Re-imagining Education Through AI: Students Insights from *DigiEduHack*

Giulia Paludo[1*†], Carlotta Vielmo[2†], Francesca Fiore[1†], Agnese Del Zozzo[2†], Gisella Decarli[3†], Alberto Montresor[1†] and Milena Bigatto[4†]

[1*]Dept. of Information Engineering and Computer Science , University of Trento, Via Sommarive 14, Trento, 38123, Italy, .
[2]Dept. of Mathematics, University of Trento, Via Sommarive 9, Trento, 38123, Italy, .
[3]Dept. of Psychology and Cognitive Sciences, University of Trento, Corso Bettini 84, Rovereto, 38068, Italy, .
[4]Hub Innovazione Trentino, Piazza Giannantonio Manci 17, Trento, 38123, Italy, .

*Corresponding author(s). E-mail(s): giulia.paludo@unitn.it;
Contributing authors: carlotta.vielmo@unitn.it; francesca.fiore@unitn.it; agnese.delzozzo@unitn.it; gisella.decarli@unitn.it; alberto.montresor@unitn.it; milena.bigatto@trentinoinnovation.eu;
†These authors contributed equally to this work.

Abstract

This exploratory study examines the role of Artificial Intelligence (AI) in enhancing digital education through the lens of the 2023 *DigiEduHack* hackathon. Engaging 29 university students, the study leverages a participatory approach where students utilize their academic experiences to design novel AI-augmented learning solutions. Central to our inquiry is how these students reinterpret their AI knowledge to innovate in education. The hackathon, integrating peer-to-peer collaboration and expert mentorship, acted as a fertile ground for this exploration. Our findings highlight the effectiveness of this challenge-based learning format in fostering innovative educational methods and tools, underscored by the students' active involvement in the design process. This

study not only reflects on the integration of AI in education but also proposes a novel participatory approach for educational development.

Keywords: AI Education, Hackathon, Participatory learning, Digital Education

1 Introduction

DigiEduHack is an international annual hackathon promoted by EIT, currently in its 4th edition. This event comprises a series of 24-hour grassroots local hackathons spread across Europe and beyond, aiming to nurture innovation, collaboration, and creativity. At each location, participants tackle a unique digital education-related challenge and collaborate to devise innovative solutions.

The University of Trento (UniTrento) has participated in all previous editions, with its teams securing first place in 2020 and 2022. This year's local challenge, held in November 2023 and focusing on the enhancement of digital education through AI, was organized by the Computer Science and Cognitive Science departments of UniTrento, alongside HIT - Hub Innovazione Trentino. It involved 29 students from diverse backgrounds.

The challenge underscored the increasing importance of AI in education and inspired students to utilize their educational experiences to develop AI-enhanced solutions to the proposed challenge. The hackathon acted as a platform for students to reprocess and recontextualize their educational experiences. It integrated periods of peer-to-peer work with interactions with AI and education experts, who served as judges and mentors, thereby enriching the students' projects and ideas.

The hackathon format provided us with an opportunity to closely observe not only the final products but also the entire creative process. It served as a testbed for gaining insights into AI in education by engaging students in the process of educational innovation and the design of new methods, involving them both as participants and collaborators. Our exploration of the challenge also led us to question whether such experiences might have influenced students' perceptions of education and the integration of AI within it, as well as how to effectively articulate this impact. The central research question we aimed to address was: *How do university students reinterpret their knowledge and experiences with AI to develop innovative approaches to learning while participating in the challenge-based setting of DigiEduHack*?

We aimed to address this question by focusing on three key aspects. First, the hackathon event, coupled with its challenge-based learning approach, offers an ideal opportunity to understand student thought processes and actions [1]. By leveraging their diverse backgrounds, we can facilitate the exploration of innovative ways to integrate AI into education. Second, their experiences

with digital services were the starting point to enhance existing digital education tools and develop new ones, thereby promoting innovative educational methodologies. Finally, this study investigates a new participatory approach to designing education, which aims to emphasize the bottom-up and interactive methods in educational development.

2 State of the Art

2.1 Defining AI in Education

The early 2020s have been marked by rapid and unprecedented progress in AI, a period dubbed "AI Spring" [2]. This advancement is significantly impacting various fields, including education.

