

Teaching Tip
Incorporating AI Tools Into Database Classes

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Teaching Tip

Incorporating AI Tools Into Database Classes

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ABSTRACT

This teaching tip explores the integration of AI tools into database education. The author describes how instructors can use AI tools to prepare teaching materials and how students can use AI to facilitate database development. The teaching tips provided encompass both course-level objectives and assignment-specific strategies. The inclusion of AI prompts and the comprehensive coverage of tasks indicates an integrated approach to enhancing overall course delivery while providing specific guidance on individual assignments. Surveys and email interviews with students revealed positive feedback regarding the AI-integrated assignments. Students found AI tools helpful for learning database concepts, developing databases, understanding SQL code, and improving their problem-solving and critical thinking skills. Additionally, students expressed a desire for further learning in prompt engineering and better communication with AI tools. Although student feedback is positive, educators must also consider challenges such as over-reliance on AI and the need to train students in critical thinking and problem-solving skills. Designing assignments that require reflections and detailed documentation of the problem-solving process could be an effective approach. The detailed process and associated materials in the appendices provide useful resources for instructors who want to incorporate AI tools into their database courses.

Keywords: Database management systems (DBMS), Generative AI in teaching, Structured query language (SQL), Artificial intelligence, Case study, IT education

1. INTRODUCTION

The Bureau of Labor Statistics predicts that, from 2022 to 2032, database jobs will increase by 8% (Bureau of Labor Statistics, 2024). SQL is the most in-demand talent to be employed in 2024, according to Coursera and Indeed (Baraka, 2024). These statistics show that it is important for students to gain SQL competencies to make them more marketable. In addition to SQL skills, with the rapid adoption of AI tools (e.g., ChatGPT, Copilot, Gemini), the demand for artificial intelligence (AI) skills has been growing. According to Indeed, AI job postings increased twentyfold in the first ten months of 2023 (Dumas, 2024). The Access Partner (2023) survey reports that 75% of employers consider AI hiring their top priority. Companies find hiring people with AI expertise difficult, and employees want to learn about AI but are unsure where to get the necessary training. Colleges and universities are in an excellent position to help close the skills gap in artificial intelligence as interest in the field grows among students (Leckrone, 2023).

Information systems (IS) teachers should assist students in developing human-AI integrated business skills to better prepare them for future professions (Chen, 2022). AI and database management systems are increasingly converging together: for instance, the crucial task of query generation or query auto-completion, the tricky problem of optimizing database storage, and the often challenging task of retrieving data from a database more effectively by using AI algorithms are now AI-augmented database management processes (Kim

& Lee, 2023). By teaching students to use AI tools in database courses, we prepare them better for roles needing these AI-specific skills. Thus, integrating AI with database education will help fill the gap between AI job demands at an abstract level and AI competencies at a more specific level.

Increasingly, universities are signing agreements with leading AI platforms (such as ChatGPT and Copilot) for students and employees to use at work and in their studies. The intention is to stay current and relevant and embrace AI. IS educators must introduce rapidly evolving and in-demand technology to their students (Topi et al., 2017). AI could benefit students and educators (Labadze et al., 2023) and improve learning motivation. The drive to incorporate AI into the IS curriculum arises from its ability to improve educational outcomes and the growing demand to equip students with the AI and data analytics skills increasingly valued in today's workforce (Nah et al., 2023; World Economic Forum, 2023). This teaching tip explores how students can use AI to learn about database development and how instructors can leverage AI tools to prepare teaching materials and assessments.

AI offers numerous benefits to instructors. Typical tasks, such as quiz creation, lecture material preparation, and grading, can be partially automated (MIT Sloan Teaching & Learning Technologies, 2024), allowing instructors more time to engage with students and focus on personalized attention. This deeper connection enhances the instructor-student relationship. By getting to know their students better, instructors can offer more

tailored support, which ultimately contributes to student success (Jederlund & von Rosen, 2023).

Research supports this trend. Ofosu-Ampong (2024) found that more than two-thirds (84%) of lecturers in Ghana are willing to embrace AI for their students. Using a quantitative approach, data from 46 EFL (English as a Foreign Language) instructors showed that they strongly relied on AI applications to streamline tasks, provide data-driven insights, and customize learning experiences for each student. In language learning, instructors reported enhanced engagement, motivation, and teaching efficiency when AI was integrated into their teaching (Hazaymeh et al., 2024). In foreign language learning, AI also provides students with an enjoyable and engaging learning experience.

The US Department of Education (2023) also highlights the benefits of AI's course planning and design. Evidence continues to grow in favor of AI's utility in teaching, particularly for automating tasks and powering adaptive assessments. For example, AI can aid in creating and scoring exams (Celik et al., 2022) and offer adaptive assessments that adjust student performance (Seo et al., 2021).

2. COURSE OVERVIEW

The lesson described in this paper was based on an undergraduate database course taught in Spring 2024 at a large Southeastern university. MySQL and AI tools were used in this class. The course was designed to introduce popular database software tools in response to market demands. MySQL was used to teach database concepts, relational database design, and physical implementation. The learning objective of this class was to develop comprehensive data models that reflect business requirements and rules, design and implement relational databases, and gain proficiency in SQL for effective data manipulation to support business decision-making.

A background survey was conducted in the first week of the semester to understand students' prior experience with databases and programming. The survey included questions

about students' SQL experience and their attitudes toward coding. Among the 35 students, one was a finance major, one was a criminal justice major, and the rest were IS majors. Notably, 80.5% of the students had no prior SQL experience, while 19.5% had experience with SQL either at work or during their internship programs. When assessing students' attitudes toward coding, we used the statement, "I like coding." The responses to this statement showed that 66.7% of students favor coding, 23.8% are neutral, and 9.5% dislike coding.

The database class was scheduled for a 16-week term and is a required course for IS majors. A few non-major students can also take the course if their minor or concentration is in IS. The AI-related exercises on SQL coding and problem-solving were introduced after the mid-term exam. The first five weeks of the semester were spent on logical database design, followed by three weeks of SQL coding. The midterm exam tested students' knowledge of entity relationship models and basic SQL coding. Before the mid-term, students were explicitly asked not to use AI tools to generate answers. These teaching tips focus on learning activities after the midterm exam.

3. COURSE DESIGN

Table 1 displays the course alignment, including objectives, instructional materials, learning activities, and assessment methods. We begin with content related to how professors use AI tools, followed by content on how students use AI tools in database design.

3.1 AI for Professors

AI can assist professors in preparing course materials, saving them significant time. Professors use various pedagogical approaches, but we focus on using AI to generate mini-cases and quiz questions for this teaching tip. Course materials can include mini-cases to help students develop higher-order thinking skills, while quizzes can be used to assess students' learning.

