"I Would Share It, But..." Exploring Ways to Optimize the Privacy-Personalization Trade-Off in Intelligent Tutoring Systems

Adrienn Toth(✉), Neele Roch, Noé Zufferey, and Verena Zimmermann

ETH Zurich, Zurich, Switzerland
{adrienn.toth,neele.roch,noe.zufferey,verena.zimmermann}@gess.ethz.ch

Abstract. Personalized learning is increasingly improving through AI-enhanced intelligent tutoring systems (ITS). However, ethical and privacy aspects of ITS, such as the privacy-personalization trade-off, are under-researched. We conducted an interview study with $N = 32$ university students and found that students were not largely concerned about privacy as such but implications of data collection for social aspects, their education, and society at large. Students preferred ITS to supplement rather than replace human teachers in certain tasks, leveraging the benefits of both. We provide recommendations on addressing the identified concerns for ITS design and successful integration into a curriculum, for which AI literacy and student autonomy emerge as crucial factors.

Keywords: Intelligent Tutoring System · Human-centered Artificial Intelligence · Data Privacy · Higher Education

1 Introduction

Personalized learning tools can substantially help students in their learning process while enabling professors to more efficiently use the scarce in-person time in classrooms. While intelligent tutoring systems (ITS) [22] are increasingly considering human-centered aspects such as usability [2,20], students are generally absent from the ITS development process [3] and are often only recruited for post-deployment evaluation [3]. In addition, there is little attention to aspects outside of learning outcomes, such as the question of data privacy and ethics [23,30,35]. As personalization relies on personal data processing (e.g., students' performance, behavior, and personal data), it is crucial to take the privacy-personalization trade-off (PPTo) into account when developing ITS [4], involving actual students in the process. In this article, we aim to answer the following resulting research question: *In the context of higher education, what factors play a role in students' assessments of the PPTo associated with ITS, and how do these factors shape their decision-making?*

We conducted an interview study with $N = 32$ university students to understand their requirements and concerns regarding ITS and the PPTo. Students'

A. I. Cristea et al. (Eds.): AIED 2025, LNAI 15881, pp. 68–76, 2025.
https://doi.org/10.1007/978-3-031-98462-4_9

concerns range from social, educational, to high-level societal implications of ITS, which can be addressed in different ways. Based on our findings, we derive concrete design recommendations for future ITS, focusing on technical functionalities and successful integration into course curricula.

2 Related Work

There is a growing interest in using AI-related education techniques [17,35]. ITS provide students with tailored feedback, and instruction such as hints [22]. Various interventions, like high and low scaffolding, [7], how ITS could support self-regulated learning [24], how gamification can be integrated into an ITS [21,24], and comparing ITS to traditional methods [5] have shaped ITS development. ITS can use students' data to support collaborative learning [6,34], and for time management [1]. However, privacy concerns, as well as a lack of understanding of how ITS work, generally result in not trusting ITS [11,27,29], and therefore hinder educational institutions from adopting these tools [8]. Research in this area is limited [23,35], even though students could provide crucial insights to support the design process [3,28], and privacy research calls for improved human-centered approaches [18,25]. Only a few recent works focus specifically on designing systems considering privacy [33]. Kwapisz et al. [19] and Greenhalgh et al. [14] explored privacy concerns of students regarding data sharing practices of learning management systems, while others focused on analytics dashboards [31] or collaboration analytics [36]. Our study takes a first step toward addressing the lack of student involvement in ITS design, aiming to derive concrete recommendations for the data handling of future ITS.

3 Method

We conducted individual interviews (45–60 min. each) with $N = 32$ students from ETH Zurich and the University of Zurich, from various fields of study. They were all fluent in English and had already completed at least three semesters. They were 24 years old in average ($SD = 2$, $min = 20$, $max = 28$), 15 were men, 17 were women, 13 were Bachelor students, 18 were Master students, and one was a PhD student.

Each interview consisted of four main sections aiming to (1) capture students' definition of personalization, their main usage context, and their beliefs, (2) explore how personalization could improve educational practices, (3) critically reflect on the benefits and risks associated with personalized ITS, and (4) explore the willingness of data-sharing with respect to the types of data, the students' need for transparency and control over data collection, storage, and processing. In this short paper, only the results of the two last points are presented in detail with other crucial insights mentioned where necessary.

