

The Effects of Integrating Artificial Intelligence in an ITC E-learning Course

Executive summary

The SME Trade Academy (SMETA) of the International Trade Centre (ITC) conducted a pilot course in Q4 2024 to evaluate the **impact of integrating AI** in an asynchronous e-learning course. Inspired by Bloom's "2-Sigma Problem," which demonstrated the increased effectiveness of one-on-one tutoring over "standard" classroom teaching, the pilot sought to determine whether **AI-driven personalized feedback** could improve learner outcomes, compared to "traditional" e-learning.

The AI pilot saw **improvements in learner engagement**, although **completion rates were lower** than traditional SMEA courses, likely due to the increased difficulty and cognitive load of AI-powered questions. That said, quantitative and qualitative analyses revealed notable benefits of AI integration. While **AI-powered questions increased course completion time**, they significantly **enhanced learner engagement, motivation, and conceptual understanding**. **Participants appreciated the AI's personalized feedback**, which helped refine their responses. The **AI-powered forum facilitated discussions**, while the **AI Tutor functionality provided immediate clarification in case of questions**.

Despite lower completion rates, those learners that did engage with the content demonstrated knowledge improvement across modules, suggesting that AI-driven mastery learning is effective. Moving forward, **SMETA plans to gradually implement AI Tutors and Moderators across its courses while reserving AI-graded questions for advanced learners**. The findings indicate that AI can enhance personalized e-learning but must be tailored to different learner profiles to maximize inclusivity and impact.

Introduction

The **SME Trade Academy (SMETA)** is a section of the International Trade Centre (ITC), a joint agency of the United Nations and the World Trade Organization, that develops and delivers online learning and various other digital training solutions to ITC's beneficiaries (businesses, entrepreneurs, trade-support institutions, government entities), mostly in the fields of international trade and entrepreneurship.

From September 23rd to October 20th, 2024, **SMETA delivered an "AI-powered" pilot course** to 438 active registered learners. An existing SMETA online course, "Raising Funds for Your Business"¹ was chosen for this, and enhanced with 3 AI "personas" (see below), as well as 9 AI-powered questions.

Its aim was to assess the effect of AI integration **on learning outcomes, learner satisfaction, completion times and completion rates**, when applied to an asynchronous e-learning course delivered via a Learner Management System (LMS). More specifically, the objective lay in seeing whether "**mastery learning techniques**, whereby a learner is made to repeat the same task and given personalized feedback to help them until they reach a certain level of proficiency, could be replicated online using an "AI Tutor."

Section 1: Background and Objectives

1. Educational Context

i. *The 2-Sigma Problem*

In 1984, educational psychologist Benjamin Bloom published a now-famous report in the Educational Researcher Journal. Entitled "The 2-Sigma Problem," it identified a phenomenon whereby **average students tutored one-to-one using mastery learning techniques** performed two standard deviations ("2-sigma") better than students educated in a traditional classroom environment. As quoted by Bloom, "*the average tutored student was above 98% of the students in the control class.*" The famous "problem," then, involves finding methods of group instruction capable of replicating, or even approaching, the identified 2-sigma effect.

ii. *The effectiveness of LMS-based e-learning*

In the 21st century, asynchronous e-learning delivered through LMS has made great strides in replicating the effectiveness of offline classroom environments.² However, providing online learners with **timely personalized feedback** and **adaptive learning features** has been difficult. Bloom's mastery learning techniques have proven especially hard to replicate online, particularly in asynchronous settings. Like so many new training methods, it seemed until now that LMS-based e-learning would also fail to tackle the 2-Sigma Problem in any meaningful way.

