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Integrating AI to Enhance Business Analysis Education

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Abstract

This study examines how AI tools can be integrated into college education to promote active and efficient learning for students in a Quantitative Business Analysis course. The main focus of the course is to teach statistics and data processing with R to a class of 50 first-year International Business Administration students. With the variety of topics and assignments, it is a challenge to provide personalized feedback for a class of this size. To resolve these issues, AI tools are used along with traditional lab sessions and supplementary video lectures. A mid-semester survey was conducted to evaluate students' experiences with this new methodology. Its effectiveness in improving their skills and comprehension, and their preferences of future AI integration were examined to determine the optimal level of AI integration to improve outcomes in the course.

The survey shows that students evaluate AI and video lectures as highly effective in learning R coding and completing assignments. However, many still prefer to retain in-person interactions such as lab sessions. We need to find an optimized mixture that combines traditional teaching methods with AI tools to improve students' satisfaction and their learning outcomes. It is worth noting students without prior coding experience showed almost the same responses regarding AI-assisted course with students with prior experience. This proves AI-integrated method can satisfy both groups. Only small differences between two groups were observed in students' confidence and their support for further AI integration. This issue can be resolved with additional help for no experience group such as orientation sessions at the beginning of the semester. The originality of this study lies in its empirical evaluation of AI as a new educational tool that can make personalized learning possible. This new method allows students, even in large classes, to progress at their own pace and skill level. This research can contribute to finding a new educational framework adaptable to diverse learning contexts.

Keywords : AI Assisted Education, R Programming, Customized College Education, Quantitative Analysis, Teaching Methodology

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1. Introduction

Proficient programmers have long used artificial intelligence (AI) to accelerate code development. However, the question remains: how can AI be effectively integrated to support beginners with minimal programming knowledge? This paper investigates the potential for AI to provide personalized, skill-level-tailored support for college students in coding education. In addition, the study evaluates student satisfaction with this innovative approach through surveys.

The main goal of this study is to develop an effective AI-assisted methodology in college education that can provide customized support to students with little prior experience. In programming, AI's risks -such as hallucinations or misinformation- are relatively minimal, making it a reliable tool for personalized learning. In the introductory coding classes, students still try to learn language syntax and develop problem-solving skills, and AI can be a valuable resource to help them overcome many initial challenges. However, instructors should stay vigilant of the risks that students rely too much on AI in the process.

The demand for data analysis skills rapidly grows in many fields like digital marketing, and business education started emphasizing development of quantitative skills. Recognizing this need, D University launched a course to equip students with the ability to analyze data using statistical skills. However, challenges arose as students from liberal arts backgrounds often lacked programming experience, and a large class size made individualized instruction very difficult.

To resolve these problems, AI tools and online video lectures were added to traditional methods of teaching statistics. With the help of new technologies, students could progress at their own pace and finish the assignments. It also helped narrow the gap between students with different prior experiences since each can determine the level of utilizing those resources as needed. They could use AI and video lectures as their personal tutors.

A survey was conducted to evaluate the impact of AI-assisted learning on students' understanding of R programming within the QBA course. It also collected students' opinions on the effectiveness of video lectures. With AI and video tools, students could repeat the difficult sections in both theoretical concepts and data analysis. I will detail the methodology for integrating these resources and analyze the student survey responses regarding their experiences with this new teaching method.

2. Literature

As AI is a relatively new technology, the literature on AI-assisted teaching methodologies in college education has limited duration and scope. The rapid evolution of AI applications also makes it hard to establish stable methodologies in education. There are several bibliometric studies that cover recent papers on the topic. We can also compare outcomes of notable case studies to develop better methodologies. Since integrating AI into higher education is a new undertaking, this process inevitably involves trial and error. By examining the experiences of others, we can find better approaches.

In a bibliometric analysis by Afzaal et al., a sharp increase in AI-related research in education started around 2018. The study finds that the United States and China are leading in the research on the topic [Afzaal, 2024].