In the context of AI and education, it is crucial to differentiate between AI Literacy (AIL) and AI in Education (AIED) [3]. AIL focuses on teaching *about* AI, providing students with meta-knowledge about how AI functions and promoting its conscious use. In contrast, AIED involves using AI as a tool to support teaching and learning. From this perspective, AI is seen as a novel opportunity to enhance the learning experience through active assistance.

For *DigiEduHack*, we asked students to concentrate on, contemplate, and reevaluate their educational experiences in the context of AIED's educational and instrumental dimensions [3]. According to [3], particular emphasis is given on smart tutoring, educational content suggestion, and learning experience personalization.

Cruz-Benito identifies three main areas where AI enhances education: customizing learning experiences, providing feedback, and improving communication between students and teachers [4]. AI's ability to dynamically personalize educational content to individual needs may significantly improve learning outcomes, helping teachers to meet diverse learning requirements. Furthermore, AI-driven feedback enhances learning by enabling students to promptly identify and rectify errors. It also empowers teachers to track student progress and gather insights, thus facilitating informed decisions to refine their teaching methodologies [4].

2.2 Literature perspectives on AI

The recent interest in AI for education is focused on AI literacy, including transparency and ethics [5], as well as tool application [5, 6].

Research has also explored users' perspectives [7]; however, gaps remain, particularly in integrating AI to innovate and redesign educational experiences. Bahroun et al. highlighted opportunities to enhance pedagogical approaches, teaching methods, learning outcomes, and student engagement [5].

Survey studies revealed a general positive attitude toward AI in education, not neglecting potential drawbacks on the interpersonal aspects of learning [8], with usability, benefits, privacy, and security considerations influencing attitudes towards AI adoption [9].

Studies on sensitive topics like writing and assessment suggest a balanced approach to AI integration to address misconceptions, such as AI being considered cheating in essays [10], or leading to over-dependence [11]. In this perspective, AI is seen as enhancing autonomous abilities, motivation, self-efficacy, as well as creativity within a positive dynamic of collaboration rather than just delegating, as it could be assumed [10, 11]. This aligns with the literature supporting AI as a collaborator for idea generation and reflection stimulation, essential for user-centered innovation.

2.3 Participatory approaches, challenge-based learning and hackathons

AIED is particularly relevant in the complex, delicate, and unique context of educational environments, since its use is becoming intensively widespread nowadays. Thus, their treatment requires a lens of inquiry that can accommodate their nature.

We focused on integrating participatory approaches with challenge-based learning (CBL) in a Hackathon format. The constructivist nature of challenge-based learning met the needs of students re-evaluating their learning experience with AI [12]. This approach provided an ideal environment for students to address real problems, apply AI, and find practical solutions based on their firsthand experiences. Bahroun et al. noted a predominance of surveys and qualitative research including interviews and focus groups [5]. Recognizing the potential of varied methods, we chose a participatory approach for deeper insights.

2.4 The Challenge Content

The challenge faced by the participants during DigiEduHack focused about the integration of AI in education, encouraging participants to reframe their educational experience and address the issues they encountered with AI-driven solutions. Students were required to integrate AI in teaching methodology or educational tools and the proposed solutions were expected to address diverse learners promoting inclusion. Furthermore, the challenge stressed the topics of sustainability and ethical considerations prompting participants to envision the impact and long-term viability of their solutions within educational curricula.

3 Methods

This section presents a case study of the *DigiEduHack* 2023 hosted by UniTrento, utilizing pre- and post-event questionnaires along with an analysis of the final artifacts.