¹ Raising Funds for Your Business: <https://learning.intracen.org/course/info.php?id=1007>

² See, for example: Bell, B. & Federman, J.E.; Cornell University: Center for Advanced Human and Resource Studies – [How Effective is E-learning Relative to Traditional Learning?](#) January 2013; and Meng, W. et al.; Digital Education: [A Systematic Review of the Effectiveness of Online Learning in Higher Education During the COVID-19 Pandemic Period](#) January 2024

2. Design of the Pilot

AI presence in the course was divided into **three “personas,”** each with a separate role. How to effectively interact with all 3 AI personas was repeatedly communicated to learners during the pilot through a [video](#), as well as via text instructions before each AI-powered question.

i. Persona 1: The AI Tutor

The AI Tutor consisted of a small blue button present permanently on the bottom right of the screen. Learners could access the tutor at any time by clicking on this button, upon which it expanded to reveal a chatbot available to answer any questions having to do with the course’s contents. Importantly, questions on other topics were refused.


Example of interaction with the AI Tutor



ii. Persona 2: the AI Moderator

The AI moderator intervened solely in the course’s forum. Its role was twofold: first, it provided detailed replies to any learner posts. Second, after a set interval, it generated a pinned post summarizing forum contributions so far, thus helping to synthesize thoughts and making it easier for recent forum participants to join in.

Example of summary post by the AI moderator

 **Post by ITC AI Moderator** -, -Monday, 23 September 2024, 8:08 AM 248 Words

Summary of posts on: 14/Oct/2024

It's been really insightful reading through all the posts! I appreciate how contributors like **Fr [redacted] o** and **Th [redacted] s** have provided a comprehensive overview of capital providers in their regions, highlighting both traditional and alternative funding sources. It's clear that SMEs across different countries face similar challenges when it comes to raising funds, particularly around financial management and preparation.

I'd love to dive deeper into some of these issues:

- **For those who mentioned poor financial records as a common mistake (e.g., To [redacted] i from Zimbabwe or Na [redacted] e from Antigua & Barbuda)**: What are some practical steps SMEs can take to improve their record-keeping? Are there any tools or software you've found helpful for small businesses?
- **For [redacted] e** raised an interesting point about cultural resistance to equity financing in Nigeria. How do we overcome this challenge? Could educating business owners on the benefits of shared ownership help them see equity as less risky than debt?
- Several contributors like **Ra [redacted] m** pointed out the issue of mismatching short-term funds with long-term projects. For those who have experienced this firsthand, what strategies would you recommend for ensuring better alignment between funding types and project needs?


Looking forward to hearing more thoughts on these points—let's keep learning from each other!

iii. Persona 3: the AI Grader

The final test of the course was removed and replaced with 9 short essay questions placed at the end of each of the modules' sections. Learners were given a total of **3 attempts** to answer each question. Each was given a **grade out of 5**, with a **4/5 considered a "pass"**. A minimum grade of **9/15 (60%)** was required to pass each module. All grading was done entirely by the AI Grader persona, based on an objective grading scheme.

After each attempt, learners received feedback from the AI Grader, orientating them on ways to obtain a higher grade – a replica of the mastery learning techniques detailed by Bloom. After the third attempt, the question was considered "closed"; learners were no longer able to submit further attempts, and the AI Grader provided them with the correct answer, whether they had obtained a passing grade or not.

Example of interaction with the AI Grader

 Consider the following case study. Then, explain which financing instrument would be most appropriate for the company and why.

Case study: GreenFuture AgriTech

GreenFuture AgriTech is a start-up focused on developing sustainable agricultural technologies. The company has gained attention for its innovative methods that reduce water usage and increase crop yields. Having completed its product development phase, GreenFuture is now ready to scale its operations and enter new markets. To support this expansion, the company is seeking \$2 million in outside funding.

GreenFuture AgriTech projects strong growth potential, but as a start-up, it does not yet have stable cash flows. The company anticipates significant upfront costs in manufacturing, marketing, and distribution to bring its products to market. While the company is confident in its growth prospects, it recognizes the risks associated with scaling operations, especially given the uncertainties in the agricultural sector.

Which financing instrument would be most appropriate for GreenFuture AgriTech? Why?



Interaction history:

i would think the most appropriate financing instrument for GreenFuture AgriTech would be grant. this is because, it is a startup and about to expand. Grant is the most secure option and less risky provided the condition will not hinder the objective and vision of the company.