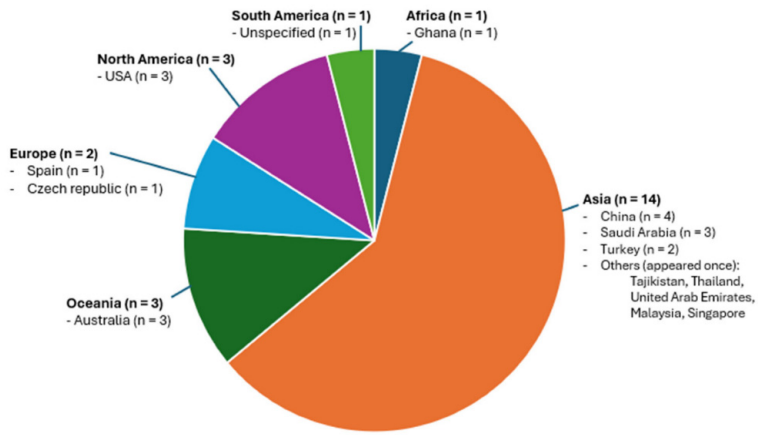
There is another mapping study emphasizing the transformative role of AI in reshaping teaching and learning methods. Shoeibi et al. shows AI can make personalized and adaptive education possible, improving human-computer interaction between students and teachers. The research highlights user-friendly AI tools' significance in improving the learning environment [Shoeibi, 2023].

There is also a review paper with a content analysis that examines generative AI's impact in particular areas, including medical and engineering education. It shows the applications of GAI include evaluation, personalized learning support, and smart tutoring systems. ChatGPT is the most popular GAI tool, and there was a dramatic growth in GAI research in 2023 [Bahroun, 2023].

Other papers are based on case studies. Schei et al. [2024] examine empirical data from 24 studies from various countries and study students' perceptions of AI chatbots like ChatGPT, Copilot and Gemini. As shown in <Figure 1>, AI research papers are published more frequently in Asian countries, probably because they are less conservative in adopting new technologies in education. The research shows that students find these tools useful and motivating for tasks like writing and coding, although concerns remain such as accuracy issues and the potential effects on critical thinking. To ensure the safe implementation of AI tools for effective and responsible learning, educators need to address these issues [Schei, 2024].

As for empirical case studies of AI application in college education, we can find several in Asian countries. According to Nguyen et al, ChatGPT has significantly affected students' learning behaviors in Vietnam. Its accessibility and efficiency are appealing, but we need a balanced approach to maximize benefits while avoiding potential harm. This study highlights the need for strict policies to ensure ethical usage of AI to promote independent learning [Nguyen, 2024].

Another exemplary case study is from South Korea. "Use of ChatGPT in College Mathematics Education" explores the integration of a customized ChatGPT model in an introductory mathematics course. The AI was trained with course-specific materials such as textbooks and prior student discussions to provide more course-specific support. When



<Figure 1> Origin of Empirical AI Papers

students faced difficulties, they could ask questions in natural language, and ChatGPT would offer relevant examples and guidance for effective learning [Lee, 2024].

These empirical studies, examining the effect of AI utilization in college education, shed light on AI's potential to provide better support to students. Especially, the use of custom-trained ChatGPT in the Korean college math course demonstrates AI can make learning in large classes personalized. This case serves as a key example of AI utilization for college level education, suggesting similar applications can be adopted in other courses. It also shows the need for further research to examine AI's growing role in academia.

From these recent studies, it is clear that AI is becoming an invaluable tool in education. However, it is not simple to find the optimal level of utilization in the classroom while avoiding over-reliance. To figure out the appropriate integration of AI into educational systems, it is crucial to have more empirical research with case studies to fine-tune the use of AI in each class. Evaluating student satisfaction and performance with different degrees of integration in various settings will give us better answers. Examining more data through surveys in various courses, including studies like this one, is much needed for developing better methods of AI use in college education.

3. Methodology of AI Assistance in R Education

To teach more practical data processing skills, Quantitative Business Analytics (QBA) is designed for first-year IBA students who have completed Business Statistics. The course includes topics such as hypothesis testing, regression analysis, and linear programming. It is not possible to cover all of coding examples for every topic in traditional computer lab sessions, given that nearly 50 students are enrolled and the course is taught in English. Consequently, AI and YouTube video lectures are incorporated into the learning process to supplement regular classes. Students are encouraged to use AI tools as personal tutors.

The assignment sets consist of Excel and R files, designed to teach quantitative analysis. Students learn how to perform hypothesis testing, regression analysis, and linear programming with real data. Each chapter presents a set of problem-solving assignments and corresponding data files. With specific learning objectives such as two sample hypothesis testing, students solve same problems using both Excel and R. For Excel assignments, step-by-step video tutorials are provided, allowing students to follow along at their own pace. For R tasks, example code is provided, and students are asked to modify it. This structure enables students to develop their skills progressively, with extra help offered through tutorials and pre-written code.

