

GPT vs. Google: A comparative study of self-code learning in ODL students

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Highlights

- This study compared the experiences of using the ChatGPT large language model (LLM) and the Google search engine for students' self-learning of JavaScript functions.
- In this study, it was determined that learners experienced less disorientation, reduced cognitive load, and higher satisfaction when learning coding via ChatGPT compared to using the Google search engine.
- The research contributes to understanding AI applications in education, particularly in self-directed learning scenarios in open and distance learning.

Abstract

This research investigates the comparative effectiveness of the ChatGPT and the Google search engine in facilitating the self-learning of JavaScript functions among undergraduate open and distance learning students. The study employed a quasi-experimental post-test control group design to analyze the variables of disorientation, satisfaction, cognitive load, navigation performance, and test scores among 471 learners. Results indicated a marked advantage for ChatGPT users in reducing cognitive load and disorientation, improving navigation performance and increasing test scores. The study also explores the evolving dynamics between conventional keyword-based search engines and AI-driven conversational models, reflecting on their mutual influence in the domain of information retrieval. These findings suggest that AI chatbots like ChatGPT not only enhance the learning experience but also signify a paradigm shift in how information is accessed and processed in educational settings. The research contributes to understanding AI applications in education, particularly in self-directed learning scenarios in open and distance learning.

Article Info: Research Article

Keywords: Open and distance learning, artificial intelligence, cognitive load, disorientation, navigation performance

1. Introduction

Hypermedia is characterized by its non-linear, flexible, and interactive nature. The Web, a prime example of hypermedia, offers users control and flexibility. However, it also presents significant challenges in terms of navigation and information retrieval. In hypermedia environments, learners, particularly in self-directed learning contexts, often encounter navigation problems such as disorientation and cognitive load due to the complex structure of these environments. This complexity can adversely affect a learner's experience in online self-directed learning environments (Amadiou et al., 2009).

With the emergence of ChatGPT, the use of artificial intelligence-based chatbots in educational environments has gained prominence (Guo et al., 2023). As Large Language Models (LLMs) become increasingly prevalent in education, educators and institutions are confronted with critical decisions regarding their effective integration (Darvishi et al., 2023). There is a clear need for more in-depth scientific research on integrating AI into education. Although Generative Artificial Intelligence (GAI) is

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still developing, it can already compete with traditional methods in specific areas, such as code interpretation (Popovici, 2023; Yilmaz & Yilmaz, 2023; Rahman & Watanobe, 2023; Shoufan, 2023).

Code interpretation, involving the analysis of a code's logic, structure, and the interaction of its different parts, is crucial in software development. It enables developers to understand and modify existing code (Firdous et al., 2023). ChatGPT has demonstrated notable success in code interpretation due to its accuracy and precision. This success can be attributed to the canonical and standardized nature of programming languages, which large language models like GPT can process with minimal errors. ChatGPT's capabilities extend beyond writing code to debugging, fixing, and returning code. To explore ChatGPT's potential for self-directed code learning, participants in this study were tasked with learning JavaScript code using both ChatGPT and Google.

ChatGPT emerges as a significant tool for self-directed learning (Firat, 2023), particularly in the domain of coding and code learning. It offers interactive, personalized learning experiences that can adapt to individual learner's styles and paces. Its ability to provide instant feedback, clarifications, and code examples makes it an invaluable asset for learners who are navigating the complexities of programming languages and coding principles. Furthermore, ChatGPT's conversational interface lowers the entry barrier for beginners, making coding more approachable and less intimidating. Simulating a tutoring experience allows learners to explore, make mistakes, and learn at their own pace. This feature is especially crucial in coding, where understanding often comes from trial and error and iterative learning. Additionally, the AI's vast repository of coding knowledge and examples serves as an on-demand resource, offering insights and solutions that are tailored to the learner's current problem or query. The potential of ChatGPT in revolutionizing self-code learning lies not only in its technical capabilities but also in its ability to make learning more accessible, engaging, and aligned with the needs of contemporary learners who prefer autonomy and instant assistance in their educational journeys.

