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Innovation to improve critical thinking skills in generation Z using peeragogy as a learning approach and Artificial Intelligence (AI) as a tool

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Abstract: The current generation, known as generation Z (Gen Z), is a generation that has an affinity with the latest IT technology in their daily life, including but not limited to be used for learning. In addition, Gen Z is characterized by teamwork, in cyberspace also, to solve problems. Gen Z also has the ability to adopt Artificial Intelligence (AI) technology as a learning tool. Meanwhile, Gen Z faces the challenge dealing with 21st Century skills that require Higher Order Thinking Skills (HOTS), among them this paper will focus on the Critical Thinking skills (CT). For this reason, it is very important to improve competence of CT skills for Gen Z using a model that combine 7E learning cycles, with peeragogy learning approach and AI. Practice in the classroom demonstrated that this model has shown promising results to improve CT skills for Gen Z.

Keywords: Innovation in Learning, Critical Thinking, Generation Z, Peeragogy, Artificial Intelligence.

Introduction

Technological innovation is part of a process that is in harmony with the progress of human civilization. Humans always innovate to be able to make their lives better. Therefore, technology plays a major role in helping human activities including but not limited to the teaching and learning process. The technological innovations created by mankind have developed in an unprecedented form. Currently, more technological innovations are based on information (IT) and digital technology. This development has affected many aspects of human life today such as Society 5.0, namely a society that lives side by side with intelligent, sophisticated technology.

Currently the use of IT, digital and social media has made the way of human life different from before, including in learning, because distance is no longer a barrier for humans to learn. The current generation, generation Z, known as Gen Z, is a generation that lives side by side with this technology on a daily basis. So that Gen Z is very familiar and seemingly dependent on this technology.

In order to live fulfilled, Gen Z requires to have the competence of 21st Century skills categorized in learning skills, literacy skills, and life skills. This paper will especially elaborate learning skills of 4Cs i.e. critical thinking, creativity, collaboration, and communication. The critical thinking (CT) skills will be the main focus of this paper as it is considered an important skill for Gen Z. CT skills among others is actually a part of Higher Order Thinking Skills (HOTS) which in fact are still ranked quite low in the Program for International Student Assessment (PISA). Efforts related to improving CT skills have been carried out in several studies using various methods. However, methods for improving CT skills specifically aimed at Gen Z with its unique characteristics are still deemed necessary in the current conditions. Therefore, the objective of this paper aims at elaborating method to improve Gen Z competence in CT skills that in tune with characteristic of Gen Z and utilizing the latest IT technology i.e. peeragogy approaches combine with Artificial Intelligence/AI.

Methods

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The methodology used in this paper is a literature study that is directly related to the topic. In addition, this paper also develops a method to achieve the objective. The method is to adopt 7E learning cycles and peeragogy as a learning approach combined with the use of artificial intelligence/AI as a tool. Another methodology used in this paper is action research where this method is applied directly to the teaching and learning process in the classroom at a higher education institution.

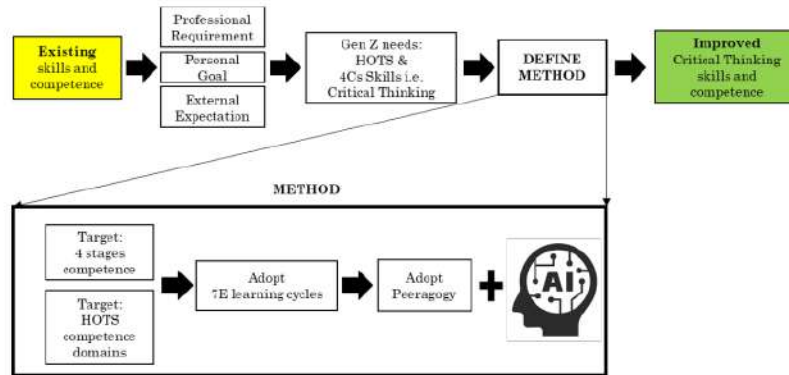


Figure 1. Method to achieve competence of critical thinking

Generation

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Generations represent a distinct and separate group of people with a common set of beliefs, experiences and values about how the world works. Generations are a group of individuals who live in the same period of time, have the same age, year of birth, and similar events in the lives of these individual groups [1]. In the characterization of generations based on the year of birth according to Codrington, and Grant-Marshall [2] at least we already know some of them: Boomers (1945-1964), Gen X (1965-1979), Gen Y/Millennial (1980-1994), Gen Z (1995-2010), and Alpha generation (2011-2025). There are several characteristics of each of these generations, the most prominent being mastery of IT, internet, use of gadgets, and active use of social media such as SMS, email, BBM, Whatsapp, Line, Facebook, Instagram, online applications, etc.

