Students will be able to identify and describe three major environmental issues.
- Students will be able to explain the causes and effects of each environmental issue.
- Students will be able to discuss possible solutions to each environmental issue.

Lesson Activities:

1. **Introduction:**

- The teacher will begin by asking students to brainstorm a list of environmental issues.
- The teacher will then introduce three major environmental issues: climate change, pollution, and deforestation.

2. **Causes and Effects:**

- The teacher will lead a discussion on the causes and effects of each environmental issue.
- The teacher will provide students with resources, such as articles, videos, and websites, to help them learn more about each environmental issue.

3. **Possible Solutions:**

- The teacher will lead a discussion on possible solutions to each environmental issue.
- The teacher will encourage students to think creatively about solutions that they can implement in their own lives.

4. **Assessment:**

- The teacher will assess student learning through a quiz or discussion.

Teacher Role:

- The teacher will facilitate the discussion and provide students with resources.
 - The teacher will help students to understand the causes and effects of environmental issues.
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- The teacher will encourage students to think creatively about solutions to environmental issues.

Differentiation:

- For students who need more support, the teacher can provide them with more specific resources or break the activities down into smaller steps.
- For students who are ready for a challenge, the teacher can ask them to research a specific environmental issue in more depth or to develop a plan of action to address an environmental issue in their community.

Materials:

- Whiteboard or projector
- Markers or pens
- Handouts or articles about environmental issues

Time:

- 45-60 minutes
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(Note: the output is added to the table as it is.)