2. Related Literature

AI applications today are rapidly transforming the way we teach and learn (Tonbuluğlu, 2023). The advent and evolution of large language models, particularly ChatGPT, have marked a significant shift in various fields, including education, technology, and programming. This literature review aims to explore the diverse applications, compare them with traditional methodologies, and examine the potential impact of ChatGPT across these domains.

Several studies have highlighted the use of ChatGPT in educational settings. Adamopoulou and Moussiades (2020) define chatbots, like ChatGPT, as interactive agents capable of simulating intelligent conversation. Karadağ(2023) noted that ChatGPT's potential to automate the grading process is one of the most critical impacts of AI on online assessment. OpenAI (2023) elaborates that ChatGPT, developed for natural language processing, assists in generating contextually relevant responses. Building on this, Lin (2023) notes that ChatGPT aids adult learners in self-directed learning by helping them set goals, locate resources, and design personalized learning plans. Furthermore, Balasubramanian (2023) suggests that ChatGPT promotes learners' autonomy by providing tailored assistance, enhancing the overall learning experience. Expanding on the theme of self-directed learning, Varghese (2023) observes that ChatGPT can boost motivation and engagement among autodidactic learners through prompt-based, AI-generated text responses. This is echoed in the work of Biswas (2023), who emphasizes the importance of understanding ChatGPT's role in autodidactic learning to guide the evolution of technology-assisted education.

Kasneci et al. (2023) and Zhu et al. (2023) discuss ChatGPT's role in facilitating learning by offering customized code snippets and identifying syntax errors, while Barber et al. (2021) focus on its applications in remote learning environments. Complementing these perspectives, Wu et al. (2023) found that ChatGPT, when used in a blended learning context, offered more targeted, real-time responses than

traditional Google search, thereby enhancing the self-regulation phase of learning. Similarly, Alshahrani (2023) explores ChatGPT's impact in blended learning environments, highlighting its potential to improve engagement, motivation, and self-directed learning through immediate feedback.

In the evolving field of information retrieval, a series of studies have compared ChatGPT and Google, revealing varied insights. Haleem et al. (2022) highlighted ChatGPT as a promising new-generation alternative to search engines, addressing its use, capabilities, and limitations. Moving to 2023, Xu, Feng, and Chen noted better usability and satisfaction with ChatGPT than Google, particularly emphasizing its task-completion efficiency. Hristidis et al. (2023) provided a contrasting view, finding that while ChatGPT offered more relevant answers, Google was superior in sourcing reliable information. Furthering this comparative narrative, Xu et al. (2023) presented a comprehensive user experience analysis, underscoring the trade-offs between ChatGPT's ease of use and the potential for overlooking incorrect information. Arcila (2023) echoed this by discussing ChatGPT as an alternative to traditional search engines, delineating its advantages and limitations. Lastly, Al Afnan et al. (2023) explored ChatGPT's potential in education, specifically in communication and business correspondence courses, concluding through 30 tests that it could rival search engines by providing accurate and reliable information to students.

Shifting the focus to programming and software development, ChatGPT's influence is also noteworthy. Popovici (2023) discovered its adeptness in reviewing code for student programming assignments. Studies by Yilmaz and Yilmaz (2023), Rahman and Watanobe (2023), and Shoufan (2023) indicate its effectiveness in offering quick and mostly accurate answers, enhancing debugging, and improving confidence in coding. These studies highlight its potential yet caution against potential over-reliance, reflecting similar concerns raised in the educational context.

Despite its wide-ranging applications, ChatGPT faces limitations. Megahed et al. (2023) observed that while ChatGPT performs well in structured tasks like code translation and explaining well-known concepts, it struggles with less familiar terms and creating code from scratch. Similarly, Sakib, Khan, and Karim (2023) noted challenges in improving solutions based on feedback, pointing to accuracy issues. Due to the need to make interactions between learners and educators more effective, there has been an increasing focus on the implementation of innovations produced in open and distance learning. The development of ChatGPT since November 2022 and the opportunities it offers have been the subject of many studies on how it can be utilized in open and distance learning. Examples of these studies include Thu et al. (2023) on the Opportunities and Challenges in the Integration of ChatGPT into Online Education Systems, Firat (2023) on self-directive learning, Naidu and Sevnarayan (2023) on online assessment, Ali et al. (2023) on learning motivation, and Alseddiqi et al. (2023) on its potential use in MOOCs. Additionally, Van Wyk et al. (2023) found that ChatGPT was applied in distance education and is seen to have immense potential to facilitate teaching, learning, and engaging scholarship. The literature features studies on the utilization of search engines in various contexts, such as second language acquisition (Mracek, 2019), finding and correctly using collocations in the processes of learning and teaching English (Zengin, 2009), and conducting course-related reading and research (Gomathi & Sivasubramanian, 2019).