Course Objective	Instructional Materials	Learning Activities	Assessment
Develop comprehensive data models that reflect business requirements and rules	Read Chapter 3 - Relational Database	Read the mini-case and identify the entities and attributes of each entity	Mini case analysis
Design and implement a database that improves business performance	Read Chapter 4 - Entity Relationship Diagram	Develop ERD based on the mini-case; Develop sample data based on the entity and associated attributes	Independent Solution AI-Solution
Gain proficiency in SQL for effective data manipulation to support business operations	Read Chapter 7 - Introduction to Structured Query Language	Write SQL queries to create tables based on ERD; Write SQL queries to insert data into each table	Independent Solution AI-Solution
Develop a database to solve business problems	Read Chapter 8 - Advanced SQL	Develop analytical questions; Write SQL queries to answer business questions	Independent Solution AI-Solution
Keep up with the latest technology developments and trends	Read instructions on the sample AI prompts and revise as needed	Practice AI tools to learn ERD and SQL statements	Student's reflective assessment

Table 1. Course Learning Objectives Alignment

3.1.1 AI-Generating Mini-Cases. Numerous studies provide evidence of teaching effectiveness when case studies are used (Gasim et al., 2024; Nilson, 2016). Because case studies involve

students actively in the case, they are an excellent tool for teaching core skills, including critical thinking and problem-solving techniques (Song et al., 2022). Case-based learning

improves students' information retention, retrieval, and reasoning (Gasim et al., 2024). Students who get case-based learning do well and find the material enjoyable (Albanese & Mitchell, 1993). However, writing a good case takes time, as it needs to be realistic and practical with effort and imagination (Egleston, 2013; Nilson, 2016). AI tools can be used to generate mini-case studies for teaching purposes. Leveraging AI tools such as Copilot can save tremendous time for instructors to produce a mini-case to demonstrate concepts to students.

Below are examples of prompts used to generate the mini-case. AI tools such as ChatGPT and Gemini can be used; however, we used Copilot (version 3.0) for demonstration purposes, as it is the AI tool approved by the author's university.

3.1.1.1 Prompt Example 1. "Generate a mini case study about a health clinic planning to implement a database system to manage patient appointments and services. The clinic uses Excel spreadsheets and paper-based systems to document its business activities. The case should provide sufficient context for students to identify this scenario's main entities and relationships."

Figure 1 below contains the mini-case generated by Copilot. A good case should contain setting and problems, ask students to produce solutions, also have a sense of urgency, and maintain a level of ambiguity to promote critical skills, and problem-solving skills for students and allow students room for creative thinking and critical analysis (Nilson, 2016) and be effective in developing skillsets for students (Grimes, 2019).

Case Study: Streamlining Patient Services at ABC Medical Center

Background
 ABC Medical Center is a community healthcare facility that has been relying on a combination of Excel spreadsheets and paper records to manage patient appointments, medical histories, and service coordination. As the clinic experiences growth, the limitations of this manual approach have become evident. Staff members struggle with appointment scheduling, data accuracy, and timely follow-ups. To address these challenges, the clinic's management has decided to implement a modern database system.

Objectives
 The primary objectives of adopting the new database system are as follows:

1. **Efficiency:** Simplify appointment scheduling, reduce administrative overhead, and enhance overall operational efficiency.
2. **Accuracy:** Eliminate errors associated with manual record-keeping and improve data accuracy.
3. **Accessibility:** Enable authorized staff to access patient information securely from any location within the clinic.
4. **Scalability:** Prepare for future growth and adapt to changing patient needs seamlessly.

Proposed Solution
 ABC Medical Center plans to develop a comprehensive database system that integrates the following functionalities:

1. **Patient Registration and Demographics:** Capture essential patient details, including personal information, medical history, and insurance data.
2. **Appointment Management:** Provide staff with tools for efficient scheduling, rescheduling, and appointment tracking. Automated reminders will be sent to patients.
3. **Electronic Health Records (EHR):** Maintain digital health records for each patient, including diagnoses, treatments, medications, and lab results.
4. **Billing and Payments:** Streamline billing processes, manage insurance claims, and track payments.
5. **Service Coordination:** Facilitate referrals to specialists, follow-up appointments, and preventive care.
6. **Reporting and Analytics:** Generate reports on patient demographics, appointment trends, and clinic performance.

Figure 1. Mini-Case Copilot Output

Figure 1 satisfies the attributes of the good teaching case, as Sheehan et al. (2018) suggested. While concise, it is a solid starting point for enriching the mini-case. The author incorporated the AI-generated storyline to enhance the details and revised the case for teaching purposes. This exercise aims to gain database design and SQL coding skills and acquire AI

skills for students. Below is the revised mini-case for students to work on.

Mini-case Wellbeing Clinic: Wellbeing Clinic has been in practice for ten years, providing outpatient services to patients in the Greater Cincinnati area. The clinic offers various medical services, including general checkups, vaccinations, lab tests, and specialty consultations. With six doctors, 12 nurse practitioners, six registered nurses, two medical assistants, two administrative staff, and two receptionists, the clinic has significantly expanded its patient base as the number of patients continues to increase.

Wellbeing Clinic relies on a combination of Excel spreadsheets and paper records to manage everything from patient appointments to medication history. A calendar of appointments in an Excel table of color-coded cells and conditional formatting can cause confusion and errors. Updates to patients' information necessitate manual revisions in several other spreadsheets. The paper-based charts take time to locate and also risk being misplaced.

Doctors are increasingly experiencing double booking, lost records, phone tags and other time-consuming record-keeping. Staff often waste time searching for files or manually entering data in charting programs to record patient encounters. Patient care and clinic efficiency are both suffering.

The management of Wellbeing Clinic knows they have to change. The current system hinders the potential for greater efficiencies and prevents them from growing their patient base at higher levels. A modern database system would unlock better operations and more informed patient care. They want the new database system to manage appointments, unify patient records, streamline the billing process, and generate reports based on patient demographics, appointment trends, and clinic performance.

As an IS student, you are hired as a database consultant. You have been asked to assist in designing, developing, and implementing the Wellbeing Clinic database system.

3.1.2 AI-Generating Quizzes. In addition to generating cases, AI tools could help produce test questions. For example, we asked Copilot to create a multiple-choice question, a true/false, and a fill-in-blank entity relationships diagram. Below are the prompts and outputs.

3.1.2.1 Prompt Example 2. Produce a multiple-choice question on the entity relationships diagram.

Copilot

Certainly! Here's a multiple-choice question related to entity-relationship diagrams (ERDs):

Question: In an ER diagram, if entity B is the dominant entity and entity A is a subordinate entity, which of the following statements is **incorrect**?

(A) An A existence is dependent on B. (B) Operationally, if A is deleted, B remains the same. © Operationally, if A is deleted, so is B. (D) Operationally, if B is deleted, so is A.

