Measuring AI Education Performance with Flipped Learning Based on Bloom's Taxonomy Objectives

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***Abstract*— As the importance of Artificial Intelligence (AI) capabilities increases across industries, the demand for AI education for young job seekers is also increasing. However, non-majors in related fields face difficulties in learning due to the lack of specialized learning content and prior learning opportunities. This study aimed to implement an AI education program through flipped learning for young job seekers and evaluate its effectiveness. The study included 80 students from a South Korean university AI training program, randomly assigned into control and experimental groups with 40 majors and 40 non-majors in each. In the end, the experimental group achieved higher academic results than the control group, particularly on higher-level items.**

Keywords- Artificial intelligence; Education; Flipped learning; Young job seekers.

I. INTRODUCTION

Currently, the demand for artificial intelligence manpower is exploding in various fields, but it is challenging to supply manpower through formal education within a short time. Although artificial intelligence can be classified as a computer science discipline, it has a wide range of fields and applications, so it is not just for science and engineering majors. Still, it is considered an essential literacy for modern people in the era of the Fourth Industrial Revolution. However, in order to learn AI, primary computer languages, basic mathematics, computer algorithms, and other essential learning contents are required in common.

In the non-degree AI training program for young job seekers, a large number of trainees receive intensive training for a limited period of time. In addition, it is challenging to provide individual scaffolding for learners with varying levels of prior knowledge in the classroom, as AI education is conducted using the Project-Based Learning (PBL) method that combines theory and practice. In order to increase learner motivation and promote achievement, learner-centered education is necessary for individual learners in all majors [1]. Non-majors can repeatedly learn online video materials using the flipped learning method as scaffolding outside the classroom, based on individual capabilities and progress. It is possible to implement out-of-classroom classes in which memory and understanding in Bloom's hierarchy of educational objectives [2] are learner-driven. As a result, it is expected that efficient and effective learner-centered AI classes will be possible, as it will be possible to secure class time for complete learning and higher-level classes such as practical exercises and projects through summarizing and answering questions about core contents in the actual classroom.

This study aimed to effectively implement AI education for both non-CS (Computer Science) majors and those who struggle to learn AI. To achieve this, an experimental study was conducted using a learner-centered approach by adopting the flipped learning method. The study measured academic achievement and the effectiveness of achieving learning goals in the higher dimensions of Bloom's Taxonomy.

The remainder of this paper is organized as follows. The related works of flipped learning and Bloom's Taxonomy are presented in Section 2. The methodology of this study is explained in Section 3. Section 4 showcases the study's results. Finally, the paper concludes with Section 5.

II. RELATED WORK

In this section, we describe Flipped Learning and Bloom’s Taxonomy that are closely related to the topic of this paper.

A. *Flipped Learning*

Flipped learning is a learner-centered teaching method that allows instructors to utilize classroom time efficiently and effectively [3]. Baker used the term "The classroom flipped" [4], and Bergmann and Sams, teachers in Colorado, USA, created and provided online class videos for students who could not attend class and defined it as flipped learning [5]. Prior to that, there was a teaching method of learning the material in advance out of class and doing learner-centered activities in class. Still, with the development of technology and the advent of the information age, the role of the instructor has shifted from being a source of information to helping students learn how to handle information [6]. This phenomenon is expected to intensify with the rise of artificial intelligence and big data during the Fourth Industrial Revolution. As a result, the flipped learning teaching method is predicted to expand and advance.

B. *Bloom’s Taxonomy*

Bloom categorized the hierarchy of educational objectives as remembering, understanding, applying,

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analyzing, evaluating, and creating [2]. Bergmann and Sams reversed Bloom's hierarchy of objectives for flipped learning, suggesting that memory and comprehension occur outside the classroom, while higher-order thinking of application, analysis, evaluation, and creation are promoted in the classroom [5].

In Figure 1, Bloom's inverted pyramid [7] shows the application of Bloom's Taxonomy to the flipped learning model.

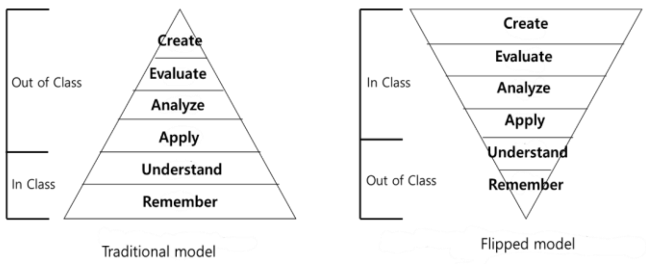

Figure 1. Bloom's reversed taxonomy [7]

Pre-learning lecture videos provided out of class are a good content delivery tool to achieve the lower levels of Bloom's taxonomy, namely remembering and understanding and in-class learning can be valuable to foster higher-level learning, namely applying, analyzing, evaluating, and creating.