The linear structure of search engines compels individual users to sequentially examine information while navigating the digital environment and attempting to access online information, leading to time-consuming searches and disorientation (Naseer et al., 2023).

Cognitive load theory has significantly influenced educational psychology (Skulmowski and Xu, 2022). Feeling completely immersed in a virtual world during a learning task can create a whole new learning experience when compared with learning with traditional media, but this immersion may also lead to a depletion of learners' cognitive resources on that experience itself rather than contributing towards learning (Frederiksen et al., 2020). Cognitive load is used to evaluate, model, and predict human performance in several disciplines, including cognitive and educational psychology, human factors, and

engineering psychology (Gwizdka, 2010). Search satisfaction is defined as the fulfillment of a user's information need (Dan&Davidson, 2016). Satisfaction is one of the measures that represents the overall judgement of the decision made, and when this is technology-assisted, satisfaction also represents the effectiveness of the assisted system (Gatian, 1994). In their study, Firat and Kabakçı Yurdakul (2016) concluded that the flexibility and information provided by hypermedia for learner control also introduce navigational challenges such as disorientation, cognitive overload, distraction of attention, and time loss, all of which adversely affect the learner's navigational performance in hypermedia environments. This study aims to compare learners' usage of ChatGPT and Google search engine by examining their Navigation Performance Scores in the context of disorientation, satisfaction, and cognitive Load. ChatGPT has yielded successful results in text-based operations since the first day it was introduced (AlAfnan, 2023). One of the advantages that ChatGPT offers to users is the ability to write code in the desired programming language (Zhu et al., 2023), which stands out as an important area of study for educators on how to use it effectively in educational environments. Unlike search engines, ChatGPT presents the searched data on the same page, preventing users from searching for data across many websites and allowing them to reach results faster. This study aims to compare the use of ChatGPT and Google search engines in terms of cognitive load, disorientation, navigation performance and satisfaction in the coding learning processes of Web Design and Coding Associate Program students in technology-based open and distance learning. The research aims to determine whether ChatGPT can be an alternative to search engines in terms of these variables for learners in open and distance learning with the features of understanding, interpreting and responding quickly.

This review underscores ChatGPT and similar large language models that have found substantial applications in education, technology, and other fields. They offer significant advantages, such as enhanced learning experiences and efficient information retrieval. However, they also present challenges like reliability and the risk of over-reliance. Future research should continue to explore these models' evolving roles and how to balance their use with developing independent skills and critical thinking.

The purpose of this study was to compare students' experiences of learning code via ChatGPT and Google regarding navigation performance and academic success. The independent variables are age, gender, JavaScript experience, and ChatGPT usage, while the dependent variables are Navigation Performance Score (Disorientation, Satisfaction, Cognitive Load) and Test Score. The research hypotheses are:

H1: Those who learn JavaScript functions in ChatGPT will have better navigation performance than those who learn JavaScript functions in Google.

H2: Students who learn JavaScript Functions in ChatGPT will have higher test scores than those who learn JavaScript Functions in Google.

3. Methodology

3.1. Research Model/Design

This study was conducted using a quasi-experimental post-test control group design and was reported according to the consort checklist. This design is quasi-experimental because the experimental and control groups were assigned according to a pre-existing characteristic (ChatGPT involvement) rather than by random assignment. The independent variables were age, gender, JavaScript experience, and ChatGPT usage, while the dependent variables were navigation performance and JavaScript functionality test.

