AI Chatbot: I Want Help, not the Answer!

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Abstract: : In recent years, the integration of artificial intelligence (AI) into educational settings has become a topic of great interest. As technology continues to evolve, educators and students are exploring how AI can enhance learning experiences. University of South-Eastern Norway (USN) and Kristiania University College (HK) are developing a web-based educational tool, DbPersist, where IT students can practice tasks within the database subject and receive automated feedback. The latest version now also offers students suggestions on how to utilize AI for learning while they are solving various database related tasks. In this study, we explore the students' experiences with getting automatically generated "prompts" for further use in their preferred AI tool, whenever they request assistance. Do they see the value in gaining experience in using prompts designed for learning? Do they believe it might help them using AI for learning purposes in other courses in their study? To answer these questions, we conducted surveys and interviews. Participants included bachelor students across various disciplines and multiple campuses at USN. The participants were all enrolled in database courses with learning goals involving the database query language SQL and ER modelling (drawing Entity-Relationship Diagrams). Early findings suggest that students appreciate the assistance provided by DbPersist's AI prompts. They value the emphasis on AI-assisted learning and find the prompts useful for getting assistance in solving difficult tasks as opposed to getting complete answers. They also see the value in gaining experience in using AI chatbots using prompts designed for learning and understanding. As AI continues to shape education, tools like DbPersist offer exciting possibilities. DbPersist exemplifies how AI may be used to empower students, emphasizing learning and understanding alongside correctness.

Keywords: Artificial intelligence, Prompt engineering, Formative feedback, Active learning, Educational tool

1. Introduction

Using chatbots for educational purposes has been a research topic for several years. In a systematic literature review from 2021, Okonkwo and Ade-Ibijola describe how chatbot technology may be used for educational purpose (Okonkwo & Ade-Ibijola, 2021). Some of the primary benefits of using chatbot applications in education were having quick access and immediate assistance. A year later, ChatGPT was launched in November 2022. In the short time that has passed since ChatGPT was launched, AI chatbots have received a lot of attention in higher education and the research on how chatbots may be used for educational purposes continue (Patel et al., 2023). With the introduction of ChatGPT, some describe the dangers of cheating and misinformation (Rudolph et al. 2023). Gradually, new opportunities for learning begin to be discovered, including increased motivation (Yilmaz, 2023), individually adapted feedback, and more active learning (Rasul et al., 2023). In this paper, we look at how AI chatbots can enhance the effect of a learning tool for use by students in an introductory database course.

Learning technology and AI have a long history (Watters, 2023), and intelligent tutoring systems (ITS) have been developed for various subjects, including for learning database design and SQL (Mitrovic & Holland, 2020). Despite rapid technological development, basic educational challenges are far from being solved. It is not given that increasingly advanced learning technology will contribute to better learning for a heterogeneous student population (Watters, 2023). Although advanced ITSs have been developed and shown to have positive effects on learning in controlled experiments, these tools have not gained the widespread use one would imagine. In part, this probably has to do with the fact that it is expensive to build up the knowledge base (domain knowledge) that such systems require, but also that teachers find it demanding to fit ITS into practical teaching against fixed learning goals (Utterberg Modén et al., 2021).

Today's chatbots, such as ChatGPT, are based on artificial intelligence, machine learning and large language models. They are designed to communicate with the user in natural language. They are also quite capable at generating program code (interpreted in the broadest sense) from instructions in natural language, including for the query language SQL (Chang & Fosler-Lussier, 2023; Dong et al., 2023). Although you can communicate with the chatbot in natural language, heuristics and practical techniques have been developed for how to ask effective questions to the chatbot, e.g. prompt engineering. Chatbots are also programmable, in part you can further train it on your own data with "fine-tuning" techniques (Dong et al., 2023), and you can make the

chatbot communicate with other systems, by making lookups in external data sets using “retrieval-augmented generation” (Guo et al., 2023), e.g. to access up-to-date information on current topics.

Chatbots built on artificial intelligence and large language models open several new opportunities in learning technology, i.e. they may enrich the feedback capabilities of learning tools. In this paper, we investigate how students experience using a learning tool where they may receive prompts generated for AI chatbot use. The prompts are generated for the purpose of learning, and not for receiving a solution. Do students see the value in gaining experience in using prompts designed for learning? Do they believe it might help them using AI for learning purposes in other courses in their study?