AI Grader

Your current attempt: 1 out of 3. While grants can be a good option for some start-ups, they are typically limited in availability and often come with specific conditions that may not align with GreenFuture AgriTech's needs to scale quickly. It might be helpful to review how GreenFuture AgriTech's costs are outlined and what risks are associated with scaling its operations in the case study... Hopefully this provides you with some hints of how to answer this question more fully. Please give the question another try!

Rated 1 / 5

GreenFuture AgriTech can also opt for Equity. This is getting investors to be a part of the company as shareholders. If for any reasons, profits are not made at the end of the year, dividends will not be shared and the business will still be running.

AI Grader

Your current attempt: 2 out of 3. You've correctly identified that equity is a suitable option for GreenFuture AgriTech, but your explanation could be clearer and more detailed. It might help to focus on why equity financing aligns with the company's need for flexibility during its growth phase, as well as how it avoids the burden of debt repayments. Hopefully this provides you with some hints of how to answer this question more fully. Please give the question another try!

Rated 3 / 5

GreenFuture being confident of her growth prospect, getting people to invest in the company in form of equity is the best decision. Also considering the level of uncertainty in agricultural sector, going into debt will be very risky because other unforeseen factors may affect the growth of the business and repayment plan.

AI Grader

Your current attempt: 3 out of 3. You've correctly identified that equity financing is the best option for GreenFuture AgriTech, especially given the uncertainties in the agricultural sector and the company's growth prospects. Your explanation about avoiding debt due to potential risks is valid and well-reasoned. However, you could further strengthen your response by elaborating on how equity investors share in both risk and reward without imposing immediate financial burdens on a growing company like GreenFuture AgriTech. This was your final attempt. You are now free to proceed to the next section of this module. If you would like to ask more questions or receive further clarification on this topic, please ask the AI tutor on the bottom right of your screen.

Rated 4 / 5

As the above screenshots show, participants were able to successfully:

1. Interact with the **AI tutor** to receive further assistance and clarification;
2. Express their thoughts and interact with the **AI moderator** on the forum; and
3. Gradually improve their answers to short essay questions based on the feedback and guidance given by the **AI grader**.

In the next section, we will look at the most salient pieces of data demonstrating these results.

Section 2: Quantitative and Qualitative Results

There were **438 active enrolled participants, from 100 countries across all five continents**. This reflects a broader trend for SMETA, for which over 80% of beneficiaries come from the Global South. **54% of enrolled participants were male, while 46% were female**, also reflecting broader SMETA trends. Interestingly, **participants aged 41 to 50 made up the largest number**, followed by participants aged 31 to 40, demonstrating an ability by middle-aged learners to effectively interact with and use AI in a learning context.

Over **40% of participants identified themselves as working in an SME**, with “consulting and services” the second-highest category at 13%.

1. Quantitative Pilot Results

i. Duration

AI-powered questions significantly increased the time required to complete the course. In focus group sessions, participants emphasized that completing took them between **8 to 10 hours**, as opposed to the standard SMETA course session time of 4 to 6 hours. In light of this, the course **length of the pilot was increased** from SMETA’s usual 2-week duration to a total of 4 weeks.

ii. Technical challenges

Despite the addition of AI, 98% of participants reported either no technical challenges, or minor challenges that they were able to resolve by themselves. This is in line with standard SMETA courses, indicating that **the AI personas did not add any technical burden for participants**. Interestingly, some participants even reported that the AI Tutor helped them through their technical challenges, which was an unintended benefit.

iii. Completion rate

Of the **438 participants** enrolled in the course, 86 completed it and 78 received a certificate (**19.6% completion rate**). This compares with an average completion rate for “regular” SMETA courses of approximately 40%.