Generation Z (Gen Z)

In this paper we will specifically discuss Gen Z who were born between the years 1995-2010 and currently aged between 13-28 years. This generation was born at a time when the innovation and development of IT and digital technology has experienced a lot of progress. Not surprisingly they were born and developed in a social environment that is heavily influenced by the use of IT technology in everyday life. Due to the influence of environmental developments including but not limited to technology, therefore this generation has specific characteristics, strengths and weaknesses compared to other generations. Generation Z is also known in many references with other terms such as iGeneration, Net generation or internet generation, Post-millennials, Facebook generation, Digital Natives, Switchers, Dotcom children, C-Connection-generation, D-Digital-generation, and R-Responsibility-generation.

Characteristics of Generation Z

Some of the distinctive characteristics of Gen Z as conveyed by Singh and Dangmei [3] among others tend to be impatient, instant way of thinking, lack of ambition, have symptoms of ADHD (Attention Deficit Hyperactivity Disorder) especially attention deficit with high dependence on technology, individualistic, self-directed, too demanding, tend to be greedy, materialistic. Max Mihelich [4] provides an overview of the characteristics of Gen Z, including being very concerned about environmental issues, very aware of water shortages. In other word they are very aware and have a high sensitivity to natural resources. According to Amanda Slavin [5] this Gen Z expects that their voice to be listened, they are tech savvy but lack skills in solving problems. In making decisions, they tend not to see the contextual situation well and also participate less in social activities compared to the previous generation.

Work and study preferences of Generation Z

The work and study preferences of Gen Z are highly dependent on the weaknesses, and strengths of Gen Z. Gen Z's work preferences according to Bascha [6] include that they prefer transparency, independence, flexibility, and personal freedom which are important for them. Meanwhile, according to Teresa Bridge [7] that Gen Z prefers a work environment that provides assistance, provides learning and opportunities for self-development in a professional manner because they are quite aware that their education does not provide sufficient skills to cope with real problems in life. They like workplaces that challenge their business-like skills, and have flexible work schedules. Because they are used to living side by side with technology, they prefer workplaces that have good technology support. They also prefer a place to work with leaders who have good practices in terms of honesty and integrity [3]. In addition, they also prefer a workplace that has a high concern for social and environmental responsibility, and has a close relationship with the community [3].

Gen Z's learning preferences are highly dependent on the level of education pursued. In general, the learning preferences of Gen Z can be grouped into 1. Method, 2. Facilitator, 3. Technology. The Gen Z learning approach prefers learning by doing which has clear learning objectives and topics and hopes to get feedback quickly. In addition, they have a way of communicating using online media. Gen Z's way of learning also likes the way of learning together (co-learning) which can be done in a blended way (offline and online). Gen Z likes learning facilitators who can position themselves as friends, Gen Z likes learning technology that can be done anywhere, anytime, using gadgets and other digital media (U-learning). They are also used to doing multitasking learning.

Ways to Achieve Competence of Critical Thinking

When asking Gen Z as student to elaborate a topic in the class, not surprisingly that they will explain the topic differently. The best one may explain in a structured, clear, and confidence like explaining by intuition and right. On the other hand, the worst one may explain by intuition but wrong and even confusing. The best one or the competent one may have prior knowledge, attention, and used to interact with the topic, while the worst one may have no interest, no attention, or have low ability on the topic and lack of ability to perform well. In other words, the incompetent individual is considered lack of metacognitive skills, meta-memory, meta comprehension or self-monitoring skills [8]. This is actually related to competence level that Gen Z may have. Competence level consist of four stages which is 1. Unconscious incompetence, 2. Conscious incompetence, 3. Conscious competence, and 4. Unconscious competence [9], [10]. The Unconscious incompetence is the early stage of learning as beginner, the one who don't know about what he/she don't know. The conscious incompetence is the intermediate level of learning, the one who recognize that he/she don't know. The conscious competence is the competent level of learning, the one who make good progress in learning, still make mistakes and lack of intuitive judgment. The unconscious competence is the mastery in the level of learning, the one who develop high level of competent, still make few mistakes and has intuitive correct judgment.

This paper aims at developing a method for the Gen Z to achieve the competence of CT skills in the level of conscious incompetence (stage 2, intermediate), and or conscious competence (stage 3, competent) by adopting the 7E learning cycles, Peeragogy learning approach, and utilizing the AI (Figure 1).