1.1 DbPersist

DbPersist is a web-based educational tool developed for an introductory course in databases at university level. The tool is intended to give students the opportunity for volume training on exercises in areas such as ER (Entity Relationship) data modelling and SQL. It is multilingual, currently with support for English and Norwegian. Students from two universities located at several campuses have actively participated in the development of DbPersist.

DbPersist now contains around 50 exercises in data modelling. For each task, a scenario text and a proposed solution model have been created. The proposed solution is a detailed logical ER data model, which defines entities, attributes with data types, identifying and non-identifying relationships, primary and foreign keys. During exercise solving, the student has access to the names of entities and attributes used in the proposed solution and can build up a visual ER model by dragging and dropping these names into a drawing window.

For a selection of the modelling tasks, there are corresponding exercises in SQL, typically 10–20 exercises with proposed solutions for each database. The tool thus facilitates case-based working, where students can follow a case from an informal description via a data model to SQL queries for the resulting database. The SQL exercises test different problem types and techniques, but initially only SELECT queries are supported. Example data have been inserted into each database, so that it is possible to run SQL queries in the browser.

DbPersist is intended to support active and individually adapted learning through a combination of formative feedback and gamification. During exercise solving, the student can request feedback at any time, and then receive automatically generated formative feedback and hints based on a comparison of the student's answer and the proposed solution. The tool also has simple game mechanisms, such as students collecting points by solving exercises, there are leaderboards for overall performance and for each exercise, and you can obtain avatars based on effort and skills.

DbPersist is also an educational research project. The authors all teach an introductory database course. We use and experiment with DbPersist in our own teaching and collect the students' experiences, which are then used to improve the tool (Dæhli et al, 2018, 2020, 2021). The way the tool is developed is a “research lab”, where we have interviewed student developers about their experiences (Lauvås & Dæhli, 2022).

The tool has recently been augmented with the option of utilizing ChatGPT, or a similar chatbot, to achieve a richer form of feedback in natural language (Steiss et. al., 2024). When the student solves an ER exercise or an SQL exercise, he/she can click an “Ask AI” button to request a custom prompt to be printed by DbPersist, adapted to the specific situation. This prompt will, among other things, contain a description of the task, the sample database and the student's proposed answer. The student can copy this prompt to the clipboard at the touch of a button, and can paste it into their chosen chatbot, and optionally edit the prompt or follow up with further dialogue with the chatbot. The AI integration is therefore transparent to the students, in a way that allows them to read and modify the prompts that are generated. In doing so, the student becomes an active participant, deciding which exercises to solve and when to request feedback.

2. Method

Students from two different study programs at different campuses at USN were invited to participate in a survey. Both groups took an introductory database course, which included training in data modelling and SQL. It was respectively 70 and 77 registered students in the two groups.

2.1 Designing the Prompt

We needed the learning tool DbPersist to generate a prompt that students could copy and paste into an AI chatbot, and the response from the chatbot should hopefully work as good feedback to the students. There exists extensive research into the effects of formative feedback, and several sound principles have been

developed on what constitutes effective feedback. Formative feedback should be supportive, timely, and specific (Shute, 2008). Also, research-based principles and heuristics for what are effective ways to design prompts for AI chatbots, are about to be discovered. A prompt should be concise and clear, include context and examples (Dong et al., 2023).

From within DbPersist, we have access to information that can be used to generate such a prompt during problem solving such as the assignment text, the student's answer, and the proposed solution. Table 1 shows prompt templates used for data modelling and SQL exercises.

We explain to the chatbot that it will play the role of a teacher and should give motivating feedback (without giving away the answer), and that it will receive both the exercise text and the student's answer. It is given a list of criteria that it should use to assess the student's answers. For SQL exercises, it also gets a compact description of the database. Data models and databases are described in JSON (JavaScript Object Notation) format, which is a textual format useful for describing structured data in a compact manner. The data model includes names of tables and columns, data types, primary and foreign keys, as well as relationships with cardinalities.

We have chosen *not* to include the solution in the prompts, since the prompts will be visible to the students. If we instead had chosen to build a solution where DbPersist passed the generated prompt automatically to the AI chatbot (without showing the prompt to the student), it would probably be better to include the solution.

Table 1: Prompt templates for data modelling exercises (left) and SQL exercises (right).