Due to the large number of initial attempts, Module 1 had the lowest completion rate, at 36.1%. As fewer participants attempted the subsequent modules, Modules 2 and 3 had much higher completion rates (62.6% and 73.2%, respectively), indicating that **majority of participants who completed Module 1 also completed Modules 2 and 3**. This is a common trend for SMETA’s multi-module courses, with an initial interest quickly dropping off after the first module, but tapering thereafter.

iv. Grades

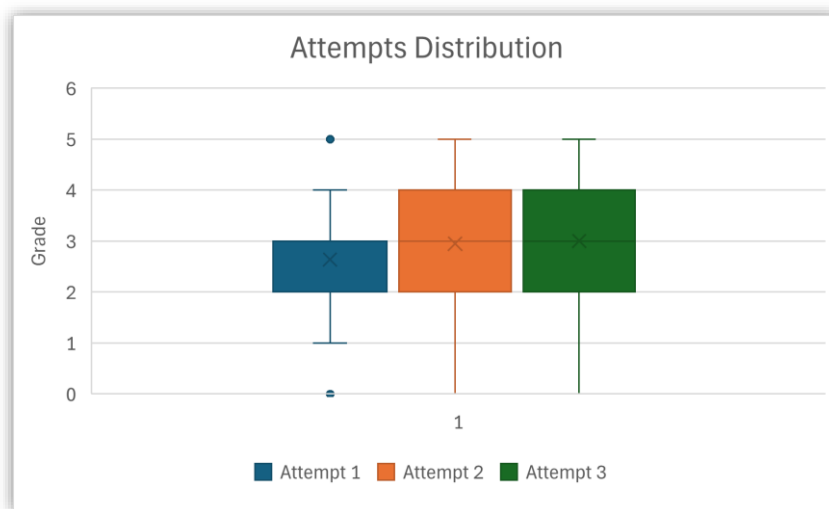
While the majority of participants received a passing grade (above 9/15) for all three modules, there is a steady progression from Module 1 to Module 3.

- **Module 1:** Average grade of 10.89
- **Module 2:** Average grade of 10.93
- **Module 3:** Average grade of 12.8

Such rising average grades from Module 1 to Module 3 suggest a cumulative effect, whereby participants' understanding and confidence improved over time.

v. *Progression and mastery learning technique*

One of the pilot's main objectives lay in testing the ability of AI to replicate the "mastery learning technique" crucial to the 2-sigma effect identified by Bloom. **Examining learners' answers to each AI-powered question shows a clear progression in the quality of their answers after each attempt.** This strongly suggests that the feedback provided to the learners by the AI Grader persona was effective in improving their understanding of the issues presented. The graphs below showcase the attempt distribution for all 9 AI-powered questions included in Modules 1, 2 and 3.



In fact, the **improvement recorded individually was greater than represented on the graph.** This is due to the fact that the majority of participants responded correctly in their first attempt, with only 1/3 using all 3 attempts. Thus, what we are seeing is a **"filtering effect" whereby high performers "filter" themselves out after the first attempt**, with remaining participants being those who truly struggle with the material. The drop in median and mean grades in later attempts (especially in Questions 2 and 3) reflects this filtering rather than a failure of the learning process.

2. Qualitative Pilot Results

82 participants completed the course evaluation. In addition, after the course concluded, two focus group discussions were held with 10 participants, providing them with an opportunity to share additional feedback. Specifically with regard to the use of AI, the results are as follows:

Many participants reported feeling "coached" throughout the course. One participant shared, *"The AI-powered system allowed for a dynamic and conversational learning process, making the experience feel more like a personalized coaching session than a traditional online course."*

Several participants were motivated to get a passing grade to progress. The grading criteria pushed them to refine their answers and strive for better results. *"I was motivated to get at least a 4 to move on from AI questions. It was a bit intense for me but a good learning experience,"* one participant remarked.