Answer: (A) An A existence is dependent on B .

Figure 2. Copilot Generated Multiple-Choice Questions on Entity Relationship

3.1.2.2 Prompt Example 3. Produce a true/false question on the entity relationships diagram.

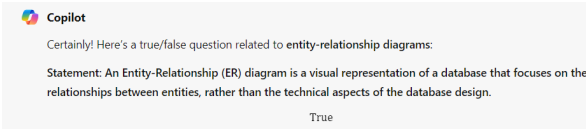


Figure 3. Copilot Generated True/False Question on Entity Relationship

3.1.2.3 Prompt Example 4. Produce a fill-in-blank question on the entity relationships diagram.

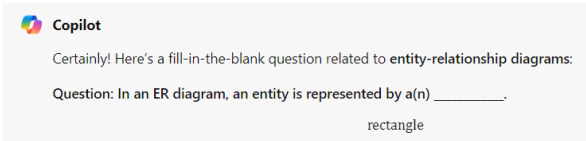


Figure 4. Copilot Generated Fill-In-Blank Question on Entity Relationship

Quizzes can engage and motivate students in learning (Cook & Babon, 2017) and are valuable in assessing students' learning students learning (Boitshwarelo et al., 2017). We could ask Copilot to regenerate multiple-choice items because it can generate questions in different formats (e.g., multiple-choice, true/false) on the same topic but with other variations. Students benefit from experiencing a variety of questions on the same topic, as different formats can target different levels of learning in Bloom's taxonomy. This allows students to understand concepts better and explain the differences. AI tools can generate multiple questions in various formats at once. Figure 5 below demonstrates the efficiency of AI in generating quiz questions, highlighting its potential to streamline the process. For demonstration purposes, we asked Copilot to create three questions. In practice, 10 or more questions on a given topic can be generated.

3.1.2.4 Prompt Example 5. Generate 3 questions on ERD with one multiple-choice, one true/false, and one fill-in-the-blank.

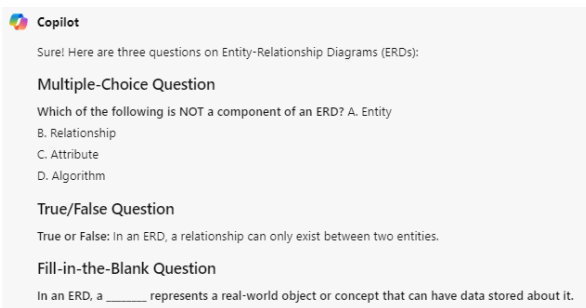


Figure 5. AI-Generated Multiple Questions at Once

3.1.3 AI-Generating Presentation Slides. Instructors can use AI to generate presentation materials, which helps them quickly prepare teaching content. Figure 6 shows slide content generated by Copilot. As shown in Figure 6, each slide provides accurate, relevant, and useful information on teaching students the basics of ERDs.

3.1.3.1 Prompt Example 6: Please generate 4 slides on entity relationship diagrams.

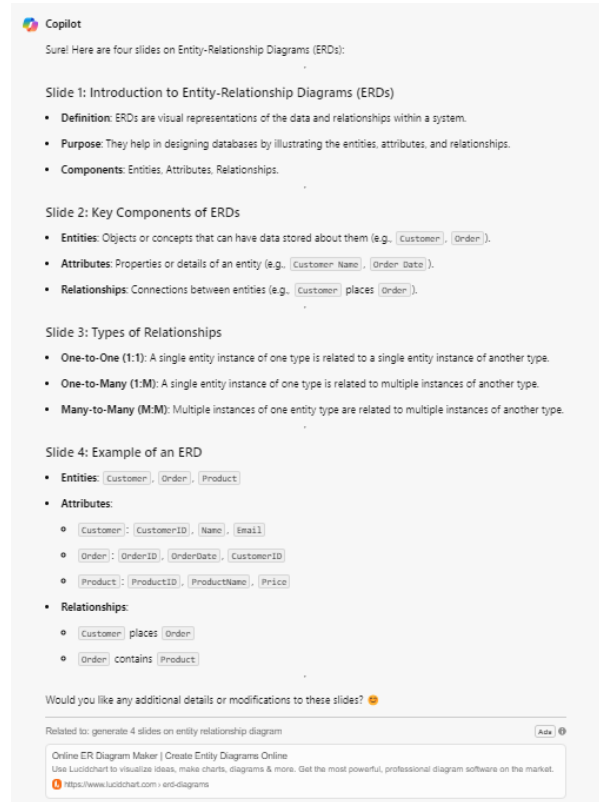


Figure 6. Copilot-Generated Presentation Slides

3.2 Database Tasks for Students

Students were tasked with designing and developing a database management system for the Wellbeing Clinic. Students were required to deliver two solutions over two weeks: one developed independently using the Wellbeing Clinic mini-case, and the other created using AI tools, comparing their answers with those generated by AI. The first solution was required to be completed independently, and the AI solution was completed using the AI tool. Each solution must contain the following three tasks. Students were guided with the following tasks for both independent and AI-generated solutions.

- Task 1.** Design the logical entity relationship diagram and draw the logical diagram in MySQL.
- Task 2.** Develop hypothetical test data sets and load the data into the database.
- Task 3.** Develop analytical questions to assess business performance. These questions should encompass various aspects, including descriptive, correlation, comparative, and trend analysis.

Detailed teaching notes include tasks, prompts, and associated outputs in the appendices. Appendix A contains details on the prompt and output related to Task 1. Appendix B provides information on the prompt and output for Task 2. Appendix C includes details on the prompt and output associated with Task 3.

3.2.1 Task 1 Independent Solution. Students were given a week to complete the database design questions listed above. They were instructed to use the knowledge and skills they had learned in the first half of the semester to design the logical model and were explicitly told not to use AI tools for their answers. They needed to identify the entities, attributes of each entity, and relationships among them. Additionally, they were asked to imagine they were the managers of the clinic and determine the business questions they would care about. Similarly, they needed to consider what business questions would be important if they were the clinicians.

Students came up with entities such as physicians, staff, appointments, visits, schedules, and billing. They identified appropriate primary attributes and foreign keys for their tables and established proper relationships between them. Although students used different names for their entities, they generally captured the essential entities and established relationships between them. The submitted work demonstrated varying levels of complexity in designing the database management systems for the Wellbeing Clinic.

