11th International Conference on Higher Education Advances (HEAd'25)
Universitat Politècnica de València, València, 2025
DOI: https://doi.org/10.4995/HEAd25.2025.20223

Study habits of university students in an AI-driven math bridging course

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How to cite: Buot, Jude C.; Garcia, M. L. B.; Guzon, A. F. H. (2025). Study habits of university students in an AI-driven math bridging course. In: 11th International Conference on Higher Education Advances (HEAd'25). Valencia, 17-20 June 2025. https://doi.org/10.4995/HEAd25.2025.20223

Abstract

Traditionally, students having difficulty in coping with the academic demands of university student life undergo coaching or mentoring by a teacher. This study, which is part of a larger ongoing research about the integration of an adaptive learning system (Assessment and Learning in Knowledge Spaces or ALEKS) in mathematics bridging courses, sought to examine the study habits of probationary first year university students required to enroll and pass these courses. The researchers administered oral interviews to four participants in the said courses. Findings from the data revealed that the students found ALEKS to be beneficial to their study habits as they found it convenient and accessible when it comes to preparing for tests and giving immediate and helpful feedback. Moreover, the built-in features of ALEKS not only assisted them in understanding the topics in the course but also helped them in accomplishing assigned tasks efficiently.

Keywords: *Adaptive learning system, ALEKS, math bridging course, study habits, university students.*

1. Introduction

It is a reality in the Philippines that some students who are admitted into higher education are less prepared to handle the demands of academic work in the university. Hence, some universities opt to offer accommodations for students in such cases (e.g., probationary status). For example, in the locale of the study, students who aim to major in management courses face the challenge of taking two calculus courses in their first year. An even greater challenge for those on probation would be to reach the academic standard of the university as this would cost them their formal admission.

University students with low admission scores in mathematics are required to enroll and obtain a satisfactory mark in two 3-unit bridging courses during their first year that cover topics typically discussed in high school level mathematics. These bridging courses are designed to ensure that the students are better prepared in taking university-level mathematics courses.

Underperformance in academic achievement is often linked with differences in the ways that students respond to instruction and pedagogy. In traditional classrooms, teachers are expected to cater to students with varying aptitudes and learning styles. However, due to different limiting factors such as the pressure of complying with directives and timetable imposed in the university academic calendar, teachers tend to prioritize coverage of the curriculum over giving timely and personalized feedback during assessments and attending to individual needs of their students in general.

Thus, in this study, the authors are interested in investigating the study habits of the current cohort of 1st year university students taking the mathematics bridging courses in School Year 2024-2025. Hence, they seek to answer the following research questions: (1) How do students integrate ALEKS when studying mathematics? (2) How do the study habits of students differ pre-exposure and post-exposure to ALEKS? With this study, it is hoped that the results will inform departmental-level policies regarding the continued use and implementation of ALEKS and/or similar artificial intelligence or AI-powered learning platforms. On a larger scale, results will help provide insights to departments in the same or other universities in their pursuit of integrating AI in university instruction.

2. Review of Related Literature

Park and Lee (2004) define adaptive instruction as “educational interventions aimed at effectively accommodating individual differences in students while helping each student develop the knowledge and skills required to learn a task" (p. 651). With the diversified needs of students in a digital age, there is a growing demand for technological software and applications that aim to provide personalized instruction. More teachers are becoming aware of the application of such tools in education and their affordances. This phenomenon has been described in Mishra and Koehler’s (2006, as cited in Graham et al., 2012) technological pedagogical and content knowledge (TPACK) framework. Theoretical frameworks about the use of technology or AI with the teacher as the center of pedagogy are abound. The use of AI in classroom settings can be classified as AI-directed, AI-supported, and AI-empowered (Ouyang & Jiao, 2021, as cited in Mohammed et al., 2022), which show the levels in which learners engage with AI, ranging from receiving AI-driven instruction to collaborating with AI, and ultimately leading their own learning. Data from Mohammed et al. (2022)’s systematic literature review also show a growing number of research investigating the use of AI in mathematics education. The incorporation of AI in education is a testament to a paradigm shift in education, away from the traditional “one size fits all” style of instruction for groups of students and addresses the students' varying learning needs, pace, and unique thinking capabilities as mentioned in Srinivasa et al. (2022).