The supportive nature of the AI tutor and the chance for immediate improvement helped create a collaborative and motivating environment. Participants valued the guidance and felt

encouraged to actively participate. *“The feedback from the AI Grader and the support from the AI Tutor further encouraged me to actively participate and strive for improvement.”*

i. Feedback on AI Grader

Participants highlighted the following in terms of their interactions with the AI Grader:

Clarity and insightful guidance: Many participants appreciated the clarity of the feedback, which helped them better understand the concepts. For example, one participant stated, *“The AI Grader provided well-structured, easy-to-understand explanations that broke down complex concepts like capital providers, negotiation strategies, and due diligence.”* Another noted, *“The feedback from the AI Grader jogged my memory to remember what I had learned and helped me add depth to my answers.”*

Enhanced engagement: Many participants noted that the AI-powered questions made the learning experience more engaging by prompting critical thinking and reflection on course concepts. One user mentioned, *“The AI-powered questions have significantly increased my engagement with the course material.”* While another said, *“AI-powered questions...promote engagement, provide immediate feedback, and encourage critical thinking.”*

Real-time and tailored feedback: The real-time aspect of the AI Grader was frequently praised for allowing participants to make immediate adjustments. Another participant shared, *“The real-time feedback helped address my doubts immediately, keeping the learning momentum strong.”* The personalized responses were also valued, with one participant stating, *“The AI adapted its responses to my specific questions, making the guidance feel personalized.”*

Increased confidence: Participants frequently cited the AI Grader’s feedback as a major factor in boosting their confidence. For instance, one participant mentioned that *“The AI Grader’s timely and constructive feedback also played a crucial role in boosting my confidence, as it highlighted my strengths and guided me on areas that needed improvement.”*

Frustrations with literal feedback and retakes: Two participants found the AI Grader’s feedback too literal or repetitive, which led to frustration. One participant commented, *“Sometimes it missed the answers submitted and repeated them as guides, which was frustrating at times.”* Another participant expressed, *“It was a bit frustrating when I had to rewrite my answer entirely, as I couldn’t cut and paste from previous answers to make minor adjustments.”* This was also raised by some participants who took part in the focus group discussions who highlighted that the AI grader was too rigid and strict describing it as “harsh teacher”.

ii. Feedback on AI Moderator

Participants highlighted the following in terms of their interactions with the AI Moderator:

Networking and community building: Several participants highlighted that the AI Moderator fostered a sense of community, allowing them to connect and exchange insights. For example, one participant mentioned, *“The AI-powered forum functionality was awesome. It provided a platform that feels like a real classroom or school setting where cross-exchange of ideas and insights was made possible.”*

Immediate feedback: The AI Moderator’s prompt feedback was appreciated, as it guided discussions and kept them focused and relevant. Participants mentioned that, *“the AI-powered prompts also helped guide discussions, ensuring they remained relevant and focused”* and *“I appreciated that the Forum Task AI-Moderator gave immediate feedback.”* Some participants part

of the focus groups even mistook the AI moderator for a human facilitator, indicating its seamless integration into the discussion.

Lacking depth: Similar to regular SMETA courses, a few participants perceived the forum activity as lacking depth and seeing it as a “tick-box exercise”, while others found it challenging to engage with due to the volume of posts, making the forum less effective for their learning. One participant mentioned *"I didn't (in fact, never had in other courses) find value in responses of other participants because the way it's presented is too tedious for me to read through."* While another respondent stated *"I just answered the question. No time to read other people's comments."*

iii. Feedback on the AI Tutor

48% of participants reported using the AI tutor to help them answer the module questions, a fact borne out by the pilot’s data logs. Specifically, participants highlighted the following:

Enhanced understanding and engagement: Several users found the AI Tutor helpful in breaking down complex topics and clarifying doubts, allowing for a deeper understanding of the material. Its ability to provide immediate answers and clarify difficult concepts made it a beneficial tool for learning on demand. One user mentioned: *"My experience with the AI Tutor was generally positive... it broke down concepts into simpler terms, making them easier to understand."*

Interactive and immediate support: For users who engaged with it, the AI Tutor was an accessible and flexible resource, offering instant responses to questions without the need for scheduled meetings, which was particularly appreciated for late-night study sessions. One participant stated, *"The real-time assistance provided by the AI gave me the confidence to explore and ask questions without hesitation. Knowing I could get immediate clarification or guidance if needed helped me stay on track and solve problems as they arose."*

Room for improvement: While helpful for quick explanations, some users felt the AI Tutor occasionally lacked depth for more complex queries. Others noted that it could improve by being more detailed in certain areas and offering examples for deeper understanding. *"The AI Tutor was effective for quick clarifications but lacked the depth needed for in-depth questions."* Some participants suggested that they were unclear on how to access or engage with it effectively. *"I did not use it; I was not clear on how to engage."* Others suggested improvements, such as allowing for continuity in responses to avoid repetitive re-typing of similar questions.

