An Attitude Paradox? Examining Ability Beliefs and Persistence Intentions in a Middle School Conversational AI Learning Experience

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Abstract. As AI education expands in K-12 classrooms, there is a growing need to understand how AI learning experiences shape students' motivational and affective orientations toward AI. *Ability beliefs* and *intentions to persist* are key constructs in AIED because they influence learners' engagement in learning environments and continued participation. This study examines how a project-based AI learning experience affected these outcomes among middle school students. Ninety students completed a 10-hour AI module embedded within their science classes, in which they learned foundational AI concepts and designed conversational AI agents. Pre- and post-survey analyses showed increased ability beliefs but decreased intentions to persist in AI learning. This divergent pattern suggests a complex motivational response to hands-on AI instruction, indicating that gains in perceived competence do not necessarily translate into sustained persistence intentions. We discuss implications for the design of AI learning environments and for theoretical models of motivation and engagement in AI-supported learning contexts.

Keywords: Artificial Intelligence Education · Attitudes · Ability Belief · Intention to Persist · Conversational agents.

1 Introduction

AI education has been expanding across various educational levels, particularly in K-12 classrooms [23]. Many initiatives and research efforts have focused not only on recognizing and understanding AI but also applying and engaging with AI [22,27]. In K-12 classrooms, integrating AI learning into established subjects, such as science, has emerged as a promising way to introduce AI and enhance learning [15,20,28]. For example, in Singapore, machine learning was introduced in science classes, where students built models to predict scenarios like solar energy feasibility on Mars, fostering skills in data interpretation and modeling [16]. In the U.S., middle school students used natural language processing (NLP) to analyze social media sentiment on environmental issues, linking AI-driven analysis with scientific inquiry [8]. In Nigeria, AI tools supported self-directed learning in environmental science, allowing students to explore complex scientific concepts independently [14]. In South Africa, AI-driven simulations in STEM education enabled students to investigate chemical reactions in virtual labs, enhancing engagement and understanding [6]. These examples demonstrate the potential of integrating AI learning into existing STEM subjects to foster STEM-related skills.

While these integrations show promise, there is very limited research on how such experiences influence students' self-perception of their abilities in AI and their intention to persist in AI-related learning. Research on the impact of AI learning has primarily focused on short-term engagement and on students' learning outcomes [19,1], and there is a lack of empirical studies on how AI learning experiences affect attitudinal outcomes [18]. As such, more empirical studies are needed to provide a deeper understanding of how students' attitudes toward AI might change, and of factors that maintain a sustained interest in pursuing future STEM opportunities.

To address this gap, this paper explores the changes in middle school students' ability beliefs and intention to persist in AI before and after a project-based AI learning intervention in the classroom. In the study, we first delivered a 10-hour AI learning module that introduced students to concepts of AI and conversational agents (chatbots) in their science classrooms, and then students collaborated in pairs to develop a science-themed chatbot using a learning environment to create conversational agents [22]. To understand how participation in AI learning experiences shapes students' attitudes toward AI, we ask the following research questions:

1. To what extent do middle school students' ability beliefs in AI change after project-based AI learning in science class?
2. To what extent do students' intentions to persist in AI learning change after the AI classroom intervention?

We answer these research questions by reporting pre-to-post survey results from 90 students. This study contributes to AIED research on the motivational dimensions of AI learning and can inform the design of AI learning environments that support both competence development and sustained engagement.

2 Related work

Prior work in STEM, computing, and AI education has examined how instructional interventions influence students' motivational outcomes, particularly their perceptions of competence and their willingness to continue learning[9,12]. Studies have shown that computing and AI learning experiences can improve students' confidence and persistence-related attitudes [29,12,9,7], and that engaging learners in meaningful AI projects can support interest development and engineering identity [27,30].

Among the motivational constructs studied in this literature, *ability beliefs* and *intention to persist* in learning have been identified as important predictors of long-term participation in STEM [4,24]. *Ability beliefs* are defined as "an individual's perception of their current competence at a given activity" [26, p. 70]. Stemming from relevant theories, such as expectancy-value theory [26], motivation theory [25], and self-determination theory [2], ability beliefs are closely connected with the constructs of confidence, self-efficacy, and self-concept [10,17]. *Intention to persist* in learning captures learners' willingness to continue engaging over time and has been linked to students' actual persistence in computing courses enrollment [5] and their career choice [4]. Magerko and colleagues set "intent to persist in computing" as one of the learning outcomes of their CS education program, along with computational knowledge [12].