The target population of this research consisted of undergraduate students of the Web Design and Coding Program taking the JavaScript course at Open Education Faculty of Anadolu University in Turkey (N=471). The program is fully distance learning. The minimum sample size of 110 individuals was calculated with alpha (α) = 0.05, power = 0.80 and effect size 0.77 for this research. Participants ranged in age from 17 to 72 years, with a mean age of 30.5 years (SD = 9.87). 66.7% of participants were male and 33.3% were female. Participants took part in the survey after completing the voluntary participation form

and had the right to withdraw from the survey at any time. No personal information was collected during the survey process. JavaScript experience was categorized as basic (1), intermediate (2), and advanced (3). Since the research sample consisted of students from the same class who had not yet taken the JavaScript course, assigned randomly, a pre-test was not administered.

3.2. Data Collection Tools

Participants' navigation performance was measured using the Hyper-MNP scale developed by Firat and Kabakci Yurdakul (2016). This scale consists of a total of 15 items, 7 of which are positive statements and 8 of which are negative statements. The scale has a three-factor structure, including disorientation (6 items), satisfaction (5 items), and cognitive load (4 items). The items are 5-point Likert type. The internal consistency coefficient of the scale is $\alpha = 0.90$. In addition, a test consisting of 5 questions created by the researchers was applied to the participants to determine the learning levels of the participants for the Javascript learning task. The test content consists of javascript function topics.

3.3. Procedures

Participants were divided into two groups according to their ChatGPT experience. Participants with ChatGPT experience were instructed to self-learn on ChatGPT for at least 5 minutes with the input "I want to learn JavaScript functions", while participants without ChatGPT experience were instructed to self-learn on Google with the same input. This redirection was based on the participants' prior experience, so no random assignment was used to determine the experimental and control groups.

In order to minimize the differences between the experimental and control groups, the study was conducted only with the students of Anadolu University, Open Education Faculty, Web Design and Coding Associate Degree Program. 223 of the students indicated that they had used ChatGPT before. This group was identified as the experimental group. The 151 students who indicated that they had not used ChatGPT before were assigned to the control group. Since the research sample consisted of students from the same class who had not yet taken the JavaScript course, assigned randomly, a pre-test was not administered.

The study was conducted with the approval of Anadolu University Ethics Committee and with the approval of the Dean's Office of Open Education Faculty for data collection. Before the data collection, the participants read and approved the voluntary participation form. In conducting this research, we meticulously followed the guidelines and ethical standards the Committee on Publication Ethics (COPE) set forth, ensuring integrity and ethical rigor throughout the study.

3.4. Data Analysis

Descriptive statistics were utilized for dependent and independent variables, including frequencies, percentages, standard deviations, and means. Parametric test assumptions were analyzed to compare the Navigation Performance Score (Disorientation, Satisfaction, Cognitive Load) and JavaScript Test scores of the experimental and control groups. Shapiro-Wilk test results for the dependent variables indicated that the data were not normally distributed. Homogeneity (Levene) test results also showed that there was no homogeneity of variance between groups. Given the sample size, normal distribution statistics, and normality values of this study, the most appropriate test was determined to be Welch's. Therefore, Welch's t-test was used to compare the results of the experimental and control groups. Welch's t-test method (Welch, 1947) allows for more effective results when the number of samples in the two groups is different and the group variances are not equal (Ruxton, 2006). Welch's degrees of freedom (df) is a test that is calculated based on sample sizes and variances. This calculation produces more accurate p-values when the variances and sizes of the samples are different. The effect of the independent variables on the dependent variables was evaluated at a significance level of $p < .05$. In addition, Cohen's d was used to determine the magnitude

of statistical differences. Cohen's *d* indicates a small effect size of 0.2, a medium effect size of 0.5, and a large effect size of 0.8 (Rice and Harris, 2005).

4. Findings

To test the two hypotheses of the study, the Navigation Performance Score (including Disorientation, Satisfaction, and Cognitive Load) and Test Scores of the experimental and control groups, who engaged in self-learning JavaScript functions using ChatGPT and Google, were compared using Welch's *t*-test. The results of Welch's *t*-test are presented in Table 1.