You are a helpful university teacher who gives an IT course in databases and gives formative feedback to the students. I am a student, and I will enter an assignment text and the data model I have created as an answer to the assignment. Give me motivating and constructive feedback. The feedback should not give away the correct answer, but still be concrete. Limit the response to 700 characters. Structure the feedback as follows: Are there any errors with the names of the tables? Are there errors with the names of columns, or in which table they are located? Are there errors with primary keys and/or foreign keys? Are there any errors with relationships? Are there other errors in my data model? You can skip points that are not relevant. The assignment text in HTML format: <<TEXT>> The data model in JSON format: <<JSON>>	You are a helpful university teacher who gives an IT course in databases and gives formative feedback to the students when they solve tasks in the query language SQL. I am a student, and I will enter an assignment text, the data model for the assignment in JSON format, and the SQL query I have created as an answer to the assignment. Give me a motivating and constructive feedback. The feedback should not give away the correct answer, but still be concrete. Limit the response to 700 characters. Structure the feedback as follows: Am I using correct tables in the FROM clause and are they linked correctly? Have I made a mistake in the WHERE condition? Am I showing the correct columns in the SELECT clause? Am I using GROUP BY and any aggregate functions correctly? Am I using ORDER BY correctly? Are there any other errors in my query? You can skip points that are not relevant. The assignment text: <<TEXT>> The data model in JSON format: <<JSON>> The SQL query: <<SQL query>>

2.2 Lab Exercise

Lab exercises were carried out at two campuses in the last part of the semester. The teacher first demonstrated how to use DbPersist and the chatbot “Sikt AI”, which is a “safe” wrapper around ChatGPT 4 provided for free to students at Norwegian universities. The teacher also demonstrated how to use the “Ask AI” button. The students were then assigned to solve one exercise in data modelling, and three SQL exercises. They were told to use the “Ask AI” button in addition to other help integrated in the tool. We recommended Sikt AI, but they were free to alternatively use their favourite AI chatbot.

2.3 Survey

The survey was carried out directly after the students had tried out DbPersist with AI. The first part of the survey included general questions regarding the students' use of AI in the database subject, and their thoughts on AI in their future professional life (described in chapter 3.1). These questions in the first part were influenced by the Norwegian annual student survey (Studiebarometeret, 2023, pp. 47-52) in which questions regarding student use of AI was included for the first time in 2023. The second part dealt with AI in DbPersist (described in chapter 3.2). The survey contained both multiple choice questions and free text questions. 26

and 31 students, respectively, responded to the survey. In total, this gives 57 answers, which corresponds to a response rate of 39 % of registered students at the two study programmes.

2.4 Interview

After the survey had been completed, we recruited 6 of the students (3 from each campus) for a group interview to go a little more in depth. The interview was conducted on Zoom, without recording. One of the authors conducted the interview, the other two took notes. The transcribed result was anonymous. The group interview used the results from the survey as a starting point. The students were presented some of the most important findings from the survey and were asked to comment/elaborate on the answers. They were also encouraged to follow up each other's answers.

3. Results

3.1 Students use of AI in General

Question: *To what extent do you use artificial intelligence (AI) when learning about databases?* 9% of the respondents do not use AI at all, 16% use AI rarely, 47% use AI occasionally, while 28% use AI often. So, among our respondents 24% do not, or only rarely use AI for learning in their database course. The clear majority (76%) uses AI sometimes or often for learning in their database course.

Question: *What do you use AI for when learning about databases?* Several answers to this question were possible. The result is illustrated in Figure 1. 76% of the respondents use AI to explain concepts and terminology, and 63% use AI to generate code. Close to half the respondents use AI to check their own text (quality assurance) and as a discussion partner.