3.2.2 Task 1 AI-Generated Solution. In the week following the submission of the independent case solution, students were given another week to complete the same tasks using AI tools. They were required to use AI to generate the solutions and then compare and contrast their answers with those produced by AI tools (e.g., ChatGPT, Copilot). Students were warned that the output from ChatGPT is sensitive to its input (Reynolds & McDonnell, 2021). They were recommended to experiment with different prompts and provide specific context in their inquiries to AI tools to ensure that the output better matched their needs. The purpose of this exercise was to understand both human and machine intelligence. As part of the grading rubric, students were required to document their prompts and write an assessment by comparing the answers they produced with those generated by AI tools.

3.2.3 Task 1 Sample Students' Evaluation of AI-Generated Solutions. Below is a sample of a student's assessment of AI-generated output.

"In addition to using the Wellbeing Clinic case, I generated a few using AI. Of the several mini-cases I generated, this was the only generation sample with a "description and use" explanation for each table. I am surprised that the other mini-case generations did not include this, as it makes the logic of the relationships understandable. Entities all appear to be elements that support the KPIs listed in the generated mini-case. I would have shortened the entity/column names to be more efficient in queries (e.g., VisitDateID vs. Patient_Visit_Date_ID). I am still trying to understand how the data from each table will be integrated with the queries. Hopefully, it will click a bit better once I get to the final questions."

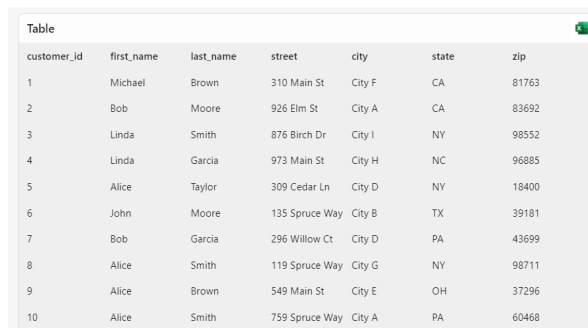
Students' evaluation of AI solutions involved critical thinking, analysis, and higher-order cognition. We can identify multiple learning processes by analyzing their evaluation of the AI solutions. The assessment demonstrates attention to detail and critical analysis, and their surprise that not all cases included necessary explanations indicates their expectation for comprehensive and complete documentation. Their understanding of entity-relationship concepts (entities and attributes) and their comment on shortening entity names show

they are practical and can apply theoretical concepts to real-world situations. This comment also suggests the student's motivation to learn. Proactive learning is evident in the student's eagerness to understand how data from each table would be integrated into queries. Additionally, the student's expectation that additional questions will deepen their comprehension demonstrates a growth mindset.

3.2.4 Task 2 Independent Solution - Develop Hypothetical Test Data Sets and Load the Data. The first solution requires students to complete it independently. Students used Excel to create sample data for each entity based on the identified entities, attributes, and relationships. This manual process allows students to visualize the data for their design tables. The sample data should align with the entities and relationships in their ERD. The students can then use this data to confirm that their proposed queries and database schema are correct and to catch issues early in the development process. This approach encourages interactions with data that will translate the requirements of business users into meaningful data. Students can visualize that process and the flow of the data.

3.2.5 Task 2 AI-Generated Solution - Develop Hypothetical Test Data Sets and Load the Data. When using AI to generate data, students enter the below prompts. Figure 7 shows the output of AI-generated sample data.

3.2.5.1 Prompt Example 7. Generate 10 entries for the customer table containing customer id (primary key), customer first name, customer last name, street, city, state, zip



customer_id	first_name	last_name	street	city	state	zip
1	Michael	Brown	310 Main St	City F	CA	81763
2	Bob	Moore	926 Elm St	City A	CA	83692
3	Linda	Smith	876 Birch Dr	City I	NY	98552
4	Linda	Garcia	973 Main St	City H	NC	96885
5	Alice	Taylor	309 Cedar Ln	City D	NY	18400
6	John	Moore	135 Spruce Way	City B	TX	39181
7	Bob	Garcia	296 Willow Ct	City D	PA	43699
8	Alice	Smith	119 Spruce Way	City G	NY	98711
9	Alice	Brown	549 Main St	City E	OH	37296
10	Alice	Smith	759 Spruce Way	City A	PA	60468

Figure 7. AI-Generated Sample Data

3.2.6 Task 2 Sample Students' Evaluation of AI-Generated Solutions. Copilot can quickly generate ten entries for the data. Students are satisfied with AI-generated data as they comment that they must think more about the names and addresses. In terms of naming convention, Copilot can follow programming conventions to name the columns appropriately. In addition, it allows students to download the data in Excel format. AI is efficient in generating sample data for database design.

The prompt below can insert records into tables when loading data into a table. Copilot can produce the correct SQL statement and also provides the option to copy the code. Figure 8 depicts a sample SQL code generated by AI.

3.2.6.1 Prompt Example 8. Write an SQL statement to insert 10 rows of data into the customer table above.

```

SQL
INSERT INTO customer (customer_id, first_name, last_name, street, city, state, zip)
VALUES
(1, 'Michael', 'Brown', '310 Main St', 'City F', 'CA', '81765'),
(2, 'Bob', 'Moore', '926 Elm St', 'City A', 'CA', '83692'),
(3, 'Linda', 'Smith', '876 Birch Dr', 'City I', 'NY', '98552'),
(4, 'Linda', 'Garcia', '973 Main St', 'City H', 'NC', '96885'),
(5, 'Alice', 'Taylor', '309 Cedar Ln', 'City D', 'NY', '18400'),
(6, 'John', 'Moore', '135 Spruce Way', 'City B', 'TX', '39181'),
(7, 'Bob', 'Garcia', '296 Willow Ct', 'City D', 'PA', '43699'),
(8, 'Alice', 'Smith', '119 Spruce Way', 'City G', 'NY', '98711'),
(9, 'Alice', 'Brown', '549 Main St', 'City E', 'OH', '37296'),
(10, 'Alice', 'Smith', '759 Spruce Way', 'City A', 'PA', '60468');

```

Figure 8. AI-Generated SQL Code

3.2.7 Task 3 Independent Solution - Develop Analytical Questions to Assess Business Performance. Students must produce four types of questions: descriptive, correlation, comparative, and trend analysis.

- Descriptive Question: An example of a descriptive question is, “How many customers do we have?”
- Correlation Question: An example of a correlation question is, “Does profit correlate with quantity sold?”
- Comparative Question: An example of a comparative question is, “What is the difference in sales between customers in groups A and B?”
- Trend Analysis Question: An example of a trend question is, “What is the trend in monthly sales for 2023?”

3.2.8 Task 3 AI-generated Solution - Develop Analytical Questions to Assess Business Performance. Below is the prompt to generate four types of analytical questions using Copilot. Figure 9 shows AI-generated analytical questions.

3.2.8.1 Prompt Example 9. I have a customer table and a sale table. Please produce analytical questions to assess business performance.