However, the relationship between students' ability beliefs and their intention to persist is not consistently positive. Some studies report that stronger competence beliefs predict greater intention to choose STEM majors in college [24], others find weak or inconsistent associations [21], suggesting that other factors, such as classroom environment and social influences, may play a more substantial role [13]. Recent work in AI and computing education further indicates that increases in perceived competence may coincide with stable or declining interest or persistence, as students become more aware of task difficulty, system limitations, or societal risks [30,11,21]. From an expectancy-value perspective, such patterns may reflect shifts in perceived task value or cost despite gains in expectancy for success [26].

This body of related work suggests that ability beliefs and intention to persist are usually positively correlated but may also diverge during STEM learning experiences. Yet, there is little evidence about how these constructs co-evolve in classroom-based AI interventions embedded within disciplinary learning, such as science. The present study addresses this gap by examining changes in students' ability beliefs and intention to persist following an "AI+science" learning intervention.

3 Methods

3.1 Middle School AI+Science Learning Module

The study was conducted in spring 2024 at a public middle school in the southeastern United States in collaboration with a science teacher. The AI learning module was aligned with course standards, and the study was approved by the university ethics board with parental consent and student assent.

Students were introduced to core concepts of AI and conversational agents through a science-integrated curriculum. On Day 1, students completed a presurvey measuring ability beliefs and intention to persist in AI. From Days 1–4, students learned AI concepts and engaged in hands-on practice using a chatbot development environment, AMBY, designed for middle school students creating chatbots without writing codes [22](Figure 1). From Days 5–8, students worked in randomly assigned pairs to design and develop science-themed chatbots by defining intents, training phrases, and responses. On Days 9–10, students completed a post-survey and assessment and participated in interviews. This paper focuses on changes in students' attitudes between the pre- and post-surveys.

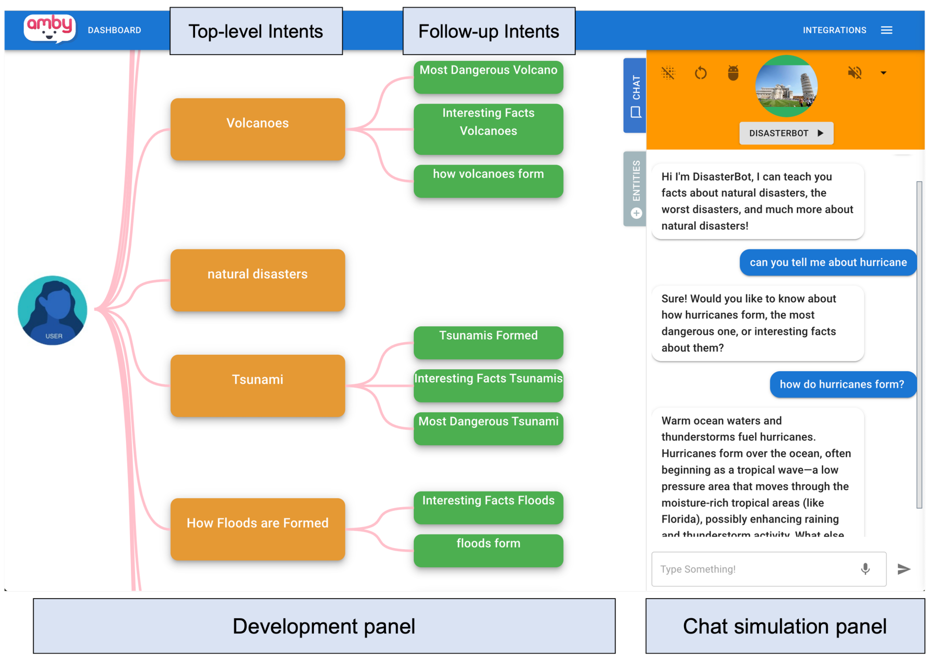

Fig. 1: The interface of the chatbot development environment AMBY.

3.2 Participants

The science teacher we partnered with has 128 students across six class periods, with 100 consenting to participate in the research. In the post-survey, 97 participants provided demographic information. Of these, 49 identified as girls, 46 as boys, one as non-binary, and one preferred not to disclose their gender. The racial and ethnic composition was diverse: 38 identified as Asian, 34 as White, 20 as Black or African American, 6 as Hispanic or Latinx, 5 self-identified with other categories, 3 as Native American, and 3 chose not to disclose. Participants could select more than one race or ethnicity. The average age of participants was

11.7 years (SD = 0.48). Regarding language background, 87% identified as native English speakers. Additionally, 54% reported speaking at least one heritage language at home while 46% were monolingual English speakers.