Conclusion

1. AI-powered mastery learning techniques are effective

This pilot conclusively demonstrated the ability of the AI Grader to implement mastery learning techniques to **improve learner outcomes**, as shown by the statistical analysis of participants’ answer attempts. What’s more, those participants who completed the course reported a **strongly positive experience**, as well as interest in pursuing more such AI-driven courses. Lingering difficulties with AI rigidity or failure to engage participants in depth are likely to be solved by improved prompting as the SMETA team gains experience, as well as improvements in the underlying AI infrastructure (the pilot being conducted using a GPT-4 API).

2. AI-powered courses require a different instructional design approach

Moreover, there is the matter of **instructional design for AI**. For testing purposes, this pilot “grafted” AI functionalities onto an already-existing, non-AI powered course. Given the results

obtained, however, it is worthwhile to consider what kind of new course and module designs might best accommodate the kinds of AI interactions that have been tested. We might imagine modules that feature shorter content presentation and use AI-powered questions as singular, summative exercises to validate a module's completion, for example.

3. AI-powered questions increase difficulty and lower completion rates

It is notable that **AI-powered questions are more difficult, and take a longer time to complete** than the “standard” multiple choice, true or false, or mix-and-match questions used by SMETA until now. That said, as participants' feedback demonstrates, this is not an artifact of using AI *per se*, but rather of asking more complex, open-ended questions; the cognitive load of having to explain a concept in short essay format is much greater than, for example, selecting the correct answer from 4 multiple choice options.

This increased difficulty likely goes a long way towards explaining the 20% drop in **completion rate** compared to “standard” SMETA courses. Another factor likely stems from “**participant mismatch.**” With the pilot advertised as an opportunity to test SMETA's AI integration, rather than to complete an entire e-learning course, many participants likely felt that they had achieved their goal after completing the first few questions of Module 1. This would explain the low completion rate (36.1%) of this module, which is significantly lower than the vast majority of SMETA courses. In the future, then, **completion rates for AI-powered courses can be expected to increase**, as participants not only become more used to AI in their learning, but also enrol to courses on topics that actually interest them, rather than as an opportunity to simply test a new pilot feature.

Next steps

Given the conclusions drawn, **SMETA will gradually implement both the AI Moderator and AI Tutor across the entirety of its e-learning offering.** This can be done at relatively low cost for SMETA and, as shown through this pilot, at considerable benefit for learners.

That said, while the implementation of AI functionalities in SMETA's online courses has proven to be effective, **adding AI-powered questions is unlikely to be a blanket solution applicable to all of SMETA's learners**, many of whom have a limited formal educational background. No matter the instructional design techniques used, the increased time given, or the accompanying support provided, the reality remains that **being asked to write short essays requiring the analysis, reflection and distillation of a topic into one's own words is a significant challenge for a large proportion of SMETA's audience.** To be effective, SMETA must meet learners where they are, and if some learners are unable to write short essays, this must be taken into account.

Thus, rather than completely replacing SMETA's standard “static” e-learning offering, **courses featuring AI-powered questions might be conceptualized as “advanced” or “extra credit” learning activities** deployed in support of, or alongside it. Such a system would enable those learners with the skills necessary to benefit from the AI Grader to access greater learning opportunities, while not “shutting out” those learners for whom it would offer no benefit.

As of early 2025, SMETA has already begun designing several of its new courses with AI-graded questions in mind. In each case, such questions are only deployed for courses aimed at a limited target audience whom it could reasonably be expected could benefit from them, such as Business Support Organizations (BSOs). Internal discussions remain ongoing as to how best to deploy AI-graded questions for courses aimed at a broader audience. **SMETA welcomes discussions with project managers in this regard.**