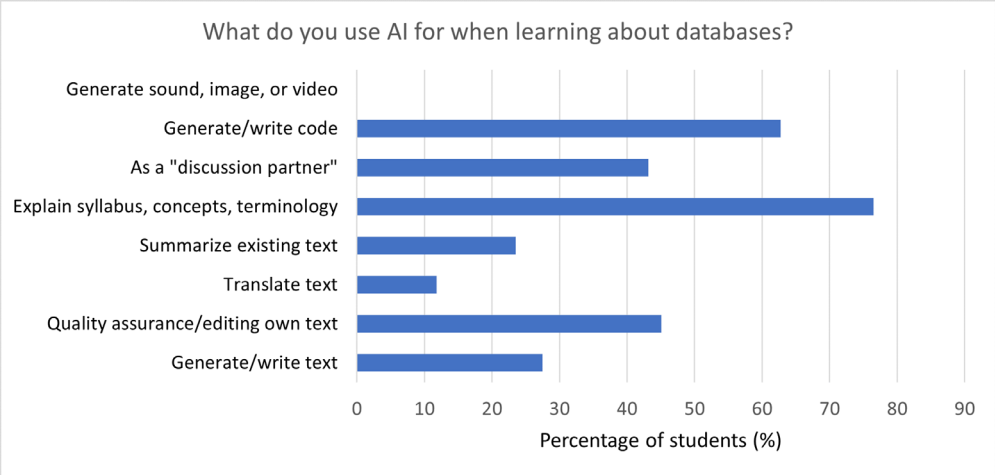

Figure 1: Use of AI when learning about databases

To this question, respondents could also enter free text if none of the given options fit. Some students mentioned the possibility of using AI to find or fix errors in their own code, and to generate test data. Generating test data were also mentioned by one of the students in the group interview: “The way I've used it is for big annoying tasks like filling databases. It has been fantastic, that you don't have to insert one and every value, so you can instead just ask: Insert 100 values, and it's done in 20 seconds.”

Question: *To what extent do you think AI will affect your everyday work in your future working career?* Figure 2 shows that the vast majory (93%) of the students in our survey believe that AI will affect their working career to some or to a large degree. 70% of the students believe AI will affect their working career to a large degree.

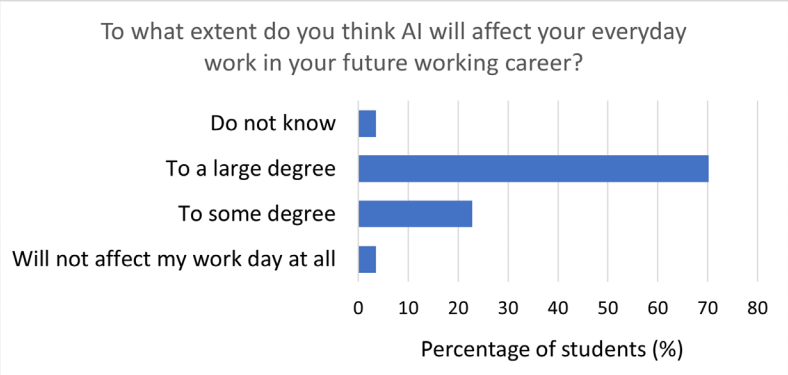

Figure 2: How students think AI will affect their future working career

Question: *To what extent do you think the use of AI should be included in the teaching of the database subject?* As most of the students believe that AI will affect their working career, it is no surprise that the students also believe AI should be included in the teaching of a database course. The majority (91%) believes that AI should be included in the teaching to some degree (52.6%) or to a large degree (38.6%). See Figure 3. However, we also notice that a minority thinks including AI is not required.

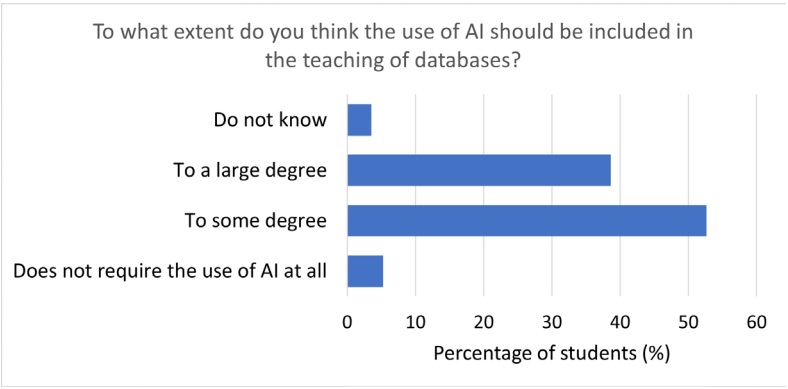

Figure 3: Including AI when teaching a database course

When following up with an open-ended question regarding *how* AI may be included in the course, we received multiple suggestions. Multiple respondents expressed a desire to learn how AI can provide aid without immediately revealing the answers. They were interested in learning how to ask effective questions to AI, and how to use AI to receive tips and guidance, rather than just conclusions. Some referred to this as using AI in "a healthy way" – for learning, as opposed to the unhealthy way for simply receiving a solution. They want to learn how to ask an AI in a way that pushes you in the right direction and encourage you to understand the substance. Some referred to this as using AI sort of like a teaching assistant.