Data Analysis. The interviews took place online with audio-recording and transcription for anonymized analysis using *trint*, yet manually validated to ensure correctness. The transcripts were analyzed using MAXQDA24. One

researcher first generated an initial code structure that was revised based on other researchers' feedback. This revision process was repeated multiple times, involving a total of four researchers.

Ethical and Open Science Considerations. Participants signed a consent form and received compensation in line with our institution's suggestions. Our method followed ethical guidelines for psychological research and has been IRB-approved. The interview guideline and supporting materials are available online[1]. Interview transcripts are made available upon request.

4 Results

We developed a framework summarizing the key concerns toward ITS and potential solutions based on the interview outcomes (see Fig. 1).

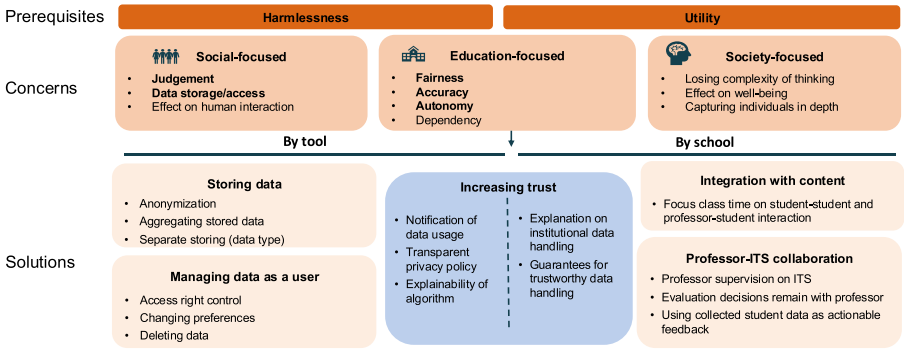

Fig. 1. Concerns toward ITS and potential solutions. Concerns directly addressable by ITS features (in bold) and those requiring measures from the institution are shown.

Unmet Prerequisites Can Prevent Students from Using an ITS. Participants generally showed a positive attitude toward ITS, but described aspects, such as certain ITS features being *harmful* for their learning process ("*I think it's [...] maybe harmful [...] to not be involved in the process at all.*" - P12) to prevent them from using these systems. *Utility* was also frequently mentioned, when discussing which data they "*wouldn't see [...] necessary for the service.*" (P24) and thus wouldn't want to be collected, despite not having particular ethical concerns.

Social Concerns were Common. Many participants' concerns were related to data access and use by others. *Judgement* refers to concerns about lecturers' perception of the data and potential negative effects, e.g., "*I still think that [the lecturer] could then be biased by what I've done in a certain test.*" (P5) or what other students think, e.g., "*not everyone is confident being talked about their*

[1] Data available on OSF.

results in front of everyone" (P7). *Data storage/access* refers to who can access educational data; while students generally accepted staff accessing their data, they opposed sharing it with peers or external parties. Finally, *effect on human interaction* related to how ITS use can affect the overall learning experience, e.g., how it would reduce interaction with peers.

Concerns about the ITS' Effect on Educational Outcomes. Students were worried about *fairness*, noting that extensive access to study data could lead lecturers to be biased (e.g., *"I would provide [time and frequency of study sessions], but only if then they're not graded."* - P30). Additionally, concerns about whether the ITS has enough data to make *accurate* predictions were raised (e.g., *"How do we know that there are no blind spots on the algorithm side?"* - P8). Students believe that *autonomously* regulating their study process should be something they do independently and were *"afraid to lose the ability to do it on my own."* (P19), which is why they prefer to be in control of their study progress and only use the support of ITS on the task-level. Finally, *dependency* on the tool, which refers to students not being able to efficiently study without an ITS, was found to prevent them from learning the soft skills necessary in a work environment later, as also described in previous research [13].

Concerns on the Effects of an ITS on Society. The final category is related to the widespread usage of personalized tools on society, such as people *"los[ing] the ability to create a thought"* (P13) or seeing each other as complex beings as an ITS would fail to *capture individuals in depth*. Finally, some were concerned that an ITS could have a negative effect on their mental health due to comparison with others, constantly being reminded of their weaknesses, or reduced social interaction. These concerns, although rare, still show the importance of addressing general worries toward AI systems, not only ITS.