3.1 Hackathon format

DigiEduHack was aligned with the hackathon format [13]:

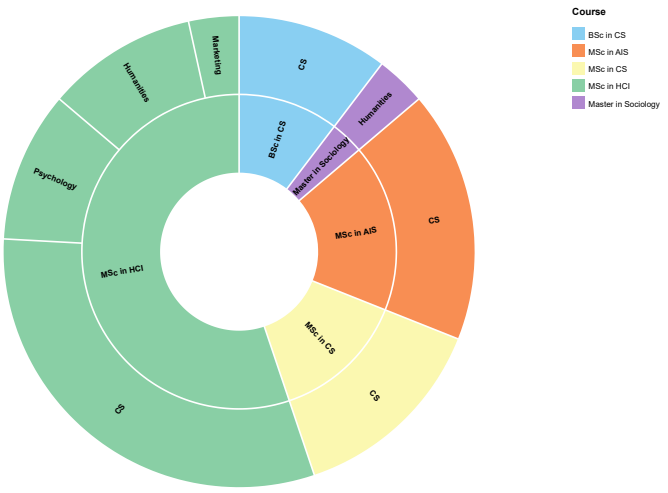

Fig. 1 Breakdown of participants by their current degree of enrollment (inner ring) and background (outer ring)

- *Team organization*: participants worked in 7 groups arranged autonomously.
- *Time constraints*: Solutions were required to be submitted within a limited timeframe. Due to logistical constraints, *DigiEduHack* was shortened from the typical 24-hour hackathon duration to just 10 hours (9 AM-7 PM).
- *Location*: Teams were situated in a shared space, providing a suitable environment for working, communicating, and sharing information on their projects.
- *Support*: Organizers offered participants access to experts for mentoring, technical assistance, resources, and other facilities to support their projects.

The event schedule was organized as follows: It began with a preliminary debriefing, featuring a short introduction to AIED by a senior organizer, then moved to brainstorming sessions and initial interactions with mentors. Post-lunch, participants engaged in an elevator pitch session, paving the way for the final project completion and presentation. In the late afternoon, they delivered and discussed their completed presentations with the jury and other groups.

The structure of the event was meticulously designed to seamlessly blend group work, encourage comparisons among different groups, and ensure effective mentoring.

3.2 Participants

The sample comprised 29 students from the University of Trento, 6 females (21%) and 23 males (79%), who are currently enrolled in various academic programs at both the bachelor's and master's levels, as shown in Figure 1: 5

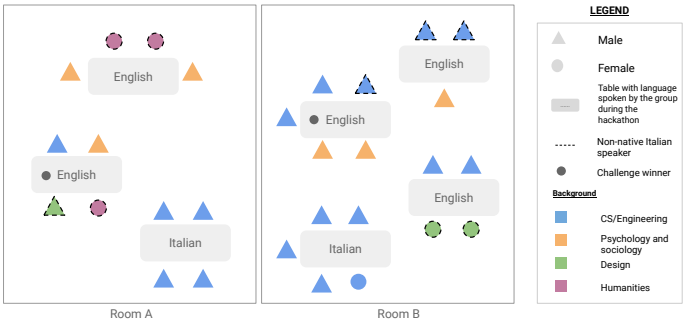

Fig. 2 *DigiEduHack* 2023 rooms and work groups sociogram with details of gender, background and the language spoken by the group

students in the MSc in AI Systems, 15 in the MSc in Human-Computer Interaction (HCI), 4 in the MSc in Computer Science, 1 in the Sociology MSc, and 4 in the BSc in Computer Science (CS). Their previous educational background was even more variegate: 9 in CS, 2 in Advertising/Communication and Economics, 3 in Humanities, and 4 in Psychology (Figure 1). Participants were recruited from UniTrento's departments of sociology, computer science and psychology which potentially introduces a selection bias from the self-selection among the students interested solely in participating to the challenge.

The uniqueness of this sample provides a broader representation of the student community, as illustrated in the sociogram in Figure 2. Mentors served as facilitators and experts, offering guidance and feedback to the groups. A total of 7 mentors were involved (four from CS and Engineering, one from Psychology, one from HCI, one from Innovation and Education), each selected for their diverse background to provide participants with an interdisciplinary perspective. It is noteworthy that the mentors hailed from diverse sectors, encompassing both academia and industry. This diversity equips them with a unique perspective on the essential skills that the industry demands from university graduates and provided a new point of view for the involved students.

3.3 Data Collection and Analysis

This study combines quantitative and qualitative methods. The data we used are the participants' responses to a pre- and post-questionnaire, and the artifacts produced by each group work during the event. The pre-questionnaire was administered at the beginning of the event and before the start; the post-questionnaire immediately after the end of the event, setting the deadline for completion after a few days.