One of the increasingly used adaptive learning systems or platforms is ALEKS, which stands for Assessment and Learning in Knowledge Spaces. Cosyn et al. (2021) describe ALEKS as a web-based intelligent tutoring system based on the Knowledge Space Theory, which is founded on the idea that a learner transitions from one knowledge state to another across a knowledge space. Additionally, each knowledge state is defined by a particular set of items that a learner is capable of answering correctly. McGraw Hill (2025) claims that it is the most effective adaptive learning program to date, offering Mathematics, Chemistry, and Statistics courses. ALEKS employs adaptive learning and assessment, adjusting item difficulty based on students' responses and guiding them through cycles of learning and evaluation until they reach a satisfactory level of mastery (Cosyn et al., 2021). While ALEKS personalizes the learning experience, instructors can fine-tune the system by selecting specific items, ensuring alignment with instructional goals and student needs (ibid.).

The use of ALEKS in instruction and/or assessments is not entirely new as it has been introduced as a supplement to traditional assessments and/or intervention to student learning in the past few years. A testament to this is the meta-analysis conducted by Fang et al. (2018) on studies related to the effectiveness of ALEKS on learning. Their findings seem to reveal neutral results such as: (1) that the use of ALEKS in instruction does not differ much from traditional instruction as it only has a very small positive effect on student learning; (2) that the learning efficacy is relatively comparable across different levels of education of the learners; (3) that the effectiveness of ALEKS on learning does not differ whether it was used for principal or supportive instruction; and (4) that there is no significant difference between the learning outcomes of those who were tested using instructor-designed tests and of those using standardized tests. However, in the same study, it is interesting to note that ALEKS was more effective when it was used for a semester as compared to when used for a year.

As for the use of ALEKS in specific subject matters, there are existing studies documenting recent applications in mathematics and chemistry. A meta-analysis by Sun et al. (2021) noted positive effects of ALEKS on students' learning, specifically in studies whose research design involved the use of ALEKS ranging from 4 weeks to 1 school year. Two other moderating variables that they identified were pedagogical use and student characteristics (e.g., gender, race/ethnicity, level of education). On the other hand, Harati et al. (2021) revealed a rather contrasting set of results among students in chemistry courses using ALEKS for four months. They detected a significant decline in the self-regulated learning skills of students, which they claimed to be linked with lack of motivation and social presence. Finally, Craig et al. (2013) discussed the implementation and impact of ALEKS as an intervention in a 25-week after-school program for Grade 6 students struggling in mathematics. They found that students who interacted with ALEKS obtained equal or higher scores in terms of math performance, conduct and involvement than those who were in the teacher-led classrooms. While the difference among mean scores is not found to be statistically significant, the authors have reason to believe that there is value in the use of ALEKS in after-school intervention programs due to the decreased amount of assistance needed by students. In terms of study habits, some literature sought to establish links between study habits and mathematics achievement (see Odiri, 2015; Verma et al., 2022).

3. Methodology and Findings

There were 73 students who took the mathematics bridging course in the university for SY 2024-2025, and all of them were invited to participate in this study. The population consists of students with varying ability levels based on their final math grade in the previous semester. Of these 73 students, 23 had grades less than 50% (below passing), 49 had grades between 50% to 86% (moderate), while only one student obtained a grade above 86% (high). There were 32 students who agreed to participate in our study, but only nine agreed to be interviewed about their experience in using ALEKS. However, due to scheduling constraints, the data gathered for this manuscript consisted of interview transcripts from only four students. All four of them have a moderate ability level.

The interview questions were about the changes in their study habits prior to and during their use of ALEKS in their mathematics bridging course. The interviews were conducted by pairs, and on-site. Analyzing the interview transcripts gave rise to four emergent themes, which are as follows: (1) ALEKS makes it convenient and accessible for students when it comes to preparing for tests; (2) ALEKS has unique built-in features which assisted them in understanding the topics in the course; (3) ALEKS provides immediate, accurate, and meaningful assessment feedback; (4) ALEKS provides a form of structure as to when they need to study math and accomplish the tasks. These themes shall be expounded in the succeeding paragraphs.

The mathematics bridging course is situated in a computer laboratory with university-provided laptops. This set-up allows students to access ALEKS at any point during classroom instruction. During the interviews, students also said that they access ALEKS using their personal laptops and smartphones. When accessing ALEKS via their smartphones, they either go to the ALEKS website, open the ALEKS application, or through the university's official learning management system. These varied options present students the opportunity to study math and continue doing the modules in ALEKS, especially before scheduled ALEKS quizzes, and even outside of their usual study spaces (i.e., home).