Table 1.

Welch's *t*-test results

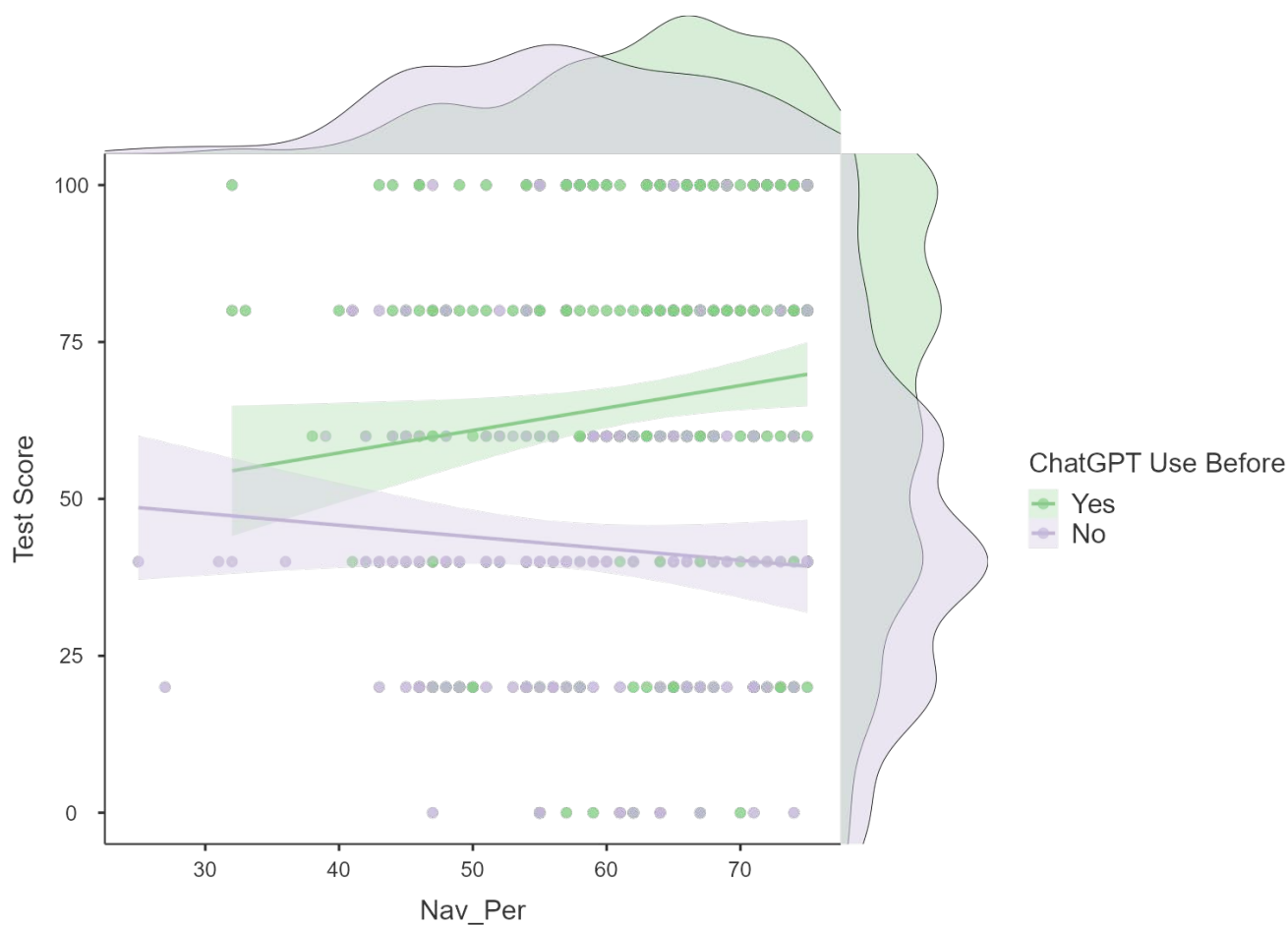
Dependent Variables	Test	Statistic	df	p	Mean difference	SE difference	Effect Size Cohen's <i>d</i>
Disorientation	Welch's <i>t</i>	4.77	271	< .001	0.359	0.0752	0.478
Satisfaction	Welch's <i>t</i>	4.58	284	< .001	0.436	0.0951	0.456
Cognitive Load	Welch's <i>t</i>	5.44	282	< .001	0.450	0.0827	0.542
Nav_Per	Welch's <i>t</i>	6.15	291	< .001	6.131	0.9967	0.609
Test Score	Welch's <i>t</i>	9.32	371	< .001	22.652	2.4316	0.882