3.4 Questionnaire

Both questionnaires include not only closed questions but also open-ended ones, to cope with the exploratory nature of this study and the consequently non-predictability of answers [14].

The pre-event questionnaire[1] was administered at the very beginning of the challenge, before the formal introduction. It includes basic demographic information (gender, educational background), and open-ended questions to investigate participants' motivations for taking part in the challenge, and their expectations in terms of both motivation and the contributions they intended to make. Additionally, it aims to frame their initial experiences with AI and initial individual ideas (e.g., "How confident do you feel with AI?" and "Which specific university course have you attended that you believe could benefit from a AI-driven approach?"), using words from the event's flyer to provoke reflection.

The post-event questionnaire[2] concretely focuses on:

(1) the participants' perspectives on the individual work carried out (e.g., "What contribution in terms of skills, experience, and ideas do you think you brought to your group?") and the final project presented (e.g., "Do you think your final project is a valuable resource that can be adopted in a concrete educational context? Why?");
(2) the perceived impact of the activity on their future;
(3) the group work dynamics, investigating the groups' creation criteria and the interactions among the members and with the mentors;
(4) the participants' perception about their knowledge of AI and AI in education, before and after the activity. We informed this aspect using the Intrinsic Motivation Inventory (IMI scale) [15];
(5) a final reflection on AIED in relation to their experience. Specifically, to investigate this aspect, participants were ask to share a specific example of when they had to reconsider their previous conceptions about didactics or came to new insights into the potential of AI in education. We considered to ask for an example instead of posing a direct question (e.g., "Has your conceptions about didactics changed after this experience? How?"), which would have required students' meta-reflections that cannot be taken for granted.

3.5 Artifacts

During the event, each group produced various artifacts to describe and present their work: a standardized solution canvas, presentations, demos, and UI prototypes. These artifacts provided a valuable source of information, offering concrete insights into the students' educational journey and their reprocessing outcomes.

[1] Questionnaire available at https://forms.gle/Ue1Wz5oTPeBDqtZY8
[2] Questionnaire available at https://forms.gle/ZnUsDkELapCCwRAN8

For this study, we focus on the solution canvas from each group. This canvas presented a template that students were required to fill with their proposals. The template included fields such as the solution's description, context, target group, impact, "Describe it in a Tweet," innovativeness, transferability, sustainability, and teamwork. To analyze each completed canvas, we conducted a thematic mapping of their content. In this context, we used thematic mapping in order to best represent the relationship between the themes emerged by visually reprenseting them in the map.

3.6 Data Analysis

Data collected have been analyzed both qualitatively and quantitatively. Qualitative data coming from artifacts and open ended questions within the questionnaire have been thematically analyzed according to Braun and Clarke methodology for thematic analysis [16]. Concretely, given the nature of the data collected, we took advantage of thematic analysis which fitted best the need of identifying patterns, the recurring themes, emerging from data. Instead, for quantitative data we engaged descriptive statistics and address statistic significance with a paired t-test.

4 Results

The results underscore the transformative potential of participatory approaches that actively involve students in innovating education and learning processes. In this context, the amalgamation of various resources and the activity format–encompassing mentoring, peer-to-peer learning, and challenge-based learning–successfully engaged students in re-evaluating their educational experiences through the lens of AI.

4.1 Post-event questionnaire

The discussion of the result of the post-event questionnaire follows the structure described in Section 3.3.

Perspective on the work carried out

The arguments about their solutions efficacy and feasibility reported both the potential of easily introducing their proposals in existing tools enabling a high impact on the learning experience "*Because students would really benefit from a chatbot always available that can reference to different part of the material you have to study and also for the professors*, (...)"

Regarding efficacy and proposal implementation, students expressed views like, "*I think the project could really be implemented because students nowadays interact a lot with conversational AI tools to help them study and create valuable content for their courses. It's also very useful in the learning process and*

can be personalized to meet various needs." These responses highlight the perceived value of making learners feel more supported throughout the process, with enhanced and easier access to quality content.

