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Learning Style for AI Convergence in Technology Education

Mika Lim

Chungnam National University, Daejeon, Korea
mika@cnu.ac.kr

Abstract

The purpose of this study was to devise a model of learning style for individualized learning of AI convergence in technological problem solving, which is the main teaching-learning method of technology subject. Among the dimensions of recognition-judgment, creativity, execution, attitude, and interaction of technological problem-solving learning styles, the dimensions that act mainly according to the problem content and learning form were selected and constructed as a model. The method of research for this purpose was Kolb's research method, which derives four learning styles by synthesizing the correlation between two types of information perception methods and two types of information processing methods. Therefore, in this study, a creativity-execution model was devised in consideration of the 'adaptation-innovation type' of the creativity level and the 'reflection-action type' of the execution level. In addition, an interactive-attitude model was devised in which the 'independent-cooperative type' in the interaction dimension and the 'avoidance-participation type' in the attitude dimension act dynamically. In addition, a five-factor learning style model for technological problem solving was devised and presented, with all five dimensions of recognition-judgment, creativity, execution, interaction, and attitude of the technological problem-solving learning style as factors. The learner characteristics defined through the model design suggested the direction of AI convergence education considering individual characteristics of learners and provided basic data for it. In the future, it is suggested that specific individualized teaching and learning development research be conducted in AI convergence education, taking into account the characteristics of learners according to the learning style of technological problem solving.

Keywords: *AI, AI convergence education, Individualized learning, Learning style model, Technological problem-solving*

1. Introduction

When a revolutionary change in human life occurs due to an automated labor force or intelligence, it is called the industrial revolution. And now, artificial intelligence is at the forefront of the 4th industrial revolution, an intelligent information society that is explained by technologies such as IoT, big data, and augmented reality (Lim, 2020) [1]. The Oxford English Dictionary defines AI as 'the ability of computers or other machines to display or imitate intelligent behavior' (OED, 2018) [2]. Governments and private sectors around the world are preparing and conducting AI training courses. AI4AL (AI for ALL), a non-profit organization in the United States, insists on the need for artificial intelligence education to solve social problems and says that AI education should be for all citizens. The fields of AI and education

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are still in the early stages of research, so there are many areas where concepts and terms are not clearly defined. Lim (2020) [1] classified AI into 'education about AI' and 'education using AI'. It is expected that AI convergence education will be able to achieve quantitative and qualitative expansion of education by enabling education beyond the limitations of time and space. Among them, one of the major changes will be the promotion of individualized instruction that considers learners' characteristics. However, since AI education research is currently in the beginning stage, there is a need to be more actively researched in various subject education including technology education. Holmes, Bialik, Fadel (2019) [3] introduced the AI in Education (AIED) system to date with the Intelligent Tutoring System (ITS) and the Dialogue-Based Tutoring System (DBTS), and exploratory learning environment (ELE). It is expected that AI convergence education will be able to achieve quantitative and qualitative expansion of education by enabling education beyond the limitations of time and space. Among them, one of the major changes will be the promotion of individualized instruction that considers learners' characteristics. However, it’s still hard to find artificial intelligence convergence and individualization research in the area of technology education. Therefore, the purpose of this study was to develop a learning style model for individualized learning of AI convergence in technological problem solving, which is the main teaching-learning method of technology education, and use it as a basis for teaching and learning in technology education. Research questions to achieve the purpose of the study are as follows. Research questions to achieve the purpose of the study was as follows. How to structure the types of learners that can be used for AI convergence design in technology education?