Potential Solutions Exist both on the ITS and Institution Level. The acceptance of ITS depended heavily on its integration into the students curriculum, therefore not all concerns can be tackled by ITS features alone. Within ITS, the best way of *storing data* depended on perceived data sensitivity. A lot of students were only slightly concerned about sharing data as long as it is anonymized, or, in the case of their personal data, stored separately from their detailed results and behavioral data. More concerned participants preferred the data to only be available in aggregated format from a class *"for the professor to understand which topic is less clear or if he should focus more on that [topic]"* (P5), without providing their individual records. Some suggested restricting access to certain recipients or data types individually, whereas others preferred to choose the functionalities and the system to only collect the data necessary for those, e.g., *"I imagine it would be tied to some services, what data you need to use or you need to provide"* (P24). Almost all participants considered being able to *change their data-sharing preferences* easily and *deleting* parts or all of their data from the system very important. They illustrated how continuous transparency could *increase their trust* in the tool. They also mentioned that understanding better *"how [the tool is] coming to the suggestions"* (P13) would

convince them of the accuracy of the ITS. However, certain recommendations require the institution's involvement. In case an ITS would be a core element of their course, some participants expected the information to come directly from the university instead of the tool, saying "*it would make sense to maybe have a [...] class that just focuses on what this tool [does].*" (P10). Also, the ITS and classroom teaching have to complement each other instead of just coexisting or replacing the other ("*I feel like they could work well together instead of like against each other*" - P6).

5 Discussion

Personalization should Happen at the Task Level, while Students Remain in Control Over what and when to Study. Based on students' concerns related to losing autonomy over their learning and becoming overly dependent on the ITS, it is not recommended to design the ITS in a way that takes high-level control of the learning process and behaviors. Instead, the personalization should remain on the task level, providing step-by-step guidance and feedback. This helps students maximize their learning outcomes on the micro-level, while also helping them with self-regulated learning, e.g., supported by the integration of pedagogical agents shown to be successful in improving learning outcomes [12]. This can prevent harmful cognitive offloading that can cause the decline of critical thinking skills if students are too dependent on the tool [13] and reduce the enjoyment of learning [15].

The Tool should be Functional Regardless of a Student's Data Sharing Preferences. Tools should ensure that users' privacy preferences are adhered to without limiting their ability to use the system [16], as privacy preferences vary greatly depending on context [18]. This is in line with some students' thought that if an ITS was used as part of a course, they should still be free to grant and revoke consent to data collection without suffering major drawbacks. This could be achieved by integrating different'learning modes' associated with different data collection practices. For example, students can target their weak areas with relevant exercises, but for that rich interaction data has to be collected from them. However, if they wish to only review material without specific focus on their weaknesses, then no or little data is required.

Information on Data Collection should be Provided from a Learning, not a Legal Perspective. Students showed trust in their institution to store and handle their data securely, reflecting previous studies [23]. Therefore, a traditional privacy notice might not be the most efficient way of informing them. Instead, as students named multiple concerns related to how data collected by an ITS could negatively affect them within the institution (e.g. unfair evaluations, judgment from classmates if they can access the data), designing a student-centered notice and consent system could be beneficial. For example, instead of asking "Do you consent to provide your data about the time and duration of your study sessions?", the questions should be "Would you like to get feedback

related to your study schedule and productivity?" along with an explanation of the data collection implications of the decision. This would also better equip students to make similar future decisions and improve AI literacy, which many in higher education are currently lacking [14].

Consider the ITS as a Complementary Asset to the Course, not as a Standalone Tool. Many participants agreed that there are some advantages to learning from a human which digital tools simply cannot substitute: showing empathy, explaining new material in the most suitable way, and engaging in reflective discussions. However, an ITS is advantaged in its availability and capacity to provide an infinite amount of exercises. Therefore, instead of looking at ITS as a substitute for human teaching, institutions should take advantage of both when designing courses. Teaching new, complex materials are best to stay in the hands of human lecturers who can engage students the best. Meanwhile, ITS could serve as a tool for individual practice and revision, the required amount of which might differ greatly between students, so they can benefit greatly from continuous personalized feedback [31,32]. Previous research has also demonstrated the success of combining human mentoring with AI tutoring [9].