With R, students report that their biggest problem is determining whether their outcomes are correct or not, even when the modified code runs without errors. Given parallel Excel and R assignments, students can compare the results from both to verify their outputs in R. By working on both Excel and R assignments, students not only gain experience with two statistical tools but can also verify their R code's accuracy through comparison. They can identify issues in R and revise their code until they get things right.

Students are initially asked to modify the provided base code on their own. For example,

in hypothesis testing, example code with simulated data is given, and they are asked to run it with real data files. Additionally, when a one-tailed test is provided in the base code, the task might require a two-tailed test, requiring further adjustments. Most of the time, students are asked to use specific functions or commands to make sure that they acquire the necessary skills.

If students encounter errors or uncertainties, they are encouraged to consult AI to check their work. AI assists by identifying errors and providing debugging support. However, by feeding the original code first, the modified AI-generated code remains close to the provided one. This helps prevent confusion for beginners, who might struggle if the AI's suggestions diverge too much from the initial structure.

In addition, YouTube video lectures on theory and coding are made available as supplementary material, reinforcing concepts covered in class and offering further guidance on modifying code. This approach provides customized support while promoting practical problem-solving skills in data processing.

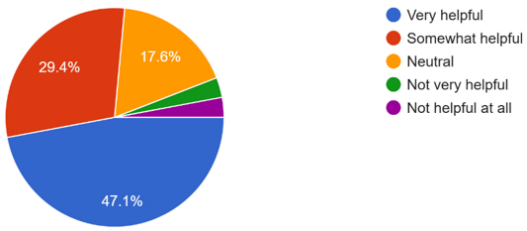
4. Survey and Its Findings

To evaluate the students' learning experience at mid-semester, a survey with 25 questions was conducted after two months of Excel and R assignments. Four key areas of interest were covered:

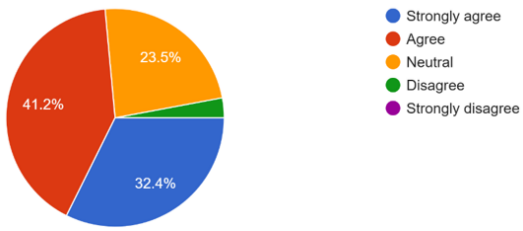
- Programming and AI Skills
- AI Tools Usage
- Learning Resources and Preferences
- Feedback and Future Improvements

The survey provided a thorough evaluation of students' experiences and perceptions, encompassing various aspects of their learning journey. 34 students participated in the survey. The complete list of survey questions is available in the 〈Appendix A〉.

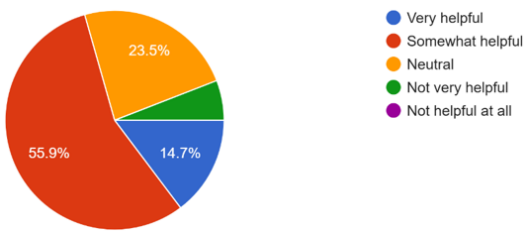
Out of 34 respondents, about half had taken one semester of an introductory Python course, 44% had no programming experience, and only one student had experience with R. 〈Figure 2〉~ 〈Figure 9〉 below display pie charts illustrating the proportions of students' responses to some of the major questions.



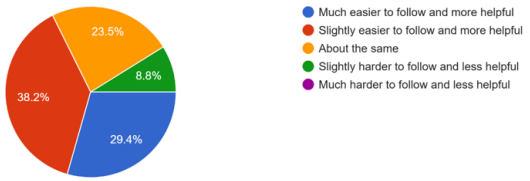
〈Figure 2〉 Q7. To what extent did AI tools help you understand errors in your R code?



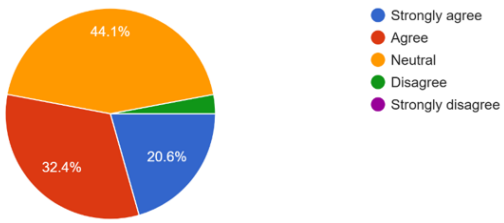
〈Figure 3〉 Q8. Did using AI tools increase your confidence in modifying and running R code?



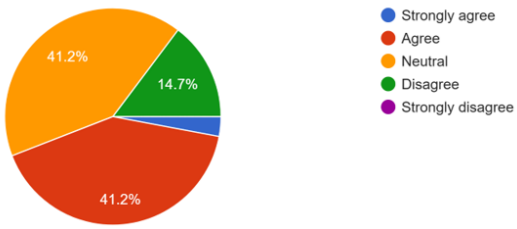
〈Figure 4〉 Q11. How helpful were the YouTube video lectures in understanding the concepts of R programming and quantitative analysis?