2. Theoretical background

2.1. AI convergence education and individualized learning

The characteristics of AI convergence education compared to existing education are realization, connection, intelligence, and convergence. Realization refers to realistic education that stimulates students' senses, connection refers to education that interacts anytime, anywhere, intelligence refers to an AI teacher who knows me better than me, and convergence refers to education that reinforces the fusion of educational content. Among them, intelligence is the trend of advancement of customized education for learners, and practical individualization and harvest instruction are possible (Nam, Cho, 2020) [4]. Shin, Shin (2020) [5] suggested the teaching and learning strategies of AI-based science education through automation, individualization, diversification, and cooperation. Automation means that AI continuously analyzes and manages individual students' information in real time, individualization means that AI enables individual learning guidance that considers students' level, and diversification means that individual customized curriculum and textbooks are provided. In addition, cooperation means promoting a multi-faceted system of cooperation between schools and communities. Wu et al., (2017) [6] provided the contents of the lesson after examining whether it had a precedent concept for the learning concept. The AI convergence education algorithm of Wongwatkit et al., (2017) [7] is shown in [Figure 1].

2.2. Learning style of technological problem solving

The characteristics of AI convergence education compared to existing education are realization, connection, intelligence, and convergence. Realization refers to realistic education that stimulates students. The learning style is a generic term for learning habits, learning methods, and learning tips that the learner continuously selects during the learning process.

Learning styles help learners to understand individually and provide appropriate information related to teaching and learning. Technological problem-solving means 'when dealing with technical problems that create tangible outputs or related systems in the process of learning, solving problem situations or learning how to solve them'. And it comprehensively utilizes the learner's cognitive, affective, and psychomotor areas. In this regard, Lim, Kim (2020) [8] identified the types of learners related to technical problem solving and learned technical problem solving based on this in order to construct an appropriate teaching-learning environment according to the characteristics of students in technology subject classes. The form was derived as shown in [Table 1].