III. Methodology

This study was conducted on 40 control and 40 experimental group students enrolled in the artificial intelligence education program at a university in South Korea. Adopting a quasi-experimental research method with a non-identical control group before-and-after comparison, the control group received a traditional curriculum with only classroom lessons and no flipped learning. In contrast, the experimental group received flipped learning lessons using pre-learning video content created by the instructor and uploaded to the LMS (Learning Management System) as TABLE 1.

TABLE I. Flipped learning plan based on Bloom's Taxonomy

Area	Traditional Class (Control group)	Flipped Class (Experimental group)
Remember	Face-to-face lecture	Pre-learning lecture video (about 30 min.) Face-to-face lecture
Understand	Face-to-face lecture	LMS, Padlet Face-to-face lecture
Apply	Hands-on programming training	Hands-on programming training
Analyze, Evaluate, Create	Project work	Project work

For the experimental study, the control and experimental groups were given the same study time, content, test difficulty, assignment content, and number of assignments.

IV. Result

The academic achievement results of the lower and higher-level items of the test of the control group and the experimental group showed a statistical difference as indicated in TABLE 2.

TABLE II. Comparison of Academic Achievement

Learning level	Group	*N*	Mean	SD	*t*	*p*
Lower-level	Control	40	27.00	13.39	2.108*	.038
	Experimental	40	32.27	8.44		
Higher-level	Control	40	16.20	11.66	2.648*	.010
	Experimental	40	22.08	7.81		
Total	Control	40	43.20	23.57	2.581*	.012
	Experimental	40	54.35	13.82		

* $p<.05$

In particular, the scores of the experimental group were significantly higher in the higher-level items compared to the lower-level items, aligning with the goal of flipped learning, which is the achievement of higher-level learning objectives. As academic achievement significantly improved in the entire test and in all lower and higher-order items, it can be concluded that flipped learning-based AI education has a positive impact on enhancing academic achievement.

V. Discussion and Conclusion

This experimental study showed that the application of the flipped learning method in AI education for young job seekers improved academic achievement in both lower and higher-level items measured by the test. In a traditional classroom, lower-level learning, which corresponds to memory and comprehension in Bloom's Taxonomy, takes place face-to-face between the instructor and the learner, so the instructor can immediately identify the learner's level of understanding and adjust the difficulty and pace of the lecture to the learner. On the other hand, the memory and comprehension learning that occurs in flipped learning is replaced by pre-made videos, which makes it difficult for instructors to identify learners' needs in real time. Despite these disadvantages, flipped learning is a self-paced learning method that allows young adult learners with diverse backgrounds and prior knowledge to learn the basics of retention and comprehension at their own pace outside of the classroom. In addition, learners can engage in meta-learning, where they can learn at a higher level through online collaboration tools outside the classroom, group activities in the classroom, and questions and answers with the instructor, which is a strength of flipped learning that is difficult to achieve in traditional classrooms with limited class time.

Since this study was conducted with a relatively small sample size, consisting of 40 individuals in each group (control and experimental) for both majors and non-majors, totaling 80 participants, it is essential to conduct multiple iterations of experimental research in the future. This will allow for the analysis of effectiveness based on results from a larger and more diverse population.

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REFERENCES

[1] B. L McCombs and J. S. Whisler, "The Learner-Centered Classroom and School: Strategies for Increasing Student Motivation and Achievement. The Jossey-Bass Education Series," Jossey-Bass Inc., Publishers, 350 Sansome St., San Francisco, CA 94104, 1997.

[2] L. W. Anderson and D. R. Krathwohl, "A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives: complete edition," Addison Wesley Longman, Inc, 2001.

[3] A. Nederveld and Z. L. Berge, "Flipped learning in the workplace," Journal of Workplace Learning, 27.2. pp. 162-172, 2015

[4] J. W. Baker, "The origins of "the classroom flip"", The First Annual Higher Education Flipped Learning Conference, Greeley, Colorado. 2016.

[5] J. Bergmann and A. Sams, "Flip your classroom: Reach every student in every class every day," International Society for Technology in Education, 2012.

[6] J. F. Strayer, "Designing instruction for flipped classrooms," in Instructional-Design Theories and Models, vol. IV. Routledge, pp. 321-350, 2016.

[7] J. Bergmann and A. Sams, "Flipped learning: Gateway to student engagement," International Society for Technology in Education, 2014.