3.2.9 Task 3 Sample Students’ Evaluation of AI-Generated Solutions. Figure 9 shows AI-generated analytical questions. The answer is very comprehensive, covering all four types of the required questions. Below is an excerpt from the student’s evaluation.

“These are considerably more performance-related questions than were requested, but I was impressed with the response, so I included it here. I had some difficulty understanding exactly how the database would function, but after reading these suggested query scenarios, I think I have a better understanding.”

4. DISCUSSION

This teaching tip demonstrates how AI can be useful in teaching and learning databases. In terms of students’ learning experience, they were placed in a consultant role, requiring them to understand a business case, identify the problem, and tackle assigned tasks. The examples span from development to analysis. Students learn how to function as analysts, dissect business problems, gather requirements, and build logical models, which they then use as blueprints to create physical databases in MySQL. Following this, students are asked to adopt the role of a data analyst and consider, as users or

managers, what kinds of business-related questions they should ask and what reports they would want to generate. In terms of learning, this process integrates problem-solving and critical thinking skills, engaging students at all levels of Bloom’s taxonomy. To evaluate students’ perceptions of these learning approaches, we conducted a survey containing questions that assessed each level. The pedagogical approach combines active learning with project-based learning.

1. Sales Trends:
 - What are the overall sales trends over a specific period (e.g., monthly, quarterly, yearly)?
 - How do sales vary across different product categories or regions?
2. Customer Behavior:
 - What is the average transaction value per customer?
 - How frequently do customers make purchases?
 - Are there any patterns in customer preferences (e.g., popular products, repeat purchases)?
3. Profitability:
 - What is the profit margin for each sale?
 - Which products or services contribute the most to overall profit?
4. Customer Segmentation:
 - Can we segment customers based on demographics, behavior, or purchase history?
 - How do different customer segments impact sales and profitability?
5. Churn Analysis:
 - What is the customer churn rate (percentage of lost customers)?
 - Are there specific reasons for customer attrition?

Figure 9. AI-Generated Solution

The assignments combine traditional database skills with emerging AI technologies. We used a mixed method to assess students’ learning experiences and perceptions of using AI to enhance their learning. An online survey was sent to students to evaluate their experience. The survey questions assess students across all six levels of learning in Bloom’s Taxonomy: remembering, understanding, applying, analyzing, evaluating, and creating. We used a 5-point Likert scale for the survey questions, where 1 represents the minimum, and 5 represents the maximum. For effective learning to occur, all levels must be involved. In addition to using surveys to collect students’ feedback, the author conducted email interviews with three students about their experience with this AI assignment.

4.1 Survey Feedback

Table 2 shows descriptive statistics of survey questions about students’ feedback on the AI-incorporated assignment. The survey questions were designed to be relevant to database design and evaluation of AI for this assignment. Table 2 shows the mean response in descending order. A few questions contain negative words to reduce response biases and the reliability of measurement instruments, as Nunnally and Bernstein (1994) suggested. As shown in Table 2, students rate highest on understanding entities and attributes (Mean=4.54, Std=0.66, Median=5.0), followed by critical analysis of AI answers (Mean=4.33, Std=0.76, Median=4.0), enhancing creativity (Mean=4.33, Std=0.87, Median=4.0), contribution to learning (Mean=4.29, Std=0.75, Median=4.0), and remembering concepts (Mean=4.21, Std=1.14, Median=4.5). The four lowest-rated questions are diminishing critical thinking skills (Mean=3.08, Std=1.44, Median=3), incorrect SQL code in analytical questions (Mean=2.96, Std=1.46, Median=3),

ineffective ER model for the specific business case (Mean=2.79, Std=1.38, Median=3). These low ratings indicate that students disagree with these statements. Students did not strongly agree with having problems with their critical thinking skills, having many logic errors in their SQL code, having inaccurate or invalid ER models and having trouble creating different scenarios.

A recent study by Boubker (2024) found that students report ChatGPT as useful and believe it improves their learning. Additionally, students give code explanations produced by large language models (LLMs) a higher rating than their peers (Leinonen et al., 2023). Together, these studies highlight the growing recognition of AI tools like Copilot/ChatGPT and LLMs in enhancing educational experiences. The feedback from students' surveys supports these recent findings.

In summary, students feel that AI tools are very useful when they help them understand tables/attributes (Mean=4.54), when they support critical thinking (4.33), when they help with creativity (4.33), and when they help their learning (4.29). This corroborates that AI tools help students with higher-level cognitive skills that fall under Bloom's higher-order thinking skills (understanding, analysis, and creating) (Anderson et al., 2001; Bloom et al., 1956). Students also think that AI tools help when they apply concepts to business problems (problem-solving = 4.17; business case generation = 4.13; generating correct SQL code = 4.17). Overall, students appreciate the ability of AI technologies to assist with real-world tasks, enabling them to apply concepts to actual tasks. However, the moderate rating for reflection on AI solutions (3.79) suggests that students do not fully reflect and critically evaluate the solutions. This indicates an opportunity for future improvement. More exercises should be designed to engage students in the reflective process, which encourages critical thinking, broadens their perspectives, and promotes deeper consideration of the solutions. While students are benefiting from AI in practical tasks, The lower rating for saving time hints that while AI tools help in problem-solving, they may not

drastically reduce the time students spend figuring out how to approach problems. This includes experimenting with different prompts and learning how to interact effectively with AI.

4.2 Feedback From Email Interviews

Besides utilizing surveys to gather student input regarding using AI tools for database construction, interviews offer valuable context and insight (Creswell, 2009). The author selected three students for the email interview, with one question: "Tell me about your experience with the AI assignment." The analysis aimed to identify themes; therefore, a thematic analysis was conducted. Following the framework for thematic analysis proposed by Braun and Clarke (2006), we identified four main themes: attitudes, learning, productivity, and suggestions. In the attitude theme, responses varied: one student fully embraced AI, calling it eye-opening; another remained neutral, describing their experience as mixed, good and bad; and the third expressed frustration with prompt engineering, finding it challenging to obtain accurate answers. In the learning theme, two out of three students believed that AI assignments contributed to developing critical thinking and problem-solving skills. In the productivity theme, however, one student noted that using AI for the first time and learning to communicate effectively did not necessarily save time. In the suggestions section, all three students recommended some activities to improve the course in the future.

The below quotes show students' attitudes and perceptions related to this assignment.

- "This was a great assignment; I just tried to push the AI to its limits and got a little too much in the weeds."
- "I was trying to reconcile what each one aimed to achieve. Each dataset seemed to align better with the assignment, and I was trying to integrate them."
- "I spent so much time trying to understand how the synthetic data that ChatGPT was generating would provide answers."