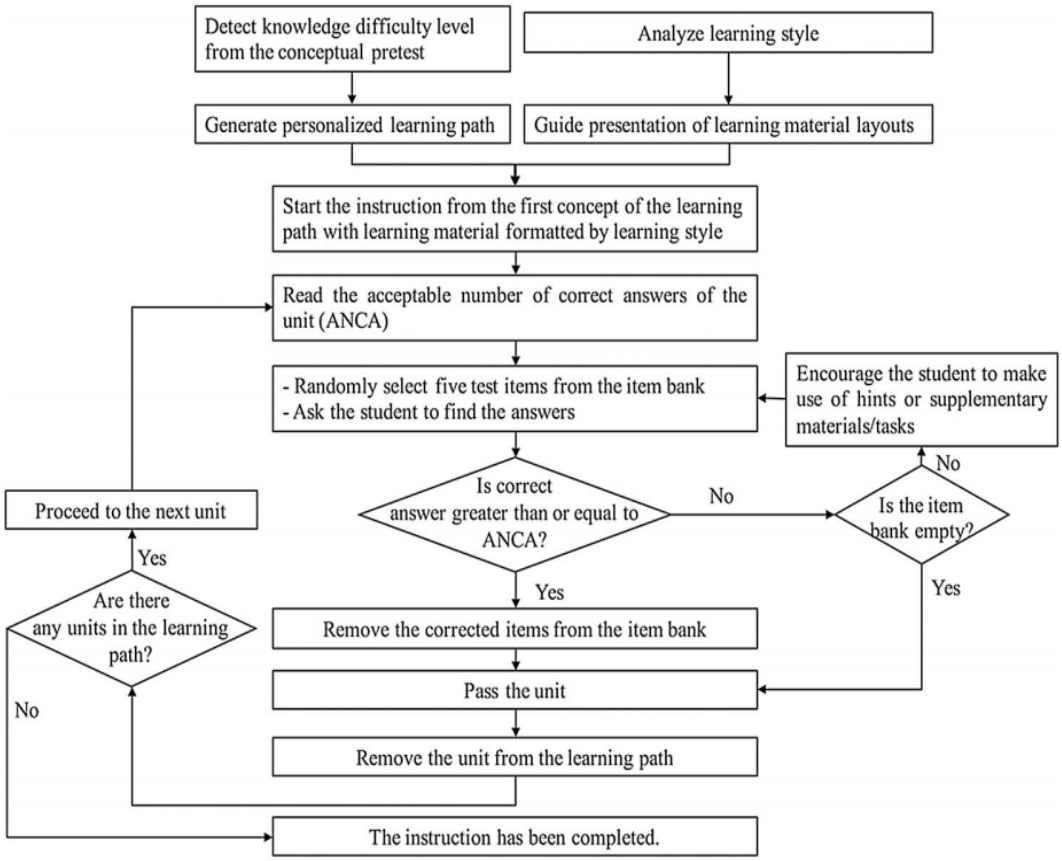

Figure 1. Procedure of the personalized web learning system based on the personalized information and formative assessment (Adapted from [7])

The dimension of recognition and judgment is divided into thinking type and intuition type. When solving a problem, a thinking learner systematically establishes a plan and develops theories, and considers the process built through thinking as important, searches for information, makes decisions, and solves problems based on logical thinking and rationality. In the process of problem solving, there is a tendency to adhere to the set steps through analytical thinking. Intuitive learners rely on external information or feelings rather than internal logic when learning. When solving a problem, there is a tendency to perceive the meaning implied in the problem as a whole, and the process of problem solving does not

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proceed sequentially. Through holistic thinking, it is often the case that jumps through steps and quickly arrives at a conclusion.

Table 1. Learning style of technological problem solving (Adapted from [8])

Dimension	Type
recognition and judgment	thinking-intuition
creative	adaptation-innovation
execution	reflection-action
interaction	independence-cooperation
attitude	evasion-participation

The dimension of creative is divided into adaptation type and innovation type. In the process of solving problems, the conformant seeks efficiency and safety, and seeks to work within regulations and agreements. The innovation type generates a lot of original ideas without being bound by a given situation, and is more interested in generating ideas rather than efficiency. In the process of solving problems, the value of further development of the idea is valued rather than the importance of rules, structures, and agreements.

The execution dimension is divided into reflection type and action type. The contemplative Hyung carefully observes and judges, and views objects from various perspectives in the process of observation. It is also related to a kind of imitation learning, rather than acting prematurely, it observes the surrounding situation or procedure, collects as much information as possible, and makes a plan of action. The action type tends to approach problem solving impulsively, omitting the reflective thinking process. They prefer to solve problems directly, draw concrete conclusions, and value the realization of results.

The level of interaction is divided into independence and cooperative. Independence learns in its own way when learning, learns what you think is important, and prefers lecture-style classes. They prefer personal activities and are more interested in solving problems than interacting with members. The cooperative type draws energy from interactions with others, discussions of possibilities, and ideas of others.

Attitude dimension is divided into evasion type and participation type. Evasion learners do not participate well in class activities when learning, and do not feel much interest in the contents of the class. Participatory learners want to actively participate in class activities when learning, and in many cases, they actively participate in activities other than classes.

3. Method

Since technological problem-solving activities take into account the abilities of various fields, it is difficult to always dynamically associate the propensities derived in [Table 1]. However, it is possible to select and categorize certain dimensions that are considered to be important. And it helps to understand learner characteristics a little more comprehensively. In addition, it can be used significantly as basic data for individualized classes in AI convergence education. Since the dimensions considered to be important may differ depending on the

learning situation, this study attempts to present several types of models that can be used mainly depending on the situation. The composition method followed the method of Kolb (1993) [9]. Kolb (1993) [9] derived four learning styles by synthesizing the correlation between two types of information perception methods and two types of information processing methods. Using this method, a model was derived by synthesizing the dimensions in [Table 1]. At this time, the type of learning style was symbolized and concisely expressed using English words expressing meaning.

4. Result

4.1. Creativity-execution model

Technological problem solving has to do with 'producing tangible products or creating a system related to it'. In this regard, Nam (2010) [10] stated that technological thinking is a process based on creative and practical activities, unlike other fields. Accordingly, in this study, among the derived learning styles, the most important dimension of the technological problem-solving learning style was considered to be the creativity and execution dimension. In addition, a creative-execution model was constructed in which the ‘adaptation type-innovation type’ of the creativity level and the ‘reflection-action type’ of the execution level act dynamically. In this model, a total of four learner types can be identified, and consideration is most appropriate for problem-oriented classes.