Welch's *t*-test results were used to test the research hypotheses. To test the first hypothesis of the study, the navigation performance scores of the experimental and control groups were compared. Specifically, the scores for the individual navigation performance factors—disorientation, satisfaction, and cognitive load—were analyzed separately, along with the total navigation performance scores. The result obtained for the disorientation factor showed a statistically significant difference between the experimental and control groups ($p < .001$). Accordingly, the self-learners of JavaScript on ChatGPT were less disoriented than the Google learners. This significant difference between the two groups has a medium effect size ($d = 0.478$). The comparison results according to the satisfaction factor showed a significant difference between the groups ($p < .001$). That is, self-learners of JavaScript on ChatGPT reported higher satisfaction than Google learners. This significant difference between the two groups had a moderate effect size ($d = 0.456$). There was also a significant difference in the cognitive load factor between the experimental and control groups ($p < .001$). Accordingly, self-learners of JavaScript on ChatGPT reported less cognitive load than Google learners. This significant difference between the groups had a greater than medium effect size ($d = 0.542$). A statistical difference was also found between the two groups regarding overall navigation performance scores ($p < .001$). Accordingly, the self-learners of JavaScript on ChatGPT showed higher navigation performance than the Google learners. This significant difference between the groups also had a medium effect size ($d = 0.609$). These results indicate that the first hypothesis of the study was supported.

To test the second research hypothesis, the JavaScript test scores of the experimental and control groups were compared. As shown in Table 1, there was a statistically significant difference between the groups at the $p < .001$ level. Accordingly, the self-learners of JavaScript on ChatGPT had higher test scores than the Google learners. Notably, this significant difference between the experimental and control groups had a large effect size ($d = 0.882$). This finding indicates strong support for the second hypothesis of the study.

The results related to both hypotheses show significant differences between the two groups regarding students' navigation performance and test scores. In particular, the large effect size of the difference in