Questions	Mean	Median	Std. Deviation
AI tools help me understand tables and their associated attributes.	4.54	5	0.66
I analyzed answers provided by AI critically.	4.33	4	0.76
AI tools aid my creativity.	4.33	4	0.87
I think AI tools contribute positively to my learning.	4.29	4	0.75
AI tools help me remember concepts.	4.21	4.5	1.14
AI tools generated reasonable data sets.	4.17	4	0.87
AI tools created the correct SQL code for my entities.	4.17	4.5	1.13
AI tools improve my problem-solving skills.	4.17	4	0.87
AI tools are useful in generating a business case.	4.13	4	1.03
AI tools created the entities as I expected.	4.08	4	0.88
I reflected on AI solutions by considering the scenario: What if I were to do it manually?	3.79	4	1.25
I spent less time figuring out how to approach this homework thanks to AI tools	3.63	4	1.41
AI tools diminish my critical thinking skills.	3.08	3	1.44
AI tools did not create the correct SQL code to answer my analytical questions.	2.96	3	1.46
AI tools have not effectively applied the ER model to my business case.	2.79	2.5	1.38

Table 2. Descriptive Statistics

- "While I have not worked much with AI before, incorporating it into my assignments has introduced a

new layer of complexity. This unfamiliar territory can be frustrating and time-consuming, particularly when

facing unknown variables. However, navigating through these challenges has provided learning opportunities and insights into the capabilities and limitations of AI technologies.”

When the student tried to reconcile different datasets, this process helped develop their critical thinking skills. This process involved considering the purpose of each entity/table, the attributes associated with each table, and what kinds of questions could be asked for business performance purposes. These tasks pushed the student to think deeply and analytically about the structure and relationships within the data, thereby improving their problem-solving abilities and understanding of the data’s organization and function.

Students also provided valuable suggestions in the email interviews.

- It may be beneficial to include an assignment that asks students to identify problems with AI-generated content (relating to SQL) to prevent over-reliance on it.
- Future assignments could include more of a report aspect, where students write a report or presentation summarizing their findings.
- Ask students to analyze a dataset using SQL and identify potential ethical issues or biases in the data for a change of pace.

4.3 Future Course Plan

In addition to providing practical tips, this study contributes to the literature on AI-enabled learning. Theoretically, AI tools are learning assistants for students, making educational resources accessible to everybody in real-time. As a result, they can significantly enhance learning retention and engagement (Malinka et al., 2023). AI tools can also contribute effectively to the active learning process. Our results on students’ surveys show positive learning experiences, consistent with prior research on using AI on task performance improvement (Kim & Lee, 2023) and learning outcomes (Boubker, 2024). Based on students’ feedback, the author would like to provide the following suggestions for future course improvements, addressing skills in prompt engineering, AI overreliance, AI ethics, and communication skills:

- *Exploring the Balance Between AI Assistance and Critical Thinking*: Future studies should investigate how to balance AI tools’ assistance with maintaining and enhancing students’ critical thinking and reflection skills. This could involve the design of tasks that explicitly require students to critique or evaluate AI-generated solutions, ensuring that evaluation and analysis are fully integrated into the learning process.
- *Longitudinal Studies on AI’s Impact on Learning*: Conduct longitudinal research to assess how sustained use of AI tools affects learning outcomes over time. Are students more likely to rely on AI for simple tasks, or does long-term exposure lead to enhanced problem-solving and creative thinking?
- *Prompt Engineering Skill*: Trains students in writing task specifications. This is an important skill for students to acquire, as students’ comments show that some are frustrated with inaccurate output. A poorly constructed prompt may result in inaccurate or unsatisfactory responses, whereas a well-designed

prompt can greatly increase the quality and relevancy of ChatGPT’s output (Ekin, 2023).

- *Overreliance on AI*: Introduce assignments with open-ended questions, require students to describe their problem-solving processes, and ask them to propose strategies to mitigate overreliance on AI in their learning.
- *Communication Skills*: Require students to write a report detailing how they use AI to communicate and develop solutions.
- *AI Ethics*: Develop scenarios for ethical education for students and invite students to contribute to the scenario generation.
- *Comparison Study*: Compare AI-generated outputs from different AI tools on various databases by collaborating with faculty across institutions.
- *Survey Instructors*: Survey instructors on their experiences with AI-enhanced teaching compared to traditional teaching.

In addition, the author did not collect students’ prior AI experience. Faculty interested in adopting this teaching tip should consider incorporating it into their courses for assessment. Instructors who use this technique may want to survey students on their understanding after completing the first assignment on their own (without AI) and compare it to what they learned after using AI to solve the same problem while accounting for their prior knowledge of ChatGPT, CoPilot, and AI.

Designing assignments that include evaluation, inference, and reflection is better to address challenges like critical thinking and problem-solving skills in AI-enhanced assignments. Each assignment should require students to reflect on what they have learned with AI versus without AI and incorporate more “what if” scenarios. For instance, in database design, students can be given different ERDs and asked to critique them. In SQL coding assignments, tasks can be designed with embedded bugs, prompting students to fix the code independently before using AI for troubleshooting. This approach encourages learning by doing and thinking before acting.

4.4 AI Application in Broader Educational Contexts

AI has been applied to many other areas in the broader education setting, facilitating personalized learning environments, adaptive assessment, and interactive learning tools (Huang et al., 2023). For example, AI language learning applications, such as Duolingo, use machine learning algorithms to allow for increasingly personalized learning paths and to improve listening and speaking ability in English learning (Handini et al., 2022). In STEM (Science, Technology, Engineering, and Mathematics) education, AI can be used in student behavior detection, automation, learning prediction, intelligence tutoring systems, educational robots, and others (i.e., AI textbook, group formation) (Xu & Ouyang, 2022). In knowledge assessment, it is well recognized that traditional peer review has challenges, with assessors lacking the ability or incentives to produce rigorous reviews (Patchan et al., 2018). AI applications can address these issues by enabling students to write and elaborate more and providing more insightful feedback; additionally, instructors can use the system’s

recommendations to identify better cases that require their supervision (Darvishi et al., 2022)

5. CONCLUSION

This teaching tip details how professors can use AI to prepare teaching materials and how students can utilize AI to learn ERD (Entity-Relationship Diagram) concepts and implement databases. It is specifically applicable to instructors teaching database classes. The approach involves two assignments: one completed independently and the other with the assistance of AI. This methodology prepares students for an AI-driven economy. Surveys and interviews with students about the learning activities show positive responses. Students found the AI-integrated assignments helpful for developing databases, enhancing their problem-solving abilities, and improving their analytical skills. Generative AI tools offer many benefits in learning and teaching despite challenges such as over-reliance on AI and opportunities for plagiarism. It is important to continue improving teaching practices and redesigning assignments to address these AI-induced challenges. Faculty collaboration and sharing teaching activities, emphasizing open-ended questions and reflections, will help develop best practices to address these issues. Additionally, obtaining students' feedback on AI reliance and how to use AI to enhance learning is another strategy for continuously improving the educational process.