Learners who are innovative at the creative level and behavioral at the execution level are classified as innovative behavioral types (VA). The innovative behavior type is good at diffuse thinking and enjoys adventurous challenges. This type of learner is suitable for presenting unstructured invention problems.

Learners who are innovative in the creative level and contemplative in the execution level are classified as innovative contemplation (VR). The innovative contemplation type is based on diffuse thinking and abundant imagination, but proceeds with a heuristic process with careful judgment. Therefore, it is appropriate to present an unstructured or semi-structured design problem.

Learners who are compliant at the creative level and reflective at the execution level are classified as adaptive reflection (DR). Since this type is good at identifying and solving problems in a logical and systematic procedure, it is appropriate to present a structured problem-solving problem.

Learners who are compliant in the creative dimension and behavioral in the execution dimension are classified as adaptive behavior (DA). Based on convergent thinking, this type solves the problem while experiencing endless challenges and trials and errors. Therefore, it is appropriate to present a semi-structured development problem.

4.2. Interaction-attitude model

In situations where it is necessary to consider the affective characteristics of learners in the process of solving technical problems, the dimension of interaction and attitude can be considered.

Learners who are cooperative at the level of interaction and participant at the level of attitude are classified as cooperative participatory (CP). The cooperative participatory type prefers group learning, is good at interaction, and mainly shows leadership.

Learners who are cooperative at the level of interaction and avoiding at the level of attitude are classified as cooperative avoidance (CO). The cooperative avoidance type prefers group

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learning, but is somewhat passive in interaction, and is dependent on the performance of other group members.

Learners who are independent in terms of interaction and avoidable in attitude are classified as independent avoidance (IO). Independent avoidance type prefers individual learning, prefers teacher-led instruction rather than self-directed learning, and shows a tendency to passively participate in problem solving.

Learners who are independent in terms of interaction and participatory in attitude are classified as independent participatory (IP). The independent participatory type prefers individual learning, wants to lead learning by itself, and tends to approach it from an objective point of view rather than considering the whole or the situation of others in the process of problem solving or judgment.

4.3. Five-factor learning style model for technological problem solving

The five-factor learning style model of technological problem solving can be constructed that takes all five dimensions of the technological problem-solving learning style as factors: perception, judgment, creativity, execution, interaction, and attitude. This model considers all dimensions and propensity of technological problem solving, and a total of 32 learner types can be identified. When constructing the model, the type with the tendency of introverted energy for each dimension was placed inside and the type with the tendency of introverted energy was placed outside. Introverted means that the learner's interest and problem-solving process is mainly directed towards the inner world or has a convergent characteristic, while extrovert means that the learner's interest and problem-solving process is mainly directed to the outside world or has a diffuse characteristic.

5. Conclusion and suggestions

The purpose of this study was to devise a learning style model for individualized learning of AI convergence in technological problem solving, which is the main teaching-learning method of technology subject. The learning model devised in this study reflects the characteristics of technical problem solving as it considers all areas of cognition, definition, and psychodynamics. Among the dimensions of recognition, judgment, creativity, execution, attitude, and interaction of technical problem-solving learning styles, the dimensions that acted mainly according to the content of the problem and the learning type could be selected and constructed as a model. And the learner characteristics defined through the model design provided the direction and basic data for the type of problem and the learning process to be presented in AI convergence education considering the individual characteristics of the learner. In the future, it is suggested that specific individualized teaching and learning development research be conducted in AI convergence education, taking into account the characteristics of learners according to the learning style of technological problem solving.

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Authors

Dr. Mika Lim, PhD

Teacher

Shindong Middle School, Seoul, Korea

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