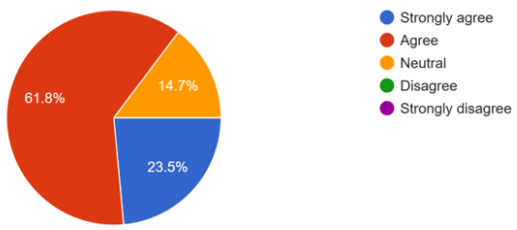
〈Figure 5〉 Q13. How do you rate the AI-based methodology used in this course in comparison to traditional lab-style lectures?



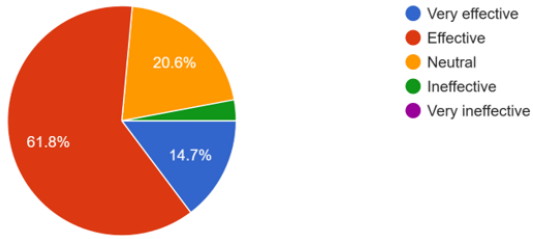
〈Figure 6〉 Q16. Did you find the flexibility of using AI assistance at your own pace more beneficial than attending scheduled lab sessions?



〈Figure 7〉 Q20. Would you feel more confident in your ability to solve quantitative business problems using R after completing the course?



〈Figure 8〉 Q21. Do you think AI should be incorporated into other coding-related courses?



〈Figure 9〉 Q22. How effective was the overall combination of traditional teaching (video lectures) and AI-based learning in helping you understand the course content?

When asked about the extent AI tools helped them correct errors in their R code, nearly half of the students (47.06%) found AI tools "Very helpful," while 29.41% rated them as "Somewhat helpful."

To the question, "Did using AI tools increase your confidence in modifying and running R code?," a significant majority of students (73.53%) either "Agreed" or "Strongly agreed" that AI tools enhanced their confidence in R programming. Meanwhile, 23.53% were neutral, and only 2.94% disagreed.

When asked "How helpful were the YouTube video lectures in understanding R programming and quantitative analysis?", over two-thirds of the students (70.59%) found the YouTube video lectures either "Very helpful" (14.71%) or "Somewhat helpful" (55.88%).

When they were asked to rate the AI-based methodology compared to traditional lab-style lectures, students rated the AI-based methodology positively, with 29.41% finding it "Much easier to follow and more helpful" and 38.24% rating it "Slightly easier to follow and more helpful."

To a question "Did you find the flexibility of using AI assistance at your own pace more beneficial than attending scheduled lab sessions?," flexibility in using AI assistance was

appreciated by 52.94% of students, who either "Agreed" (32.35%) or "Strongly agreed" (20.59%) that it was more beneficial. However, 44.12% were neutral, and 2.94% disagreed.

In a question about confidence in solving quantitative business problems using R after completing the course, 44.12% of the students answered positively ("Strongly agree" or "Agree"). An equal proportion (41.18%) remained neutral, while 14.71% expressed disagreement.

When they were asked "Do you think AI should be incorporated into other coding-related courses?," the majority of students (85.29%) supported integrating AI into other courses, with 23.53% "Strongly agreeing" and 61.76% "Agreeing." Only 14.71% were neutral.

In evaluating the effectiveness of the overall combination of traditional teaching (video lectures) and AI-based learning to help them understand the course content, 61.76% and 14.71% of students rated a combined approach of traditional teaching and AI-based learning "Effective" and "Very effective" each. Meanwhile, 20.59% remained neutral, and only 2.94% found it "Ineffective."

The key findings of all 25 questions are summarized below:

1) Programming and AI Skills (Questions 1-4)
   - Previous programming experience: The responses indicated students have different programming backgrounds. About half of the students reported limited experience with Python, and 44% no prior experience and only a few students intermediate skills.
   - Prior experience with R programming: Most students had minimal exposure to R programming before the course, highlighting the need of introductory modules.
   - Current comfort level with R programming: After two months of trial, most students reported increased comfort levels with R programming, but there is room for improvement.
   - Familiarity with AI tools: 32.4% are familiar with AI, and 50% are somewhat familiar. But students needed more detailed instruction in using AI in coding.
2) AI Tools Usage (Questions 5-9):
   - Use of AI for Coding: The majority of students utilized AI tools for modifying the given codes to complete assignments.
   - Frequency of using AI for R: 1/3 said always, 1/3 said often, and the rest answered sometime or less frequently.
   - Effectiveness of AI in understanding errors: Most students answered AI tools are helpful in understanding errors in their code. AI assistance improved their learning experience by providing immediate feedback and troubleshooting assistance.
   - Impact on Confidence: A substantial number of students noted that using AI tools boosted their confidence in writing and modifying R code, proving the value of adding supportive technologies in the curriculum.
   - AI's role in solving previously unsolvable problems: 82.4% said AI helped them solve problems they could not finish by themselves and it is essential in the learning.
3) Learning Resources and Preferences (Questions 10-16):
   - Frequency of watching YouTube videos: 41.2% answered "always" and 41.2% "often". Additional video lectures proved to be very effective in complementing regular classes.

- Helpfulness of YouTube video lectures: 14.7% answered "Very helpful" and 55.9% "Helpful". Better video resources could be identified and provided to the students.
- Video lectures vs. AI tools: More students found AI more helpful than video lectures. 16.5% answered both were equally effective.
- AI-Based vs. Traditional Methods: Overall, students rated the AI-based methodology more favorably compared to traditional lab-style lectures. They can can ask as many questions as they need and make their own pace through interactions with AI.
- Preferred Learning Techniques: Responses highlighted a preference for a combination of instructional videos, practical exercises, and AI-guided problem-solving, which allowed for personalized flexible learning.

4) Feedback and Future Improvements (Questions 17-25):
- Difficulty Level: While some students found the assignments too challenging, more than half responded the difficulty level is moderate. The course generally seems to maintain an appropriate level of difficulty that pushed students to improve without overwhelming them.
- Support and Resources: The availability of supplementary videos and AI tools was evaluated as essential support mechanisms. However, some students expressed the desire for more support from the instructor.
- Recommendations of AI and Video Resources: The majority of students expressed satisfaction with extra sources of help, recommending further utilization of AI and video resources for future courses.
- Suggestions for Improvement: Common feedback included the need for more in-depth examples, expanded use of real-world case studies, and additional time for coding practice.

To compare the efficacy of AI help for students with different levels of experiences, I divided them into two groups based on their response to Q1 -those with and without programming experience. Then the answers were analyzed for these two groups. Even though the experienced group showed a slightly stronger degree of positiveness in their responses, the two groups do not show too much difference. This proves that groups with different experience can be successfully served in the same class with the help of AI.

In two questions, Q20 (confidence in solving quantitative business problems) and Q21 (support for integrating AI into other courses), the differences between groups were most noticeable. It indicates that prior programming experience may influence students' confidence and preference for further AI integration.

Examining responses of two groups to several major questions, we can see that 84.2% of students with programming experience found AI tools helpful, compared to 66.7% of those without. Similarly, video lectures were deemed helpful by 79% of students with programming experience, while 60% of those without programming experience expressed the same sentiment.

Regarding confidence in solving problems, students with programming experience showed higher levels of confidence, with 5.3% strongly agreeing and 52.6% agreeing that they felt

capable in problem-solving. In contrast, 26.7% of students without programming experience agreed with 0% strong agreement, reflecting a gap in confidence levels between the two groups.

When asked about the potential use of AI in other courses, 36.8% of students with programming experience expressed strong support with 52.6% support, compared to 6.7% and 73.3% of students without programming experience. This suggests that familiarity with AI tools may increase students' openness to using them across different subjects.

Finally, the effectiveness of the teaching methodology was rated more favorably by students with programming experience. 26.3% of these students found the approach very effective, and 47.4% found it effective. In contrast, 0% of students without programming experience rated it as very effective, while 80% found it effective. These findings show how prior programming knowledge influences students' views on AI-based teaching methods.

The difference in confidence was rather unexpected, as even the students with programming experience had only learned very basic Python and had no experience with R. Therefore, to boost the confidence of no experience group, additional support can be provided to them at the beginning of the course. This may be the most practical finding from the survey that could be immediately addressed.

Comparison of answers of the two groups with and without prior programming experience are summarized in 〈Table 1〉.

The statistical analysis of group differences based on programming experience reveals no statistically significant differences between two groups. This proves that AI-integrated method can satisfy both groups equally. Customized AI assistance can be a very effective tool to support students with different background.