Fig. 2: Students Collaborate on AI Chatbot Development

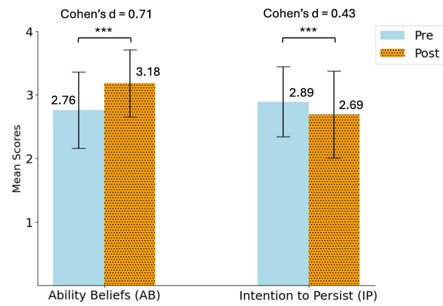

Fig. 3: Participants' (n = 90) attitude change

3.3 Attitude Outcome Measurements

The pre- and post-survey are used in this study to evaluate students' attitudes toward AI. The two constructs of *ability beliefs* (AB) and *intention to persist* (IP) were adapted from the BASICS-SQ questionnaire [3], measured on a 4-point Likert scale. The AB construct assessed students' perceptions of their competence in understanding and applying AI concepts, which included three items: "I know enough about artificial intelligence (AI) to make a chatbot on my own," "I am confident that I can understand AI," "I can figure out how to solve hard AI problems if I try." The IP construct measured students' motivation to continue engaging with AI, using four items: "I would like to learn more about AI in the future," "I would like to join an AI club," "I think I could do work in AI when I grow up." and "I would like to take a class in AI." Both constructs are assessed for reliability with Cronbach's Alpha of 0.714 for AB and 0.838 for IP. A total of 92 students completed the pre-questionnaire; 97 students completed the post-questionnaire; and 90 students provided both pre- and post-data. We include those 90 students in the following analysis.

4 Results

To investigate students' attitude change after the classroom intervention, we conducted a paired-samples t-test comparing the composite scores from each construct in the pre- and post-responses. Figure 3 shows the results. For ability beliefs, the mean score increased from pre-intervention (M = 2.76, SD = 0.60) to post-intervention (M = 3.18, SD = 0.53), showing a significant improvement,

$p < .0001$, with a large effect size ($d = 0.71$). In contrast, for intention to persist, the mean score decreased from pre-intervention (M = 2.89, SD = 0.55) to post-intervention (M = 2.69, SD = 0.68), which was also statistically significant, $p < .0001$, with a medium effect size ($d = 0.43$). A subsequent Pearson's correlation analysis on the pre-to-post change score showed no significant correlation between ability beliefs and intention to persist ($r = .023$, $p = .834$).

5 Discussion and Conclusion

Research in computing education generally suggests that students' beliefs in their abilities are positively related to their intention to persist in learning [4,24]. However, our study suggests a potential attitude paradox: students reported stronger beliefs in their ability to understand AI concepts and create AI applications after the intervention, yet expressed lower intention to pursue further AI learning. This pattern may reflect how students' motivational appraisals evolve as they gain more authentic experience with AI systems. Similar patterns have been observed in computing education, where instruction can increase perceived competence while decreasing interest or persistence [21,30].

According to expectancy-value theory, persistence is determined not only by learners' expectancy for success (i.e., ability beliefs), but also by their subjective task value and perceived cost [26]. Although our intervention appears to have strengthened students' expectancy for success with AI, it may also have altered their valuation of the domain. As students learn more about the complexities underlying AI, such as generating training data, debugging incorrect AI responses, and interpreting intent classification, they may have recalibrated their perceptions of effort, difficulty, or utility [11]. This interpretation aligns with findings from prior work showing that more demanding or error-prone learning experiences can reduce enjoyment even when learning improves. For example, teaching agents through natural language has been found to be less enjoyable than simpler interaction paradigms due to increased frustration and effort [11]. Similarly, AI project-based activities that foreground system limitations may reduce the novelty or perceived "magic" of AI, shifting motivation from fascination toward effort-based judgments [21,7].

This pattern can be explained by broader developmental trends in K-12, where students' ability-related beliefs tend to decline, with their expectations of success and persistence in each subject area diminishing over time [26]. AI, as both a popular media topic and a novel learning experience, could present unique challenges for students; they may start to view it as comparable to other challenging STEM subjects. Further research is needed to more deeply illuminate the factors in this phenomenon and the extent to which it is observed across contexts.

Overall, our findings contribute to AIED research by highlighting the importance of examining how motivational constructs co-evolve during project-based AI learning experiences. From a design perspective, this suggests that AI learning environments should not only scaffold technical understanding but also explicitly address students' affective experiences, including frustration, perceived difficulty, and relevance to personally meaningful goals [26,22].

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