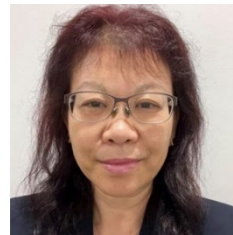
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APPENDICES

Appendix A. Design Logical Model

Read the description of the mini-case in section 3.1.1 and complete the tasks using AI tools.

Prompt Exercise 1: Design the logical entity relationship diagram and draw the logical diagram in MySQL using the Wellbeing Clinic mini-case below.

Output 1:

Certainly! Let's break down the requirements for a clinic management system based on the Wellbeing Clinic's needs:

1. **Patient Management System:** The system should handle patient registration, medical history, and demographics. It should allow easy access to patient records and enable efficient updates.
2. **Appointment Scheduling:** Implement an automated appointment scheduling system to prevent double booking and improve clinic efficiency. This system should also send reminders to patients.
3. **Electronic Health Records (EHR) Management:** Create a digital repository for patient health records, including diagnoses, treatments, medications, and lab results. This will streamline record-keeping and enhance patient care.
4. **Billing and Invoicing:** Develop a billing module that generates invoices, tracks payments, and manages insurance claims. Integration with insurance companies is crucial.
5. **Reporting and Analytics:** Design a reporting system that provides insights into patient demographics, appointment trends, and clinic performance. This will help the clinic make informed decisions.
6. **Security Management:** Ensure robust security measures to protect patient data and comply with privacy regulations (such as HIPAA).
7. **Inventory Management:** If the clinic dispenses medications or supplies, implement an inventory management system to track stock levels and reorder when necessary.
8. **Prescription Management:** Enable doctors to create and manage prescriptions electronically, reducing paperwork and errors.
9. **User Roles and Permissions:** Define roles (doctors, nurses, administrative staff) and assign appropriate permissions to access and modify data.
10. **Integration with Existing Systems:** Migrate data from Excel spreadsheets and paper records to the new system. Ensure seamless integration to avoid data duplication.

Remember, the logical entity relationship diagram (ERD) will represent the relationships between these entities (such as patients, doctors, appointments, and medications). Once you've designed the ERD, you can create the corresponding MySQL database schema. If you need further assistance or have specific questions, feel free to ask!

Prompt Exercise 2: Design ERD using the entities above

Output 2:

Certainly! Let's create an Entity-Relationship Diagram (ERD) for the clinic management system based on the provided entities. I'll outline the main tables and their attributes:

1. **Users:**
 - **Customers (Patients):**
 - customer_id (Primary key)
 - customer_name
 - customer_email
 - customer_tel
 - customer_address
 - **Staff:**
 - staff_id (Primary key)
 - staff_type (e.g., "Doctor," "Administrator," "Receptionist")
 - staff_name
 - staff_email
 - staff_tel
 - staff_password
2. **Sessions & Prescriptions:**
 - **Sessions:**
 - session_id (Primary key)
 - session_date (Timestamp)

- session_type (e.g., “Consultation,” “Treatment,” “Screening”)
- session_notes
- **Prescriptions:**
 - prescription_id (Primary key)
 - session_id (Foreign key referencing Sessions)
 - medication_name
 - dosage
 - instructions

Remember, this is a simplified example, and you can customize it further based on your specific requirements. Feel free to add more tables or modify existing ones as needed.

In the current version of Copilot, creating an ERD image remains a limitation. However, the entities and their associated attributes are correctly specified. Students can easily translate AI-generated outputs into ERD images using diagramming tools such as LucidChart, draw.io, or Visio.

Appendix B. Task 2 - Build Database

Prompt Exercise 1: Write SQL to create tables for the entities

Output 1:

```
-- Create Users table (Customers and Staff)
CREATE TABLE Users (
  user_id INT PRIMARY KEY,
  user_type ENUM('Customer', 'Staff') NOT NULL,
  user_name VARCHAR(255) NOT NULL,
  user_email VARCHAR(255) UNIQUE,
  user_tel VARCHAR(20),
  user_address TEXT
);

-- Create Sessions table
CREATE TABLE Sessions (
  session_id INT PRIMARY KEY,
  session_date DATETIME NOT NULL,
  session_type ENUM('Consultation', 'Treatment', 'Screening') NOT NULL,
  session_notes TEXT
);

-- Create Prescriptions table
CREATE TABLE Prescriptions (
  prescription_id INT PRIMARY KEY,
  session_id INT NOT NULL,
  medication_name VARCHAR(255) NOT NULL,
  dosage VARCHAR(50),
  instructions TEXT,
  FOREIGN KEY (session_id) REFERENCES Sessions(session_id)
);

-- Create Staff Passwords table (for staff login credentials)
CREATE TABLE Staff_Passwords (
  staff_id INT PRIMARY KEY,
  staff_password VARCHAR(255) NOT NULL,
  FOREIGN KEY (staff_id) REFERENCES Users(user_id)
);
```

Prompt Exercise 2: Write SQL to insert 10 rows into each table

Output 2:

```
-- Insert 10 rows into the Users table (Customers and Staff)
INSERT INTO Users (user_id, user_type, user_name, user_email, user_tel, user_address)
VALUES
  (1, 'Customer', 'John Doe', 'john@example.com', '123-456-7890', '123 Main St'),
  (2, 'Customer', 'Jane Smith', 'jane@example.com', '987-654-3210', '456 Elm St'),
  -- ... (add more customers)
  (11, 'Staff', 'Dr. Smith', 'drsmith@example.com', NULL, 'Wellbeing Clinic'),
  (12, 'Staff', 'Nurse Johnson', 'nursej@example.com', NULL, 'Wellbeing Clinic'),
  -- ... (add more staff);

-- Insert 10 rows into the Sessions table
INSERT INTO Sessions (session_id, session_date, session_type, session_notes)
VALUES
  (1, '2023-01-10 09:00:00', 'Consultation', 'General checkup'),
  (2, '2023-01-11 14:30:00', 'Treatment', 'Vaccination'),
  -- ... (add more sessions)
  (11, '2023-01-12 10:00:00', 'Consultation', 'Follow-up'),
```

```
(12, '2023-01-13 15:00:00', 'Screening', 'Blood pressure check'),
-- ... (add more sessions);

-- Insert 10 rows into the Prescriptions table
INSERT INTO Prescriptions (prescription_id, session_id, medication_name, dosage, instructions)
VALUES
  (1, 1, 'Aspirin', '100 mg', 'Take once daily'),
  (2, 2, 'Flu vaccine', NULL, 'Administer intramuscularly'),
  -- ... (add more prescriptions)
  (11, 11, 'Antibiotics', '500 mg', 'Take with food'),
  (12, 12, 'Blood pressure medication', '10 mg', 'Take in the morning'),
  -- ... (add more prescriptions);

-- Insert 10 rows into the Staff_Passwords table (for staff login credentials)
INSERT INTO Staff_Passwords (staff_id, staff_password)
VALUES
  (11, 'drsmithpassword'),
  (12, 'nursejpassword'),
  -- ... (add more staff passwords);
```

Prompt Exercise 3: Develop a descriptive question using the tables.