HOTS and Critical Thinking Skills

Higher Order Thinking Skills (HOTS) is an important thinking skills for 21st Century. World Economic Forum (WEF) identified the top 10 work skills of 2025 which is 1. analytical thinking and innovation, 2. active learning and learning strategies, 3. complex problem-solving, 4. critical thinking and analysis, 5. Creativity, originality and analysis, 6. leadership and social influence, 7. technology use, monitoring and control, 8. technology design and programming, 9. resilience stress tolerance and 10. flexibility, reasoning problem-solving and ideation. Among them skills no. 1, 3, 4, 5, 10 are categorized as HOTS [11]. Shanti *et al.* [11] argued that HOTS ability become problem for many countries. Thinking skills are the process that emphasize on how to analyze and evaluate information gained from experiences or observations, this process involves cognitive and affective domains [12], [13]. Revised Bloom's taxonomy by Anderson and Kratwohl [14] defined the cognitive domains as C1 (remember), C2 (understand), C3 (apply), C4 (analyze), C5 (evaluate), C6 (create). Anderson and Kratwohl [14] defined (C1-C3) as Low Order Thinking Skills (LOTS), namely the ability to remember, memorize, or imitate. While (C4-C6) defined as High Order Thinking Skills/HOTS namely the ability to think analytically, critically, and creatively. In order to achieve cognitive domain of HOTS, therefore it is required to improve, among others, the critical thinking skills. Critical Thinking skills is in fact one of very important learning and innovation skills for 21st century [15]. Critical thinking skills are defined differently depends on the author. This paper defines critical thinking skills as a (logical) thinking process to be able to comprehend a topic freely

based on correct arguments and judgements. There are several other definitions of Critical Thinking as shown in Table 1.

Table 1. Definition of critical thinking

Source	Definition
Chance [16]	The ability to analyze facts, generate and organize ideas, defend opinions, make comparisons, draw inferences, evaluate arguments and solve problems.
Tama [17]	A way of reasoning that demands adequate support for one's beliefs and an willingness to be persuaded unless support is forthcoming.
Mertes [18]	Conscious and deliberate process used to interpret or evaluate information and experiences with a set of reflective attitudes and abilities that guide thoughtful beliefs and actions.
Ennis [15]	Reasonable reflective thinking focused on deciding what to believe or do
Scriven and Paul [20]	The intellectually disciplined process of conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action in actively and skillfully.
Lipman [21]	Skillful, responsible thinking that facilitates good judgment because it (1) relies upon criteria, (2) is self-correcting, and (3) is sensitive to context
Chaffee [22]	Making sense of the world by carefully examining the thinking process, as well as to clarify and improve our understanding.
Trilling and Fadel [23]	The ability to analyze, interpret, evaluate, summarize, and synthesize information
Santrock [24]	Critical thinking skills include productive, reflective, and evaluation thinking about and event

Peeragogy learning approach

The approach, method, way, or strategy for learning in education is called pedagogy, but currently other approaches have been recognized such as andragogy, heutagogy and peeragogy or paragogy, namely the latest education that is more in line with the current state of society (Figure 2.). Pedagogy is an approach, method, or traditional learning approach in which the learner is very dependent on the teacher. Pedagogy is also a method for carrying out the teaching and learning process by using various approaches to achieve learning objectives. The types of Pedagogy approaches are 1. constructivist, 2. collaborative, 3. integrative, 4. reflective, and 4. inquiry-based.

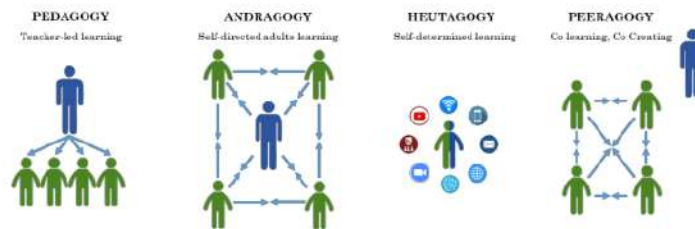


Figure 2. Types of learning approach

Meanwhile andragogy or adults learning is a self-directed learning approach, heutagogy a self-determined learning approach, and peeragogy or paragogy is another learning approach that has the basic word "Peer" which means partner (Figure 2.). Peeragogy is simply an integrative approach or way of learning with friends or collaboratively, namely being able to integrate the classroom with the outside world. This approach is actually a learning approach that is naturally carried out by humans, namely learning with other colleagues so that knowledge is produced and used together. This is a form of active learning approach (active learning) in which the learning process occurs due to interactions with fellow students. Peeragogy is a self-determined learning approach by learning peer-to-peer and not centered on educators (decentered). Furthermore, Alexander *et al.* [25] explained that peeragogy is peer learning together and helping each other in learning. In this peeragogy learning approach, everyone is encouraged to actively and freely contribute to the group. According to Corneli *et al.* [26] peeragogy is a set of techniques and patterns that can be imitated for effective peer learning and

problem solving. Corneli *et al.* [26] further explained that participants in the peeragogy approach collaborated to build emergent structures that were responsive to changes in their context.