Using multiple statistical methods (ANOVA, Tukey HSD, Mann-Whitney U, Wilcoxon, and ordinal logistic regression), we evaluated whether students' prior programming experience affected their perceptions of AI tools, video lectures, and the overall course effectiveness. We do not see any statistical difference between two groups from any of these methods. ANOVA results are listed in 〈Table 2〉. The findings for each test are described in 〈Appendix B〉.

〈Table 1〉 Summary of Comparing Groups With and Without Programming Experience

Question	With Experience	Without Experience	Difference
Q7 (AI Helpfulness)	Very helpful: 47.4%, Helpful: 36.8%	Very helpful: 46.7%, Helpful: 20%	17.5% more with experience found AI helpful
Q11 (Video Helpfulness)	Very helpful: 21.1%, Helpful: 57.9%	Very helpful: 6.7%, Helpful: 53.3%	19% more with experience found videos helpful
Q20 (Confidence in Solving)	Strongly Agree: 5.3%, Agree: 52.6%, Neutral: 31.6%	Strongly Agree: 0%, Agree: 26.7%, Neutral: 53.3%	31.2% more with experience Agree
Q21 (Support for AI in Other Courses)	Strongly Agree: 36.8%, Agree: 52.6%, Neutral: 10.5%	Strongly Agree: 6.7%, Agree: 73.3%, Neutral: 20%	30% more with experience strongly support AI integration
Q22 (Effectiveness of Teaching Methodology)	Very Effective: 26.3%, Effective: 47.4%, Neutral: 21.1%	Very Effective: 0%, Effective: 80%, Neutral: 20%	26.3% more with experience rated it "Very Effective"

〈Table 2〉 ANOVA p-values for Difference in Groups With and Without Programming Experience

	Q7AI Helpfulness	Q11 Video Helpfulness	Q20Confidence in Solving	Q21Support for AI in Other Courses	Q22Teaching Methodology Effectiveness
ANOVA p-value	0.463	0.399	0.083	0.064	0.542

There are only two questions with small differences approaching significance, in students' confidence (Q20) and support for further AI integration (Q21). This issue can be resolved with extra help for the second group. Offering customized orientation sessions at the start of the semester for these students could improve their learning and performance in the future. A follow-up survey next year after such sessions can tell us the effectiveness of addressing group differences.

Overall, the findings suggest that students with and without prior programming experience generally found the AI tools, video lectures, and the course's teaching methodology similarly beneficial. This consistency across various tests shows that groups with different experience can be successfully served in one class. AI-assisted and video-based learning tools can be flexibly adapted to help students with different skill levels, and such resources can effectively bridge skill gaps and provide customized support for students with diverse backgrounds.

Since the survey was conducted in the mid-semester, based on the analysis of students' responses, more in-class R sessions could be provided with detailed directions. Since every student had some experience of programming by then, those sessions became more productive. This shows the importance of feedback mechanism during the course.

To improve future QBA courses, I would like to propose the following recommendations in addition to the differentiated orientation at the beginning of the semester.

First, more refined learning modules can be adopted. Courses could include separate tracks or modules for beginners and more advanced students to ensure content is engaging for everyone. More challenging assignments for each chapter can be provided with extra credit in addition to the regular ones. Different levels of coding to perform the same kind of tasks can be suggested.

Secondly, we can make AI Tools better by training them for specific courses. The positive feedback on AI tools emphasizes their effectiveness in college level learning. Future courses should continue incorporating AI tools in various tasks. Customized AI, trained on past materials from the QBA course, can provide better support for students.

Third, more balanced instructional methods can be found. Video lessons, in-class coding sessions, and interactive coding exercises with AI were all proven to be helpful. You can keep the right balance of all the resources by checking with students each semester.

Fourth, group assignment can be tried. Having a group coding project can enhance collaborative skills and provide students with an opportunity to learn from one another. Mixing students with and without programming experience will facilitate peer teaching and serve as an additional learning resource.

Lastly, feedback should be collected more often. Throughout the course, frequent feedback allows instructors to adjust contents and teaching methods in real-time. It can ensure

students' changing needs are being met. It will also improve the effectiveness of customized learning with the help of AI.

Since data analysis is technical, and many students lack prior experience or strong skills, additional strategies should be considered to use AI effectively as a teaching tool. Such additional measures will make AI support an even more effective tool in university education.