Some respondents suggested that there should be instruction on how to use AI qualitatively to explain concepts. Some already use AI to identify where they are wrong, and most importantly, *why* they are wrong.

The inclusion of complex tasks that are difficult to understand was also suggested, with AI being used to explain these tasks. Respondents believed that AI could be used to explain things in different ways and wanted to see examples of question types that may be useful to achieve that. They also wanted to learn methods to check whether their work is correct and possibly receive feedback on incorrect SQL queries and database models.

3.2 Enriching a Learning Tool (DbPersist) with AI Prompting Capabilities

The second part of the survey consisted of a mix of open-ended questions and statements to evaluate on a Likert scale.

Question: *You have now tested "Ask AI" when working on a modelling task. How did you experience it?* Many respondents found the AI to be very helpful and effective in their learning process. They appreciated the AI's ability to guide them through tasks, provide feedback, and help them understand their mistakes. But multiple respondents found the recommended AI chatbot (Sikt AI) to be slow and imprecise at times.

Many respondents found the AI to be a useful learning tool. They liked that the AI could give them tips about things they may not fully see in the assignments, and that it could help them understand something they were missing. They liked that they could get tips and feedback without falling into the "give me the conclusion" trap.

Respondents liked that they could copy everything straight into the AI, without having to describe the task themselves. They found it great to have a pre-written text that they could copy and paste into the AI. Overall, the respondents found the AI to be a valuable tool in their learning process, despite some issues with speed and precision. They appreciated the AI's ability to provide feedback and guidance and found it to be a useful learning tool.

Question: *You have also tested "Ask AI" when working with SQL. How did you experience it?* The respondents were overall positive to their experience using "Ask AI" when solving SQL exercises. They appreciated the AI's ability to provide tips, feedback, and explanations, which helped them understand their tasks better. Some respondents felt that the AI enriched their learning experience, especially for those who were not very proficient in SQL. But to understand the response from AI, you had to be at a certain level to be able to use the response. They found the AI to be a good sparring partner that could review their work without giving specific answers, which they found beneficial for learning.

A few respondents found the AI to be a bit confusing and unclear at times. As one student put it in the interview: "It works, but you must be specific […]. It is not 100%, like asking a teacher, so to speak, who understands the context, you must be very specific." They felt that the AI occasionally oversimplified the task solution by telling them specifically what to use, instead of pointing out what was wrong and letting them figure it out themselves.

As with the former question in the survey, some respondents mentioned that the AI solution (Sikt AI) was a bit slow to work with. But overall, the respondents found the AI to be a valuable tool in working with SQL, despite some areas for improvement. They appreciated the AI's ability to provide feedback and guidance and found it to be a useful learning tool.

We further asked the students to evaluate the four statements (S1–S4) below, and answer on a scale from strongly disagree to completely agree, with the possibility of not knowing.

- S1: AI-generated answers gave me good help and direction during problem solving.
- S2: I learn more when I get hints and directions than when I get the solution.
- S3: I think it is unnecessarily cumbersome to have to copy questions and paste them into an AI chat.
- S4: This use of AI in a learning tool would be useful for learning also in other subjects in my education.

The results are shown in Figure 4.