Therefore, this learning approach is suitable with the characteristics of Gen Z which tend to be oriented, even dependent on IT, digital technology, social media, and like online learning in their daily lives. According to Rheingold [27], peeragogy learning approach that use various types of online learning emphasize autonomous and interactive learning systems where knowledge can be generated through peer-to-peer learning cooperation and from many sources.

The learning cycles

The learning process is a process of acquiring knowledge as a result of learner's interaction with teacher and the environment. According to the constructivism model, knowledge is actually built by the learner because of the active interaction, known as active learning, with the environment and not merely transmitted from teacher to learner. Constructivism is a dynamic and interactive model of how humans learn [28]. The principle of constructivism emphasizes on the investigation, explanation, experimental design, evidence based conclusion, etc. In this learning process the learner may experience cognitive conflict if the initial conception or perception he/she has is different from the new phenomenon he/she is learning so that cognitive structure modification is needed. The application of this constructivist learning model is known as the learning cycle [29]. The learning cycles is initially introduced by Atkin and Karplus [29] has been developing until today such as three phases learning cycle model (exploration, invention, discovery) [30], 4E model (explore, explain, expand, evaluate) (Carin 1993), 5E model (engage, explore, explain, elaborate, evaluate) [31], and 7E model (elicit, engage, explore, explain, elaborate, evaluate, extend) [32]. Some advantages of 7E learning model according to Rahman and Chavhan [33] are 1. Help to understand deeply, 2. Makes Efficient learning, 3. Transfer of learning, 4. Motivation to learn, 5. Develop thinking skills, 6. Develop communication and social skills, and 7. As a basis of developing instruction materials. Therefore, 7E learning model is an active learning that suitable to improve critical thinking skills.

Table 2. 7E learning cycles

Phases	Description	Method & Tools
Elicit	Using existing or prior knowledge and experience to construct the new knowledge	Questionings, concept sheets, activity sheets
Engage	Motivate the learner to engage in the learning activity	Video, diagram, story-telling, activity
Explore	Using prior knowledge to explore the new understanding and knowledge	Learning together in collaboration, cooperation
Explain	Learner explain and discuss understanding	Group discussion
Elaborate	Challenge with more complex questions to reflect the gained knowledge	Focus group exercise
Evaluate	Assessment to measure achieved learning objective	Self/peer-assessment, assignment, evaluation
Extend	Retention and or transfer of learning and apply to the real situations.	Project assignment

The use of AI in the teaching and learning process

Currently, we are surprised by the emergence of various applications of Artificial Intelligence (AI) in various aspects of our lives. Many things in our lives today have intersected with the results of AI work, such as online shopping systems, online advertising, etc. In the future it is estimated that human life will be greatly influenced by AI, even AI is said to be "the coming of electricity". I myself has the view that the emergence and development of AI today is like the emergence and development of mobile phones 20 years ago which could only make calls and SMS. Because of that, we can imagine how the development of AI in the next 20 years is like the development of mobile phones that have turned into smart phones (smart phones). According to Wikipedia artificial intelligence (abbreviated as AI) is intelligence that is added to a system that can be managed in a scientific context. Meanwhile, according to Kaplan and Haenlein [34] AI is a system's ability to interpret external data correctly, to learn from that data, and use that learning to achieve certain goals and tasks through flexible adaptation. According to McCarthy *et al.* [35] in Miao *et al.* [36] AI is science and engineering of making intelligent machines, especially intelligent computer programs.

Various Pros and Cons opinions regarding AI have emerged in the public, some see AI as a threat in various aspects of life such as fears of losing jobs because they cannot compete with AI, fears of fading or expiration of education, no need for educators anymore because they are replaced by AI, as well as views that the competence of AI will exceed the competence of the human itself and the concern about the use of AI in the field of weapons

and warfare. However, not a few see AI as a good opportunity for humans to improve their quality of life and dignity, such as in the fields of education, medicine, environment, industry, etc. In the field of education, AI can help us implement a new, better teaching and learning system.