5. Conclusion

Integrating AI into teaching R programming for quantitative business analysis has proven to enhance traditional teaching methods. AI tools provide immediate feedback and support, helping students grasp coding concepts and build confidence in solving quantitative problems. The combination of AI and video resources creates a flexible and effective learning environment, especially for large classes with limited individual attention from the instructor.

Survey findings indicate that students found AI tools particularly useful for identifying errors and deepening their understanding of R. Many appreciated the ability to learn at their own pace with AI assistance, which they found more accommodating than scheduled lab sessions. Supplementary video lectures also played an important role, with some students favoring AI's hands-on support and others benefiting from the additional explanations provided by the videos.

The survey revealed a strong preference for a hybrid approach that blends AI-based learning with traditional teaching methods, balancing flexibility with structured guidance. This approach appears to maximize learning effectiveness and adaptability to diverse learning styles. The results support a blended approach that combines traditional and AI-enhanced methodologies, flexible learning paths, and collaborative exercises. Future courses can build on these insights to further improve student learning experiences and outcomes.

When analyzing responses based on prior programming experience, few differences emerged in students' feedback. It shows that students with different background can effectively study analytical skills in the same class with the help of AI. Slightly higher levels of satisfaction with both AI tools and video lectures with students with experience suggests that familiarity with programming enhances the effectiveness of these learning resources. This disparity can be resolved with extra orientation sessions for students without experience to help them successfully adopt AI-assisted learning.

While overreliance on AI is a concern, for humanities students with little prior programming experience, AI significantly reduces psychological and intellectual barriers, enabling them to undertake complex data analysis they might not have attempted otherwise. Among various academic fields, the advantages of AI-assisted education in programming are perhaps unparalleled, as AI empowers students to learn and apply programming concepts effectively.

In more advanced courses, reasoning model AIs like ChatGPT-o1 or applications like R Wizard (available in the premium version) could be used. If students derive sufficient benefits from AI assistance, the subscription fee for such tools would be easily justified.

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〈Appendix A〉 Survey Questions

R programming in Quantitative Business Analysis

1. What is your previous experience with programming (before this course)?
   None / Beginner (basic familiarity with one language) / Intermediate (comfortable with multiple languages) / Advanced (proficient in multiple languages)
2. Have you ever used R programming before this course?
   Yes / No
3. What is your level of comfort with R coding in Quantitative Business Analysis now?
   Not comfortable at all / Somewhat comfortable / Comfortable / Very comfortable
4. What is your level of familiarity with using AI tools in academic work?
   Not familiar at all / Somewhat familiar / Familiar / Very familiar
5. Didyoumodify the Rcodetemplates independently, without AI assistance?
   Yes / No
6. How frequently did you use AI to help debug or review your R code?
   Always (for every assignment) / Often / Sometimes / Rarely / Never
7. To what extent did AI tools help you understand errors in your R code?
   Very helpful / Somewhat helpful / Neutral / Not very helpful / Not helpful at all
8. Did using AI tools increase your confidence in modifying and running R code?
   Strongly agree / Agree / Neutral / Disagree / Strongly disagree
9. Did using AI help you solve problems that you would not have been able to resolve on your own?
   Yes / No / Not sure
10. How often did you watch the YouTube videos provided as part of the course?
    Always / Often / Sometimes / Rarely / Never
11. How helpful were the YouTube video lectures in understanding the concepts of R programming and quantitative analysis?
    Very helpful / Somewhat helpful / Neutral / Not very helpful / Not helpful at all
12. Which type of resource was more effective for your learning?
    Video lectures / AI assistance / Both equally / Neither
13. How do you rate the AI-based methodology used in this course in comparison to traditional lab-style lectures?
    Much easier to follow and more helpful / Slightly easier to follow and more helpful / About the same / Slightly harder to follow and less helpful / Much harder to follow and less helpful
14. In traditional lab-style lectures, would you feel comfortable asking the instructor for help?
    Very comfortable / Somewhat comfortable / Neutral / Somewhat uncomfortable / Very uncomfortable
15. In this course, how often did you feel comfortable asking AI for help with your R code?
    Always / Often / Sometimes / Rarely / Never
16. Did you find the flexibility of using AI assistance at your own pace more beneficial than attending scheduled lab sessions?
    Strongly agree / Agree / Neutral / Disagree / Strongly disagree
17. Did AI assistance and video lectures

make up for the lack of in-person lab instruction?
Yes, completely / Yes, to some extent / No, not really / No, not at all

