STUDENTS' PREFERENCES FOR VISUALIZATION TECHNIQUES AND SOFTWARE TOOLS IN ACADEMIC SETTINGS: A COGNITIVE ACTIVITY

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ABSTRACT

Introduction:
Digital technologies play a more active role in the process of modern education, opening new perspectives during teaching and learning. Digital transformation in education means not only the insertion of new technologies into practice but also a paradigm change regarding the approaches students have toward knowledge. The effective use of data visualization stands out among the key components of the transformation in question, turning out to make a significant contribution to better comprehension and long-term memory of complex information. Data visualization methods allow students to visually depict data, hence facilitating the identification of patterns, trends, and other insights that are hard to come by through traditional text-based formats; it makes data more touching. In this increasingly data-driven world, the interpretation and analysis of visual information should be core competencies for students from all walks of disciplines. The objectives of this study are: 1) to explore the most applied visualization techniques and tools according to the frequency; 2) the extent to which the used visualization tools were helpful for students in grasping and analyzing particular educational tasks, like statistical data analysis and presentation of projects; 3) to determine the reasons for students' preferences due to usability, cost, and access. By investigating these preferences, we can deduce some very valuable insights related to how best to design learning experiences that match students' cognitive needs. This has particular poignancy in our efforts to make sure that learners are better prepared with the skills to act optimally in a data-driven world. Within this arena, it becomes important that one considers ways in which visualization tools might support cognitive activities with a view to enhancing learning and engagement. It tries to close the gap between technology and education in order to make the learning environment more effective, helping students to be better prepared to enter into the challenges that the digital age is going to bring with it.

Methods:
The present study collected information from 81 graduate students(M=63, F=18) enrolled in classes involving data analytics and visualization using a mix-method approach: a quantitative online survey combined with a qualitative analysis of the

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open-ended responses. Descriptive statistics such as means and percentages to depict key trends of the students' preference. Inferential statistical tests, t-tests, chi-square test-to test hypotheses on possible differences. Graphical representation use bar chart and pie chart.

Result/Discussion:

The important result was that 84.0% of the responding population favored bar charts for visualization, followed by pie charts at 65.4%, and line graphs at 51.9%. Microsoft Excel was the most utilized software; 71 preferred it because of its ease of access and ease of use. Advanced forms of visualizations, such as scatter plots and heat maps, were less preferred because in these the cognitive load was higher. Advanced tools such as Tableau and R were used less frequently, mainly because they are more complex and expensive. Significant differences in the perceived effectiveness and the usage of different tools were observed in the statistical analyses, including t-tests and chi-squared tests.

One of the primary objectives was the visualization techniques used by graduate students more often; as indicated by the results, it is evident that the biggest preferences include the bar chart, pie chart, and line graph. This confirms the literature that these simple visualizations effectively support comprehension (Mayer, 2021). Maybe this hailed preference for bar charts above all others suggests that learners prefer using visualizations that don't overload them cognitively so that they can process and interpret information more easily effectively (Sweller, 1988). Having compared the perceived effectiveness of these visualizations in terms of their academic tasks, it was found that the bar chart came out to be much academically effective as compared to heat maps. This finding agrees with Mayer's cognitive theory of multimedia learning, which assumes that learners derive benefits from any visuals that would facilitate clear comparisons and direct development of interpretations (Mayer, 2021). With a mean effectiveness score of 3.65 for bar charts versus a mean effectiveness of 2.51 for heat maps, the critical insight is that although advanced visualizations bear a potential for rich information, they may not serve educational purposes quite so well, especially in students who are only developing their analytic competencies. Another goal of the research was an investigation into influencing factors such as ease of use and cost. This makes the strong preference for Microsoft Excel over more complex tools like Python, Tableau, or R a very vital point for educators and software developers. The participants preferred Excel because it was more accessible and hence easy to use; thus, any other tools perceived as easy to use are more likely to gain acceptance in academic settings. This finding is in concert with research by Lin and Yu (2023), that ease of use is one of the determining factors for the acceptance of technology in education.

The third hypothesis found whether there is a significant difference in gender regarding the use of pie charts for visualization and familiarity with Power BI software. There was no significant difference from the results, meaning that both genders like and are equally familiar with the facilities. This is an interesting finding given the literature suggesting possible differences between genders in technology

use and preference. It also calls for equal opportunities to be allocated to all students in the usage of different visualization tools regardless of gender. In sum, these findings ought to have important implications for educators and software developers. Educators will learn from students' preferences for visualization techniques that will help them in curriculum development, making their teaching tools relevant to the cognitive needs and preferences of the students. This will not only increase engagement and improve learning but also help the software developers to learn how to develop educational tools in such a way that usability and accessibility would facilitate the use of visualization software by students. Proper visualization tools should be user-oriented and become an organic element of educational practice. In modern education, which is based more and more on data and information, it is very important to teach learners the skills they need and provide them with instruments for effective work in complicated informational structures.

Emphasis on cognitive activities and the efficiency of different visualization techniques could provide a learning environment that is more adaptive and better prepares students for challenges in the digital age.

Conclusion:
The study points to the critical role and importance of visualization techniques in academia and creates a need for tools which consider learner preferences and cognitive capacity. This will enable us to upgrade the learning experiences and ensure a smoother transition to the digital age for education.

Keywords: data visualization, academic settings, student preferences, software tools, effectiveness, education, digital transformation

REFERENCES

Lin, Y., Yu, Z. (2023). Extending Technology Acceptance Model to higher-education students' use of digital academic reading tools on computers. *Int J Educ Technol High Educ* **20**, 34. https://doi.org/10.1186/s41239-023-00403-8

Mayer, R. E. (2021). Evidence-based principles for how to design effective instructional videos. *Journal of Applied Research in Memory and Cognition, 10*(2), 229– 240. https://doi.org/10.1016/j.jarmac.2021.03.007

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science, 12*(2), 257–285. https://doi.org/10.1207/s15516709cog1202_4