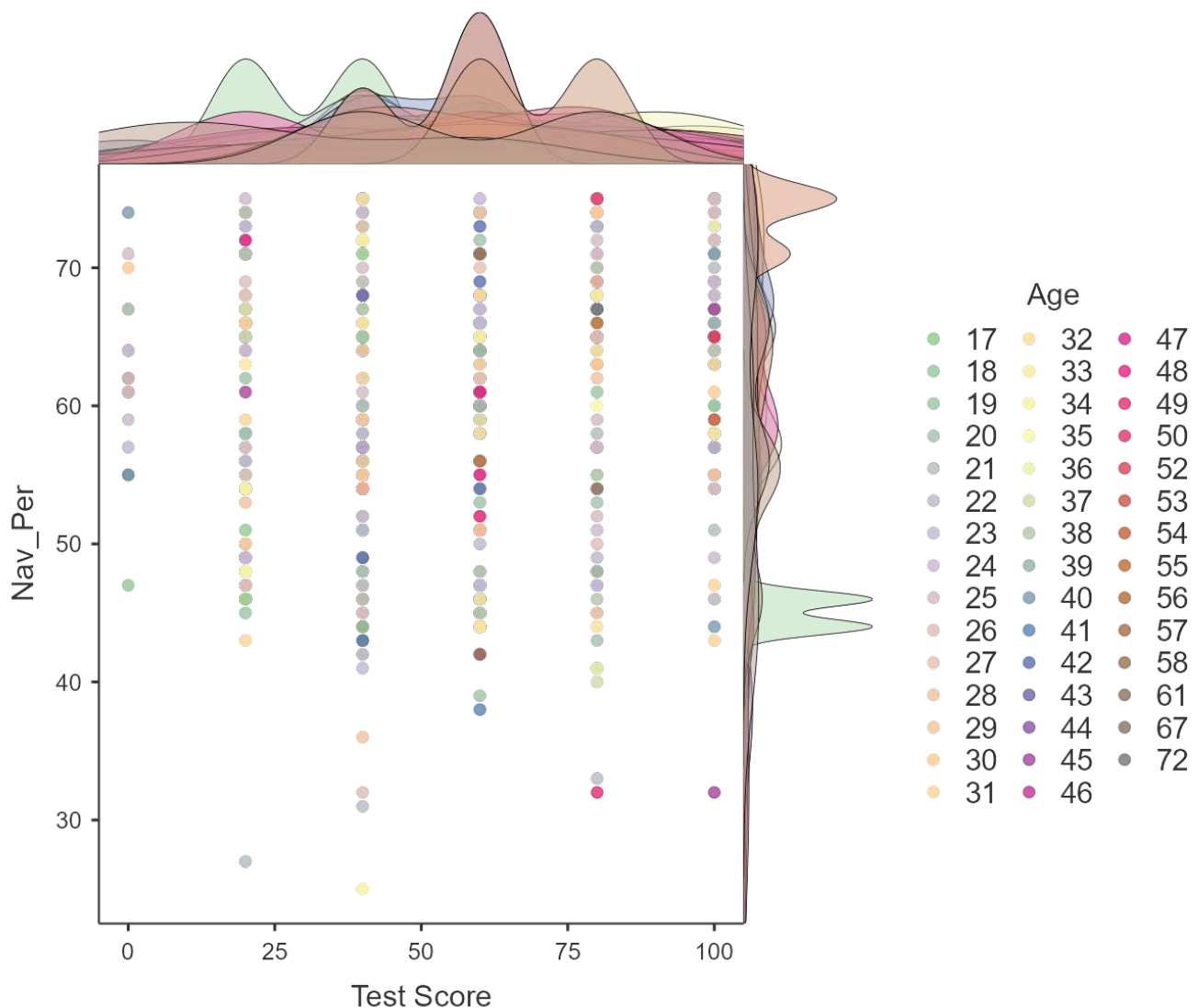
JavaScript test scores indicates that ChatGPT contributed to a more generalizable academic achievement in self-directed code learning. The data in Graph 1 below also support these findings.



Graph 1. Distribution of test scores and navigation performance according to ChatGPT usage

Graph 1 shows that the use of ChatGPT positively impacts test success. Participants who have used ChatGPT have higher test scores, and the higher the percentage of “Nav_Per”, the higher their achievement. Finally, the ages of the participants in this study ranged from 17 to 72 years old. To examine the possible

effects of age on the dependent variables, a scatter plot of test score and navigation performance by age with marginal density highlighting is presented in Graph 2.



Graph 2. Scatter plot of test score and gazinim performance by age

As seen in Graph 2, test scores do not show a significant difference between age groups. Participants between 17 and 72 years of age can score both low and high test scores. This shows that the test results do not differ significantly by age. Similarly, the vast majority of participants have a navigation performance between 50% and 70%. Again, there is no clear trend in terms of age group. Respondents of different ages are at different levels of navigation performance.

5. Discussion

In this study, it was determined that learners experienced less disorientation, reduced cognitive load, and higher satisfaction when learning coding via ChatGPT compared to using the Google search engine. This three-factor structure resulted in learners exhibiting superior navigation performance with ChatGPT. This

finding aligns with the study of Arcila (2023), who stated that ChatGPT rapidly gained prominence after its emergence, being utilized for various tasks and serving as an alternative to traditional search engines.

There are fundamental differences between search engines and ChatGPT in terms of accessing information. The world's leading search engine, Google, relies on keyword search and matching to provide users with relevant links. In contrast, ChatGPT uses a conversational approach, allowing users to formulate queries in natural language (Xu et al., 2023). The distinction between these platforms stems mainly from two factors: firstly, ChatGPT offers more tailored suggestions for students' needs than Google; secondly, ChatGPT maintains the learner's focus more effectively within the learning interaction. Zhu et al. (2023) highlighted ChatGPT's advantages, such as dialogue history (up to 3000 words) and the ability to facilitate targeted knowledge acquisition through customized queries. This capability enables learners to use ChatGPT to maintain context while learning JavaScript functions.