Regarding the specific participatory approaches employed, the students positively noted the potential for multidisciplinarity both in the idea generation phase and in the more practical phase of organizing group work into tasks.

Perceived activity impact

The analysis of the post-event survey data revealed a self-perceived improvement in participants' knowledge about AI, particularly regarding its application in education. Initially, students rated their general AI knowledge with an average score of 5.42 (SD=1.79). After the event, this score increased to 6.42 (SD=1.60; $p<0.0001$). A more notable improvement was observed in their knowledge of AI in Education (AIED); the average score rose from 4.5 (SD=2.27) to 5.71 (SD=1.85; $p<0.0015$), indicating a positive shift in participants' perception of the activity's effectiveness in enhancing their understanding of AI concepts.

Group Work Dynamics

Regarding the re-evaluation aspect of the activity, participants highlighted the value of collaborating on this topic with students from various countries and academic backgrounds. They noted, "*The brainstorming session allowed us to have a good insight on the different problems students face from different points of view.*" This diversity of perspectives enriched the brainstorming process and contributed to a more comprehensive understanding of the issues at hand.

Activity evaluation

Regarding quantitative measures, the IMI scale[3] yielded an average score of 5.50 on a scale from 1 to 7 (SD=0.33), indicating that students were generally satisfied with the activity.

Reflection on AIED

The most notable outcome, from our perspective, was the reflections linking participants' work to their prior conceptions about pedagogy. The response, "*We never thought about improving students' performance by increasing teacher-student interaction. I see it every day but never considered it*," signifies a paradigm shift in students' perception of student-teacher interactions and their impact on academic performance. Previously, the significance of a quality relationship with the teacher was underestimated in their views. However, exploring AIED to address personal experiences uncovered the potential of enhanced student-teacher interactions in improving the learning process.

In addition, the reflection on the contribution of AI with course materials for enhancing accessibility especially in case of learning disability and special

[3] https://selfdeterminationtheory.org/intrinsic-motivation-inventory/

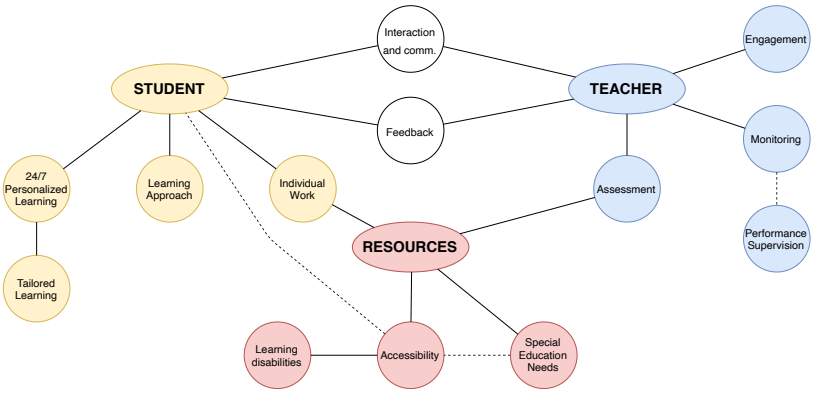

Fig. 3 Thematic mapping derived from the analysis of both the open-ended questions responses and the solution canvas provided. We systematically reviewed and categorized the textual data identifying recurring themes and pattern subsequently visually represented in the map to provide an overview of the findings

learning needs has outlined a variety of possibilities of low effort required for their adoptions by educators.

4.2 Artifacts Analysis Results

According to the taxonomy proposed by Ranieri et al. [3], the solutions proposed by participants can be clustered in the following categories of AIED:

- smart tutoring and learning experience personalization, specifically with tutoring chatbots facilitating the student-teacher interaction (3 groups);
- platforms for language learning (1 group);
- tools for different learning approaches materials adaptation (3 groups).

The thematic coding of the artifacts dimensions provided a view on the elements students reprocessed of their educational experience which are grouped according to the focus on the student, the teacher and the resources (Figure 3).

The student dimension addresses the topic of tailored tutoring based on individual learning approaches and needs. In this connection, resources were characterized with the theme of accessibility and personalization. The teacher cluster instead involved code about assessment and monitoring for performance and engagement but not only in the key of evaluation but also for data-driven didactic approach improvement.