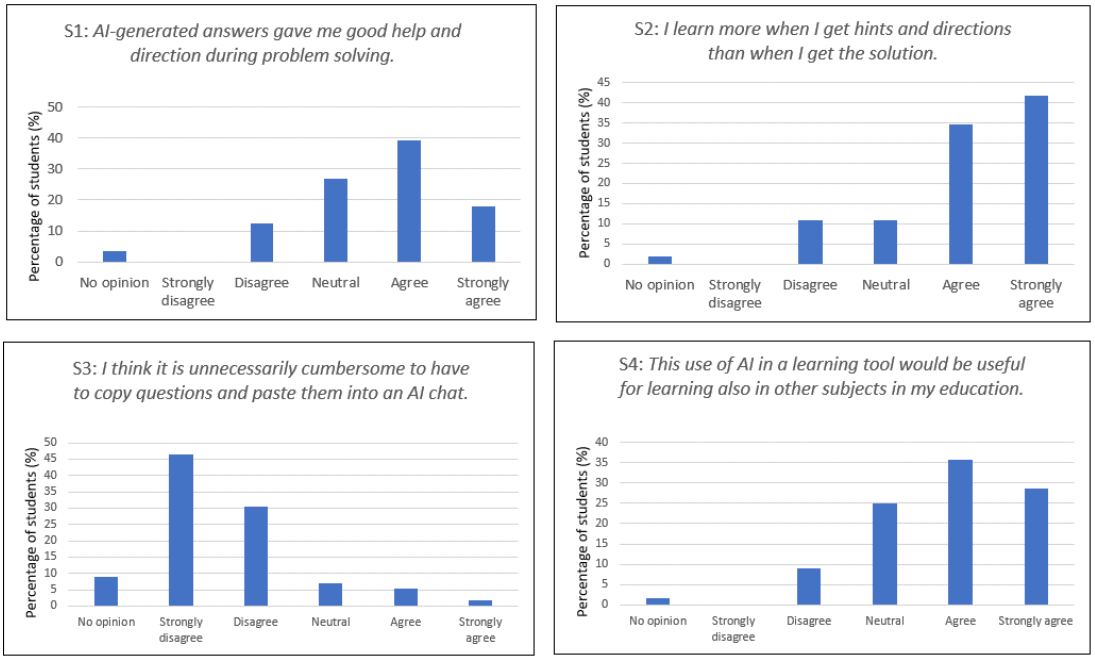

Figure 4: Answers to four statements (S1, S2, S3 and S4) regarding the "Ask AI" button in DbPersist

S1: As figure 4 shows, although not everyone agreed, there was an overall satisfaction in how the AI-generated help assisted them in their problem solving. 58% of the students answered agree or strongly agree.

S2: An even larger majority agreed to the statement that they learn more from getting hints than a solution. 76% of the students either agreed or strongly agreed.

S3: Most respondents did not find it cumbersome at all to copy and paste the AI prompt. 76% disagree or strongly disagree with this statement. On the contrary, one of the students in the group interview argued that the extra "step" was useful to be made aware of the use of AI.

S4: We see from figure 4 that the students experience using AI through the learning tool could be beneficial for other subjects as well. 64% of the students answered agree or strongly agree to this question.

Question: *After asking an AI tool for help with the recommended prompt, did you follow up with further dialogue with the AI tool?* 60% of the students occasionally followed up with further dialogue, 16% always followed up, and 16% never followed up. During the interview, students stated that an AI chatbot could be considered a conversational partner who was always available and to whom they did not have to be afraid to ask "stupid" or repetitive questions. The reason why they often did not feel the need to follow up the dialogue, was that the first response from the AI was often "spot on".

4. Discussion and Conclusion

AI chatbots are often discussed with concern in education, because of their ability to come up with solutions to exercises were students previously had to find solutions by themselves. This requires a shift towards developing the ability to ask the right questions, rather than just finding correct answers. Useful prompting requires a certain understanding of the material. Practicing preparing good and relevant prompts is therefore believed to contribute to learning and understanding.

The students obviously see the potential of AI in education, and the need for knowledge about AI in their studies and later in their professional life. They want to learn more about AI in general and how to use AI as a tool in the database course. The students are aware that you don't learn much from a tool that only output answers and see the value of getting hints that point you in the right direction, but at the same time they admit that it is tempting to use AI generated answers uncritically.

When solving exercises in DbPersist, students found it very useful to be able to generate AI prompts customized to their proposed solution. They did also like that prompts were designed to provide hints to move forward, instead of giving direct answers. Then, they could easily follow up with additional customized prompts. Working in this way, they felt they were also improving their own AI prompting skills, considered as valuable for use also in other courses. It was expected that students would find it a bit cumbersome to have prompts generated, which they then had to paste into a chatbot, but they did not. On the contrary, they see the value of having access to the prompt.

The students appreciated the chatbot's role as a "conversation partner" to whom they could freely ask questions without feeling stupid, and who did not get tired of repeated follow-up questions. There is a lower threshold for asking (many) "stupid" questions to a chatbot, compared to a teacher or tutor. At the same time, they expressed concern that AI could be used as a replacement for traditional teaching. Being able to get help from a teacher who knows the subject and the context, was seen as valuable from a student's standpoint. They considered it as important to balance the use of AI with traditional learning methods.

As for future work, we plan to further investigate how the students use AI prompts in DbPersist over time. The learning tool will still play an important part for students in multiple database courses in the coming semesters. We also want to explore new ways of tuning the prompt suggestions for AI chatbots to further improve the feedback. Over time, we hope to help students become more experienced in using AI for learning and also more self-powered learners.