The students found the following features of the ALEKS interface beneficial as they studied mathematics: the built-in "dictionary", and the review button. Whenever the students answer items generated by ALEKS, they are sometimes provided with a short discussion that would help them answer the item. In the discussion page in ALEKS, students are provided with definitions of mathematical terms (by clicking or hovering the word or phrase) that they can access at their convenience. On the other hand, the review button allows students to go back to the past questions (including the explanation to the correct answer) given to them by ALEKS. This even includes the items where they committed mistakes, thereby allowing students to rationalize their mistakes. Because of this feature, the students were able to go over what they have learned over the course of the module to help them recall what is necessary for the test.

The students felt that ALEKS works best with them because of its ability to provide immediate feedback, especially right after answering ALEKS-generated items. Such functionality is shared by AI-powered educational tools. In particular, ALEKS keeps track of student performance and is able to produce real-time reports and helpful student metrics, such as the ALEKS pie progress which comprise the topics chosen by the instructor for the course. Mastering all topics in the modules would mean getting a score of 100% in the ALEKS pie. As the student progresses through the course, ALEKS quantifies each student's progress by displaying the percentage of topics learned and mastered. During the interviews, the students felt that this numerical representation accurately depicts their performance. In fact, their personal assessment of their performance concurs with what ALEKS has shown. The students have mentioned in their accounts that such metrics motivate them to study, as the amount of time that they have spent is proportional to the amount of topics in the module they have yet to learn.

The students shared that they plan their study schedule based on the metrics available on the ALEKS interface. Whenever an ALEKS quiz is scheduled, the students ensure that they accomplish the necessary module a few days before the quiz. Additionally, they dedicate a few hours (usually on the day prior to the quiz) reviewing using the review button in ALEKS. The students also note that because of how ALEKS grades their performance (e.g., right minus wrong system), they needed to adapt strategies to progress faster. For instance, this system encouraged them to answer consecutive items correctly, as much as they could, avoid being penalized even for committing mistakes intermittently. This is because accumulating errors signals ALEKS to augment more items or subject them to repeating the requisite topics, to improve their proficiency. As an adaptive learning system, ALEKS adjusts the length and difficulty of items based on how the student answers questions on ALEKS. Additionally, since ALEKS quizzes are taken from the same pool of questions, students are compelled to finish the modules beforehand. All of these described behaviors related to the students' study habits may have been influenced by the design of ALEKS.

4. Conclusion

Exploring an AI-driven mathematics bridging course is significant because it exposes how the dynamics between teacher and students are reshaped, with students' study habits proving to be a good starting point. Credé and Kuncel (2008) argue that study habits act as a third pillar of academic success among college students, in addition to skills and attitudes. In the context of this study, students' study habits warrant attention most especially that the mathematics bridging courses have been intentionally designed to gauge students' preparedness and train them for university-level mathematics.

From the narratives shared by the participants during the interviews, it can be gleaned that students relied on ALEKS as their single, primary online source of content and sample exercises in preparation for their quizzes. Because of immediate feedback and quantitative metrics generated by ALEKS, students become more motivated to study and finish their tasks on time. In addition, the researchers found three notable changes in students' study habits before and after the use of ALEKS. First, because of the accessibility of using ALEKS with any gadget, students felt the flexibility in scheduling their study time with mathematics and their choice of physical study spaces. Second, because of immediate and relevant feedback on their answered exercises, their use of ALEKS appeared to provide closure to the feedback loop in their learning process. Lastly, their learning of mathematics, especially their out-of-classroom activities, became partially guided by AI-based diagnostics and recommendations.

These changes in study habits correspond to some of the categories of self-regulated learning (SRL; Zimmerman & Schunk, 1989) strategies that university students develop when using technologies. In the work of Yot-Domínguez and Marcelo (2017), which proposed an instrument that identifies and categorizes students' use of technology in relation to cognitive, metacognitive, and resource management strategies for self-regulated learning, these changes correspond to Factor 7 (Personal Management) and Factor 8 (Self-Evaluation). These findings suggest that the integration of AI-based learning tools like ALEKS may play a significant role in fostering and supporting students' development of self-regulated learning behaviors in digital environments.

In this regard, the authors recommend the integration of AI-powered educational tools such as ALEKS in mathematics bridging courses. The findings in this study are crucial because skills-based courses, like mathematics, require repetitive practice, which is reinforced by external prompts from ALEKS.

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