Be Clear about the Capabilities of the Tool and Its Role in the Curriculum. Understandably, most students optimize their learning strategy such that they get the best grades, therefore they might not use an ITS seriously if it is not part of their evaluation [36]. At the same time, our results show that students are uncomfortable with being evaluated based on data from an ITS, therefore it is not advised that institutions do so. They can however make sure to clarify the role of the ITS in the curriculum (e.g., independent practice of complex exercises) and how that is useful to achieve the desired learning outcomes to boost engagement and eliminate potential concerns.

Make the most of ITS by Providing Feedback to Teachers on Class Performance. Despite a focus on the student perspective, 16 participants mentioned that the ITS data could provide valuable insights to lecturers about how students interact with the course. Most of them preferred it to be in an aggregated format based on the whole class' data instead of making rich interaction data from individuals available. [10] came to similar conclusions regarding visualizing cognitive-affective states in online learning. The exact ways of how this information could be most effectively utilized on teacher dashboards is definitely worth further investigation [26].

5.1 Conclusion and Future Work

The study revealed that the question of privacy cannot be fully separated from other societal and ethical factors once we discuss using an ITS integrated into a course. Therefore, the final recommendations cover a wider scope than just data handling and suggest focusing on (1) ways to ensure flexibility and autonomy of students in using and providing data to the ITS, (2) efficiently informing students about implications of data handling not just through the ITS, but the

institution itself, and (3) designing curricula in a way that benefits of an ITS as well as human teaching are maximized.

However, there are some limitations to this study. The interviews were conducted with only local students in Switzerland. Their answers might vary from individuals studying in other countries with different education systems and data protection regulations. Future work could conduct similar studies in other cultural and educational environments. Also, the interview questions referred to the hypothetical scenario of an ITS used in university courses, and their declared opinion may be different from their actual behavior. Future studies could investigate students' perceptions in the context of actual interactions with ITS.

Acknowledgements. This research has been supported by the EPFL-ETHZ Joint Doctoral Program in the Learning Sciences and the Innovedum Fund at ETH Zurich.

References

1. Akyuz, Y.: Effects of intelligent tutoring systems (its) on personalized learning (pl). Creat. Ed. **11**(0606) (2020)
2. Alfredo, R., Echeverria, V., Jin, Y., Swiecki, Z., Gašević, D., Martinez-Maldonado, R.: Slade: a method for designing human-centred learning analytics systems. In: Proceedings of the 14th LA and Knowledge Conference (2024)
3. Alfredo, R., et al.: Human-centred learning analytics and AI in education: a systematic literature review. artificial intelligence. Comp. Edu. (2024)
4. Awad, N., Krishnan, M.: The personalization privacy paradox: an empirical evaluation of information transparency and the willingness to be profiled online for personalization. MIS Quart. **30** (2006)
5. Borchers, C., et al.: What makes problem-solving practice effective? comparing paper and AI tutoring. In: Responsive and Sustainable Educational Futures, Springer (2023)
6. Borchers, C., Yang, K., Lin, J., Rummel, N., Koedinger, K.R., Aleven, V.: Combining dialog acts and skill modeling: what chat interactions enhance learning rates during AI-supported peer tutoring? (2024)
7. Borek, A., Mclaren, B., Karabinos, M., Yaron, D.: How much assistance is helpful to students in discovery learning? EC-TEL 2009, Springer (2009)
8. Cermakova, A.L., Clary, A., Havinga, B.: Evaluation mechanisms: a way to increase trust in educational technologies? (2024), https://www.edtechstrategylab.org/s/2024_Deep-Dive-I_Evaluation-Mechanisms_EdTech-Strategy-Lab.pdf
9. Chine, D.R., et al.: Educational equity through combined human-AI personalization: a propensity matching evaluation. In: AI in Education (2022)
10. Corza-Vargas, V.M., Martinez-Maldonado, R., Escalante-Ramirez, B., Olveres-Montiel, J.: Students' ethical, privacy, design, and cultural perspectives on visualizing cognitive-affective states in online learning. J. L.A. (2024)
11. Cukurova, M., Miao, X., Brooker, R.: Adoption of artificial intelligence in schools: unveiling factors influencing teachers' engagement. In: AIED (2023)
12. Dever, D.A., Sonnenfeld, N.A., Wiedbusch, M.D., Azevedo, R.: Pedagogical agent support and its relationship to learners' self-regulated learning strategy use with an intelligent tutoring system. In: AIED (2022)