In the field of education, we may ask what AI can do at the moment which is aligned with the capabilities (advantages and disadvantages) of current AI technology/applications and what might happen and be able to do in the future. In the context of education, the use of AI can be applied to the entire educational process. This paper will only discuss the use of AI which is focused on efforts to increase effectiveness in the cognitive domain of Peeragogy learning systems.

AI applications can be used to support independent learning such as Virtual Mentors, Automatic Assessment, Personalized Learning, Educational Games, and others. AI can also be used as a way to explore, explain, elaborate, assess, verify, validate what we learn and understand (see Table 2. 7E learning cycles). For example, learners can use chatbots such as ChatGPT or other generative AI to help improve their learning, but they still have own opinion and cannot rely entirely on AI. ChatGPT is a generative AI application capable of processing natural language (NLP) and is able to respond to questions and provide answers in text form. However, the use of ChatGPT in education raises many pros and cons, especially regarding plagiarism. Therefore, in this paper, the use of AI applications in the learning process should be used as a learning aid, especially to explore, explain, elaborate, assess, verify, validate learning. Because this application can immediately respond to any questions, the effectiveness of the learning process using ChatGPT is very dependent on the ability to formulate questions. AI applications such as ChatGPT should not be used in creating scientific work as if it were personal work because this could be an indication of a violation of ethics and law.

Results and Discussions

This paper has outlined a method for improving critical thinking skills, especially in Gen Z with the 7E learning cycle, peeragogy learning approach, and artificial intelligence/AI. Utilization of 7 E learning process helps to structurally improve CT skills. Peeragogy with all its advantages and disadvantages is an appropriate learning approach for Gen Z. AI can be used to increase the effectiveness of the cognitive domain in the Peeragogy learning system, both HOTS and LOTS. Even though student can use AI for any purpose, however in education AI to be used for learning aid in class, especially in exploring, verifying and validating learning topic. Normally when student learning a new topic, they actually have previous knowledge and memory. When student explore the topic then either they confirm their previous knowledge and enrich during the learning process of the new topic or they become unsure about their previous knowledge with the new one as they cannot find any indication of correctness. For the case that they unsure and even feel a contradiction between previous knowledge with the new topic then they may ask confirmation or validation. In the old learning approach confirmation or validation can be sourced from books, references, or directly from lecturer or facilitator. With the use of AI, therefore verification, confirmation, and validation can be done also with the help of AI. Actually, AI can help student furthermore in the 7E learning process such as to explore, explain, and elaborate the topic.

The model in figure 3. has been tried in the classroom by applying the modified peeragogy learning approach in the classroom where students are divided into study groups, each consisting of 5 people. The case study is a course entitled citizenship with a 2 credit which has been taught in class for one semester. In model 1, each learner in the group can use any IT tool to help them understand the topic and freely discuss with their peers, but ChatGPT is not allowed during the discussion. Lecturer role is to facilitate the discussion and to provide feedback and summary of the discussion, the ChatGPT is used limited only to verify and validate the summary related with the topic as well as to evaluate the learning process (see Table 2. 7E learning cycles). In model 2, each learner explores and understand the topic in a group discussion. The group is allowed to utilize IT Tools and ChatGPT to help them to explore, explain, and elaborate the topic (see Table 2. 7E learning cycles). Similarly, lecturer role is only to facilitate the discussion and to provide feedback and summary of the discussion, the ChatGPT is also used to verify and validate the summary related with the topic as well as to evaluate the learning process (see Table 2. 7E learning cycles).



Figure 3. Modified peeragogy learning approach

From the classroom observation, it can be seen that class activities are very dynamic, students are enthusiastic, collaborative, confidence, able to determine their own way of learning, independent learning process, and creative and integrative, especially in connecting topics in class with the real world experience.

Conclusion

From the theoretical description and discussion, it can be concluded that the method of increasing CT skills competency for Gen Z has shown promising improvements compared to traditional approaches. Gen Z's way of learning prefers co-learning, therefore the modified peeragogy approach (Figure 3.) can be one of their preferred learning approaches.

The learning effectiveness can be increased with the help of AI, especially to improve HOTS cognitive domain. AI such as ChatGPT on the one hand can help learners in increasing learning effectiveness, especially to verify and validate their understanding on the topic. On the other hand, if AI is not controlled properly, it can make learners to choose the shortcuts path of learning which is considered unethical.

The current form of AI, such as ChatGPT, which is based on text, will certainly continue to develop and can reach levels that were never imagined. AI, like technology in general, is neutral, therefore it is the users of AI technology who will ultimately determine whether this AI technology will be used for good or bad thing. On the positive thinking, AI technologies like ChatGPT and others are currently very helpful in learning.

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