Output 3:

Certainly! Let's create a descriptive question based on the provided tables:

Question: "Which staff member conducted a consultation session with patient Jane Smith on January 11, 2023, and prescribed flu vaccine during that session?"

Prompt Exercise 4: Write SQL to answer the above question.

Output 4:

```
SELECT
  U.user_name AS staff_name,
  S.session_date,
  S.session_type,
  P.medication_name
FROM
  Users U
JOIN
  Sessions S ON U.user_id = S.session_id
JOIN
  Prescriptions P ON S.session_id = P.session_id
WHERE
  U.user_type = 'Staff'
  AND U.user_name = 'Dr. Smith'
  AND S.session_date = '2023-01-11 14:30:00'
  AND P.medication_name = 'Flu vaccine';
```

Appendix C. Develop Analytical Questions

Prompt Exercise 1: Develop a comparative question using the tables.

Output 1:

Question: “Which staff member conducted more consultation sessions than treatment sessions?”

Prompt Exercise 2: Write SQL to answer the above question.

Output 2:

```
SELECT
    U.user_name AS staff_name,
    COUNT(CASE WHEN S.session_type = 'Consultation' THEN 1 ELSE NULL END) AS num_consultations,
    COUNT(CASE WHEN S.session_type = 'Treatment' THEN 1 ELSE NULL END) AS num_treatments
FROM
    Users U
JOIN
    Sessions S ON U.user_id = S.session_id
WHERE
    U.user_type = 'Staff'
GROUP BY
    U.user_name
HAVING
    num_consultations > num_treatments;
```

Prompt Exercise 3: Develop a correlation question using the tables.

Output 3:

Certainly! Let’s create a correlation question based on the provided tables:

Question: “Is there a correlation between the number of sessions conducted by staff members and the total number of prescriptions they issued?”

Prompt Exercise 4: Write SQL to answer the correlation question.

Output 4:

Certainly! To determine the correlation between the number of sessions conducted by staff members and the total number of prescriptions they issued, we can calculate the correlation coefficient. However, since we don’t have the actual data, I’ll provide a general SQL query that demonstrates the concept:

```
SELECT
    U.user_name AS staff_name,
    COUNT(S.session_id) AS num_sessions,
    COUNT(P.prescription_id) AS num_prescriptions
FROM
    Users U
LEFT JOIN
    Sessions S ON U.user_id = S.session_id
LEFT JOIN
    Prescriptions P ON S.session_id = P.session_id
WHERE
    U.user_type = 'Staff'
GROUP BY
    U.user_name;
```

As Copilot does not produce the desired output, we need to revise the question.

Prompt Exercise 5: calculate `COUNT(S.session_id) AS num_sessions/ COUNT(P.prescription_id) AS num_prescriptions` and revise the last SQL code

Output 5:

```
SELECT
  U.user_name AS staff_name,
  COUNT(DISTINCT S.session_id) AS num_sessions,
  COUNT(DISTINCT P.prescription_id) AS num_prescriptions,
  ROUND(COUNT(DISTINCT S.session_id) / NULLIF(COUNT(DISTINCT P.prescription_id), 0), 2) AS
session_to_prescription_ratio
FROM
  Users U
LEFT JOIN
  Sessions S ON U.user_id = S.staff_id
LEFT JOIN
  Prescriptions P ON S.session_id = P.session_id
WHERE
  U.user_type = 'Staff'
GROUP BY
  U.user_name;
```

More Questions for Practice:

Prompt Exercise 6: Develop analytical questions to answer business performance-related questions. The questions should target descriptive, correlation, comparative, trend etc.

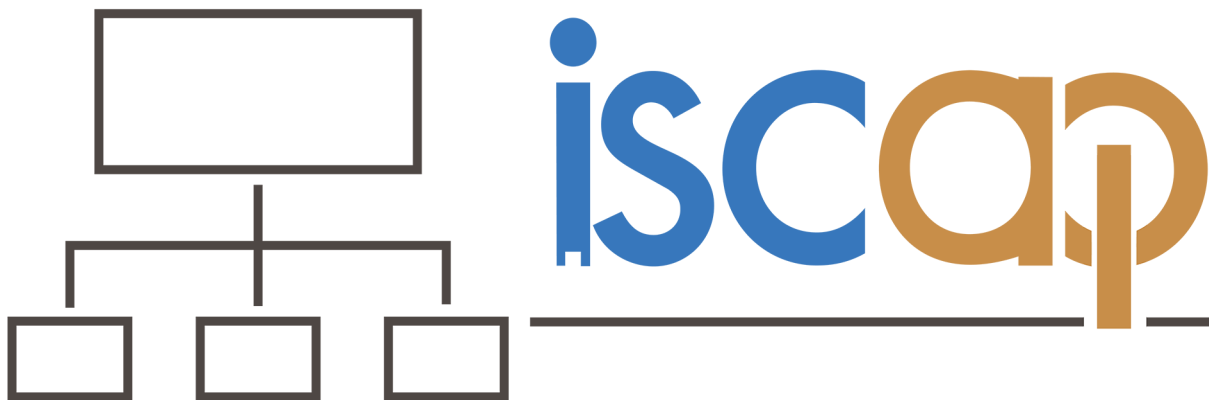
Output:

Certainly! Let's create a set of analytical questions to address various aspects of Wellbeing Clinic's business performance:

1. Descriptive Questions:
 - What is the total number of patients scheduled for each day of the week?
 - How many patients have visited the clinic in the last quarter?
 - What are the most common medical services requested by patients?
2. Comparative Questions:
 - How does the patient load vary between quarters?
 - Compare the average waiting time for appointments between doctors and nurse practitioners.
 - Is there a difference in appointment frequency based on patient age groups?
3. Correlation Questions:
 - Is there a correlation between the number of physicians and the clinic's revenue?
 - Do patients with specific medical conditions tend to schedule more frequent appointments?
4. Trend Questions:
 - How has the patient load changed over the five years?
 - Are there any seasonal trends in specific medical services (e.g., flu vaccinations)?
5. Additional Questions:
 - What is the average duration of appointments for different services?
 - How many patients have missed their scheduled appointments?
 - Is there a relationship between medication prescriptions and patient demographics?

Feel free to customize and expand these questions based on specific business needs and available data.

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