13. Gerlich, M.: Ai tools in society: Impacts on cognitive offloading and the future of critical thinking. Societies **15**(11) (2025)
14. Greenhalgh, S.P., DiGiacomo, D.K., Barriage, S.: Platforms, perceptions, and privacy: ethical implications of student conflation of educational technologies. Info. Learn. Sci. **124**(9/10) (2023)
15. Han, B., Nawaz, S., Buchanan, G., McKay, D.: Ethical and pedagogical impacts of AI in education. In: AIED (2023)
16. Hann, I.H., Hui, K.L., Lee, S.Y.T., Png, I.P.: Overcoming online information privacy concerns: an information-processing theory approach. J. Man. Inf. Sys. **24**(2) (2007)
17. HolonIQ: artificial intelligence in education. Surv. Insights (2023), https://www.holoniq.com/notes/artificial-intelligence-in-education-2023-survey-insights
18. Knijnenburg, B.P., et al.: User-tailored privacy. In: Modern Socio-Technical Perspectives on Privacy (2022)
19. Kwapisz, M.B., Kohli, A., Rajivan, P.: Privacy concerns of student data shared with instructors in an online learning management system. In: CHI 2024 (2024)
20. Lang, C., Davis, L.: Learning analytics and stakeholder inclusion: what do we mean when we say "human-centered"? In: LAK23 (2023)
21. Long, Y., Aleven, V.: Gamification of joint student/system control over problem selection in a linear equation tutor. In: ITS, p. 378–387 (2014)
22. Mousavinasab, E., Zarifsanaiey, N.R., Niakan Kalhori, S., Rakhshan, M., Keikha, L., Ghazi Saeedi, M.: Intelligent tutoring systems: a systematic review of characteristics, applications, and evaluation methods. Int. Lear. Env. **29**(1) (2021)
23. Mutimukwe, C., Viberg, O., Oberg, L.M., Cerratto-Pargman, T.: Students' privacy concerns in learning analytics: model development. Brit. J. Ed. Tech. **53**(4) (2022)
24. Nagashima, T., et al.: Designing playful intelligent tutoring software to support engaging and effective algebra learning. In: EC-TEL 2022 (2022)
25. Nissenbaum, H.: A contextual approach to privacy online. Daedalus **140**(4) (2011)
26. de Quincey, E., Parker, M.: User-centred guidelines for the design of curriculum analytics dashboards (2021)
27. Renz, A., Vladova, G.: Reinvigorating the discourse on human-centered artificial intelligence in educational technologies. Tech. Inn. Mgmt. Rev. **11** (2021)
28. Sun, K., Mhaidli, A.H., Watel, S., Brooks, C.A., Schaub, F.: It's my data! tensions among stakeholders of a learning analytics dashboard. In: CHI 2019 (2019)
29. Tan, M., Subramonyam, H.: More than model documentation: uncovering teachers' bespoke information needs for informed classroom integration of chatgpt. In: CHI 2024 (2024)
30. Viberg, O., Mutimukwe, C., Grönlund, A.: Privacy in la research: understanding the field to improve the practice. J. L.A. **9** (2022)
31. Vreugd, L., van Leeuwen, A., Jansen, R., Schaaf, M.: Learning analytics dashboard design and evaluation to support student self-regulation of study behaviour. J. L.A. (2024)
32. Weydner-Volkmann, S., Bär, D.: Student autonomy and learning analytics: philosophical considerations for designing feedback tools. J. L.A. **11**(33) (2024)
33. Williamson, B., Bayne, S., Shay, S.: The datafication of teaching in higher education: critical issues and perspectives. Teach. in HiEd **25**(4) (2020)
34. Yang, K.B., et al.: Pair-up: prototyping human-AI co-orchestration of dynamic transitions between individual and collaborative learning in the classroom. In: CHI 2023 (2023)

35. Zawacki-Richter, O., Marín, V.I., Bond, M., Gouverneur, F.: Systematic review of research on artificial intelligence applications in higher education – where are the educators? Int. J. Ed. Tech. in HiEd **16**(1) (2019)
36. Zhou, Q., et al.: Investigating students' experiences with collaboration analytics for remote group meetings. In: AIED 2021 (2021)