Acknowledgements

The project has received financial support from Norwegian Directorate for Higher Education and Skills for 2022–2024 (grant AKTIV-2021/10158). We would also like to express our gratitude towards the University of South-Eastern Norway and Kristiania University College for their facilitation of the project.

References

Chang, S., & Fosler-Lussier, E. (2023). How to prompt llms for text-to-sql: A study in zero-shot, single-domain, and cross-domain settings. arXiv preprint arXiv:2305.11853.

Dong, X., Zhang, C., Ge, Y., Mao, Y., Gao, Y., Lin, J., & Lou, D. (2023). C3: Zero-shot text-to-sql with chatgpt. arXiv preprint arXiv:2307.07306.

Dæhli, O., Kristoffersen, B., Lauvås Jr, P. and Myrbakken, H., 2018. A Supportive Web-Based Tool for Learning Basic Data Modeling Skills. In ECEL 2018 17th European Conference on e-Learning (p. 116). Academic Conferences and Publishing Limited.

Dæhli, O., Kristoffersen, B. and Sandnes, T., 2020. Lessons Learned from Developing and Evaluating an Educational Database Modeling Tool. In European Conference on e-Learning (pp. 129-XVI). Academic Conferences International Limited.

Dæhli, O., Kristoffersen, B., Lauvås Jr, P., & Sandnes, T. (2021). Exploring Feedback and Gamification in a Data Modeling Learning Tool. Electronic Journal of e-Learning, 19(6), 559-574.

Guo, C., Tian, Z., Tang, J., Li, S., Wen, Z., Wang, K., & Wang, T. (2023). Retrieval-augmented gpt-3.5-based text-to-sql framework with sample-aware prompting and dynamic revision chain. In International Conference on Neural Information Processing (pp. 341-356). Singapore: Springer Nature Singapore.

Lauvås, P., & Dæhli, O. (2022). Students' view on applying for part-time work as an on-campus software developer.

Mitrovic A. & Holland J. (2020). Effect of Non-mandatory Use of an Intelligent Tutoring System on Students' Learning. In: Bittencourt I., Cukurova M., Muldner K., Luckin R., Millán E. (eds) Artificial Intelligence in Education. AIED 2020. Lecture Notes in Computer Science, vol 12163. Springer, Cham. https://doi.org/10.1007/978-3-030-52237-7_31

Okonkwo, C. W., & Ade-Ibijola, A. (2021). Chatbots applications in education: A systematic review. Computers and Education: Artificial Intelligence, 2, 100033.

Patel, R., Bajaj, P., Kumar, A., Kumari, A., Rai, V., & Kumar, S. (2023). ChatGPT in the Classroom: A Comprehensive Review of the Impact of ChatGPT on Modern Education. In 2023 11th International Conference on Intelligent Systems and Embedded Design (ISED) (pp. 1-6). IEEE.

Rasul, T., Nair, S., Kalendra, D., Robin, M., de Oliveira Santini, F., Ladeira, W. J., ... & Heathcote, L. (2023). The role of ChatGPT in higher education: Benefits, challenges, and future research directions. Journal of Applied Learning and Teaching, 6(1).

Rudolph, J., Tan, S., & Tan, S. (2023). ChatGPT: Bullshit spewer or the end of traditional assessments in higher education? Journal of applied learning and teaching, 6(1), 342-363.

Shute, V. J. (2008). Focus on formative feedback. Review of educational research, 78(1), 153-189.

Studiebarometeret (2023), NOKUT. Available from https://www.nokut.no/globalassets/studiebarometeret/ 2024/hoyere-utdanning/studiebarometeret-2023_hovedtendenser_4-2024.pdf. Accessed 2024-05-22.

Steiss, J., Tate, T., Graham, S., Cruz, J., Hebert, M., Wang, J., ... & Olson, C. B. (2024). Comparing the quality of human and ChatGPT feedback of students' writing. Learning and Instruction, 91, 101894.

Utterberg Modén, M., Tallvid, M., Lundin, J., & Lindström, B. (2021). Intelligent tutoring systems: Why teachers abandoned a technology aimed at automating teaching processes.

Yilmaz, R., & Yilmaz, F. G. K. (2023). The effect of generative artificial intelligence (AI)-based tool use on students' computational thinking skills, programming self-efficacy and motivation. Computers and Education: Artificial Intelligence, 4, 100147.

Watters, A. (2023). Teaching machines: The history of personalized learning. MIT Press.