On this purpose, students with their solutions reported discrete urgency in tackling the topic of the student-teacher interaction as well as feedback.

With reference to the research question that guided our work (see Section 1), we can say that at the end of the event the participants not only perceived an increase in their skills in AIED, but also showed the development of a sensitivity with regard to the elements that influence the quality of teacher-student interaction. The elements that emerged, schematized in Figure 3, are not new per se. In fact, they align themselves with results already present in

literature, such as [4]. What is new is that they emerged in the form of new awarenesses of the student participants themselves, as previously discussed for instance in the paragraph *Reflection on AIED*. These new awarenesses were the driving force behind the design of the different solutions proposed by the groups.

While not the main focus of our study, it is important to recognize that students emphasized not only the sustainability and ease of integrating their proposed methods, tools, and formats into the existing educational framework via current e-learning infrastructures, but also the practical feasibility of their ideas. This approach, influenced by the format of the hackathon, encouraged them to think beyond hypothetical scenarios and base their innovative proposals in reality. Given the evolving nature of knowledge and skills in this sector, along with the existing gap in technical competencies between educators and learners, the students' focus on sustainability brought their ideas closer to practical innovations rather than just theoretical concepts.

5 Conclusions

The outcome of the *DigiEduHack* 2023 at UniTrento provided great insights both on the side of Hackathon as effective learning approaches including the CBL dimension and on students' re-processing their educational experience in light of AI.

Within the hackathon format, students actively engaged in proposing innovations in education through AI. The combination of resources, mentoring, peer-to-peer learning, and challenge-based learning effectively encouraged them to re-evaluate their educational experiences.

From an overall perspective, the IMI scale indicated a high level of satisfaction with the activity from a subjective standpoint (Mean: 5.5; Standard Deviation: 0.33). The multidisciplinary nature of the groups, comprising students from diverse countries and academic backgrounds, positively influenced collaboration and idea generation. It also provided valuable insights into educational issues based on their experiences.

Participants reported improvements in their understanding of AI, particularly in the context of AIED, reflecting the effectiveness of the activity.

The final proposals, centered on smart tutoring and personalization of learning experiences, focused on the interplay among students, teachers, and resources, and displayed a keen enthusiasm for integrating these proposals into existing tools to significantly enhance learning experiences, while also maintaining ethical awareness. Specifically, in terms of the student dimension, the proposals highlighted customized tutoring tailored to individual learning needs and methods. Regarding resources, the emphasis was on personalization and accessibility. For teachers, the proposals concentrated on assessment and monitoring to facilitate data-driven didactic improvements. The most emphasized aspect was the feedback loop between students and teachers, where AI

was identified as a potent facilitator, enhancing the communication without overburdening the teacher or overlooking the learner's needs.

Participants' reflections on how this experience made them reconsider the potential of improving academic performance by focusing on teacher-student interaction highlighted the most effective use of AI in education. It underscored the importance of a synergistic connection with the human touch.

The educational issues re-evaluated by the students can be addressed with AIED, providing better and easier access to high-quality information without overwhelming teachers and making learners feel more supported throughout the process.

6 Limitations and future directions

We acknowledge several limitations inherent in our study methodology:

- limited sample, whose size is 14 for the second questionnaire;
- limited investigation of relationship between students, mentors and tutors;
- replicability of the study and generalizability of the results. We are conscious of the setting's features combination and uniqueness, which are hard to reproduce;
- potential biases, such as selection bias for the participants;
- a lack of a more in-depth analysis for the qualitative investigation part of the study, which is focused on the questionnaires only.

However, by its nature, our investigation was intended as an exploratory study, intentionally broad to identify key insights and concern, making it a valuable starting point for later targeted research.
Therefore, an in-depth analysis arises naturally as pivotal for our study. Specifically, we plan to replicate such a research context in other academic setting to increase our sample and collect more targeted data. Based on the insights gained from this work, we are considering restructuring our questionnaire to incorporate more nuanced and focused questions, and integrating participant interviews into the design, to provide a more comprehensive understanding from a qualitative point of view.

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