18. What did you think about the difficulty of the assignments?
Very easy / Easy / Moderate / Difficult / Very difficult
19. Did using AI assistance reduce the time it took you to complete assignments?
Yes, significantly / Yes, somewhat / No difference / No, it increased the time
20. Would you feel more confident in your ability to solve quantitative business problems using R after completing the course?
Strongly agree / Agree / Neutral / Disagree / Strongly disagree
21. Do you think AI should be incorporated into other coding-related courses?
Strongly agree / Agree / Neutral / Disagree / Strongly disagree
22. How effective was the overall combination of traditional teaching (video lectures) and AI-based learning in helping you understand the course content?
Very effective / Effective / Neutral / Ineffective / Very ineffective
23. In the future, would you prefer a traditional lab-style course or an AI-assisted course (like this one) for programming?
Traditional lab-style course / AI-assisted course / A mix of both / No preference
24. Please describe any challenges you faced while using AI tools to learn R programming.
25. Do you have any suggestions for improving R programming lectures in this course?

〈Appendix B〉 Analysis of Group Differences Based on Programming Experience

To examine potential differences in perceptions and experiences between students with prior programming experience ("Experience") and those without ("No Experience"), a series of statistical tests were conducted across key questions related to course resources and outcomes: Q7 (AI Helpfulness), Q11 (Video Helpfulness), Q20 (Confidence in Solving), Q21 (Support for AI in Other Courses), and Q22 (Effectiveness of Teaching Methodology).

Each survey question was assigned a custom scoring system to quantify responses on a consistent scale, facilitating comparison. Responses were scored as follows: 20 points for the most positive response (e.g., "Very Helpful," "Strongly Agree"), 15 points for moderately positive responses (e.g., "Helpful," "Agree"), 10 points for neutral responses, 5 points for slightly negative responses, and 0 points for the least positive response. This approach enabled the use of Analysis of Variance (ANOVA) to assess whether average scores differed significantly between the two experience groups.

The analysis of group differences based on programming experience reveals nuanced findings across the key survey questions. Using multiple statistical methods (ANOVA, Tukey HSD, Mann-Whitney U, Wilcoxon, and ordinal logistic regression), we evaluated responses to gauge whether students' prior programming experience affected their perceptions of AI tools, video lectures, and overall course effectiveness. The findings for each test are described below.

1) No Significant Difference ($p > 0.05$) for Q7, 11, 22

〈Table A1〉 Summary of Different Tests

	Q7AI Helpfulness	Q11 Video Helpfulness	Q20Confidence in Solving	Q21Support for AI in Other Courses	Q22Teaching Methodology Effectiveness
ANOVA p-value	0.463	0.399	0.083	0.064	0.542
Tukey HSD p-value	0.412	0.387	0.074	0.059	0.516
Mann-Whitney p-value	0.52	0.46	0.094	0.079	0.551
Cohen's d	0.18	0.21	0.34	0.32	0.17
Wilcoxon p-value	0.52	0.46	0.094	0.079	0.551
Ordinal Logistic p-value	0.61	0.59	0.08	0.07	0.62

- For Q7 (AI Helpfulness), Q11 (Video Helpfulness), and Q22 (Effectiveness of Teaching Methodology), p-values across all tests exceeded the typical significance threshold ($p > 0.05$). Cohen's d results also indicated minimal practical significance, with effect sizes below 0.2 for these questions. This consistency across analyses suggests that students with and without programming experience had similar levels of satisfaction and perceived support from AI tools and teaching resources. These findings imply that the course was structured effectively to meet the needs of a diverse group of students, regardless of prior programming experience.

2) Approaching Significance ($p \approx 0.05$) for Q20, 21

- Q20 (Confidence in Solving) and Q21 (Support for AI in Other Courses) displayed p-values close to 0.05 in some tests, hinting at possible differences between groups. Students with programming experience tended to report slightly higher confidence in solving quantitative business problems (Q20) and greater support for integrating AI tools in other courses (Q21). Although these differences were not statistically significant, Cohen's d for these questions (approximately 0.3) suggests a small practical effect, indicating that programming experience might play a modest role in enhancing students' confidence and openness to AI applications. This finding warrants further exploration and could potentially inform targeted interventions, such as additional support for students without programming backgrounds.

In summary, while no statistically significant differences were found between experience groups for most survey questions, small differences approaching significance were observed in students' confidence (Q20) and support for further AI integration (Q21). These results suggest that, although the course effectively provided a similar level of support to all students, some slight enhancements might further benefit students without prior programming experience.

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