Moreover, Haleem et al. (2022) stated in their study that users could leverage ChatGPT's ability to understand and respond to varied language inputs, obtaining straightforward answers to their queries. This feature positions ChatGPT as a superior information retrieval platform to Google, catering to the user's individual needs and preferences. This supports the observed significant differences in disorientation, satisfaction, and cognitive load when using ChatGPT for learning purposes compared to Google.

Consequently, the findings of this study suggest that learners using ChatGPT have more positive experiences than those using the Google search engine. The enhanced guided and reinforced learning techniques or learning transfer methods provided by ChatGPT (Al Afnan, 2023) are significant factors contributing to this outcome. Additionally, Google's development of the Bard chatbot (Singh, 2023) presents an alternative to ChatGPT in this arena. Furthermore, the release of the most capable version of the artificial intelligence model named Gemini on December 6, 2023, outperforming GPT-4 in multiple-choice exams, elementary school mathematics, and other criteria (HGS, 2023), indicates ongoing competition between AI models.

While this study provides insightful findings on the efficacy of ChatGPT in learning JavaScript functions compared to traditional Google search methods, it is important to acknowledge certain limitations. Firstly, the quasi-experimental design, with pre-existing characteristics (ChatGPT involvement) determining group assignment, may introduce selection bias, as the groups may have inherent differences not accounted for in the study. Secondly, the study's focus on a specific subject (JavaScript functions) and its execution in a fully distance learning environment may limit the generalizability of the findings to other subjects or educational settings. The use of Welch's t-test, while appropriate for the data characteristics of this study, may also present limitations in interpreting the results, as it assumes unequal variances and sample sizes, which could influence the p-values and effect size calculations. Lastly, the study was conducted within a specific cultural and educational context (a state university in Turkey), which might affect the applicability of the findings to different cultural or educational environments. Future research could address these limitations by employing a randomized controlled trial design, using objective performance measures, and expanding the scope to include diverse subjects and learning contexts.

6. Conclusion

This study compared the experiences of using the ChatGPT large language model (LLM) and the Google search engine for students' self-learning of JavaScript functions. The results affirm the study's hypotheses, indicating a significant difference in favor of ChatGPT users in terms of disorientation, satisfaction, cognitive load, navigation performance, and test scores. Consequently, ChatGPT emerges as a viable alternative to traditional search engines. Recently, while AI chatbots like ChatGPT have been driving the shift from keyword-based search to question-answering (QA) systems, Google has also been transitioning towards QA, exemplified by integrating short text passages at the top of the results page for certain queries and incorporating AI models into its framework (Zhao et al., 2023; Hristidis et al., 2023). Despite their

distinct approaches to information access and presentation, both platforms seem to be influencing each other's evolution. Ayoub et al. (2023) and Liu et al. (2023) compared ChatGPT and Google in accessing medical information and found that while ChatGPT was superior in providing general medical information, it was less effective in offering medical recommendations. Additionally, Liu et al. (2023) noted surgeons' reluctance to adopt ChatGPT. The ability of ChatGPT to provide strong cues for accessing information may enhance the accuracy and reliability of AI, broadening its application scope.

7. Recommendations

ChatGPT and the Google search engine deliver distinct user experiences, operating on different principles. Google is known for its extensive search scope and diverse options, while ChatGPT offers a more streamlined search experience with concise, clear answers. Google's recent introduction of alternative question suggestions in search queries suggests its inspiration from AI-based chatbots. For ChatGPT to rival Google's functionality, it needs to incorporate a broader spectrum of data types and references. Future research should focus on enhancing the user search experience by leveraging the strengths of these two platforms, particularly in guiding users to accurate answers more efficiently. Additionally, studies examining the outputs of ChatGPT and Google in terms of accuracy, data access speed, and applicability would be beneficial in illuminating the development trajectories of these platforms.

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