

A Systematic Review on the Self Efficacy and the use of Block Based Visual Learning for Gifted Students

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Abstract

This systematic review investigates the effect of block-based visual learning on the self-efficacy of gifted students, an area of increasing relevance in contemporary educational discourse. This review synthesizes findings from three databases (Proquest, EBSCOhost, Springer LINK) of empirical studies that explore how block-based programming environments, such as Scratch and Blockly, influence the self-efficacy beliefs of gifted learners. The methodology employed includes a comprehensive search of articles, conference papers, and educational reports published between 2020 and 2024, focusing on quantitative and qualitative outcomes related to self-efficacy. Results indicate that engagement with block-based programming not only enhances technical skills but also fosters a positive self-perception among gifted students, leading to increased motivation and persistence in problem-solving tasks. Furthermore, the review highlights the importance of instructional strategies that integrate block-based programming into curricula designed for gifted education. The findings underscore the potential of visual programming as a pedagogical tool that can empower gifted learners, suggesting implications for educators and policymakers in the development of curricula that support the unique needs of this population.

Keywords: Block-based Visual Learning, Self -efficacy, Gifted Student, Visual Programming, Systematic Review

1.0 Introduction

Self-efficacy is the belief in one's ability to perform tasks needed to achieve goals, and it is important for the learning of gifted individuals. Gifted students frequently encounter a range of challenges that can undermine their self-efficacy. One significant issue is the pressure to consistently perform at high levels, which can lead to anxiety and fear of failure. This pressure is often exacerbated by external expectations from parents, teachers, and peers, who may assume that gifted students will always excel (Schneider & Preckel, 2017). Such expectations can create a paradox where gifted students may avoid challenging tasks to protect their self-image, thereby limiting their opportunities for mastery experiences that are essential for building self-efficacy (Richardson et al., 2012).

Mastery experiences, which are critical for developing self-efficacy, are often less frequent for gifted students who may not encounter tasks that challenge them sufficiently (Richardson et al., 2012). The challenges faced by gifted students regarding self-efficacy are multifaceted and deeply intertwined with their unique cognitive and emotional profiles. Gifted students often exhibit high levels of ability and potential, yet they frequently encounter significant barriers that can undermine their self-efficacy.

Research indicates that self-efficacy can significantly influence achievement, particularly in high-stakes educational environments where gifted students often find themselves (Schneider & Preckel, 2017). This relationship is reciprocal; while high self-efficacy can lead to better performance, the outcomes of these performances can further reinforce or diminish self-efficacy beliefs (Schneider & Preckel, 2017).

The implications of these challenges are profound. Low self-efficacy can lead to decreased academic performance, increased anxiety, and a higher likelihood of dropping out of school (Schneider & Preckel, 2017). Therefore, addressing the self-efficacy of gifted students is not merely an academic concern but a critical aspect of their overall development and mental health. Interventions aimed at enhancing self-efficacy

must be multifaceted, incorporating educational strategies, psychological support, and community engagement to create a supportive environment for gifted learners (Schneider & Preckel, 2017).

1.1 What is Block Based Visual Learning?

Block-based visual learning or block based visual programming is a pedagogical approach that utilizes graphical interfaces to allow users, particularly beginners, to create programs by manipulating visual blocks that represent programming constructs. This method simplifies the programming process by removing the need for complex syntax, enabling learners to focus on the logic and structure of programming rather than the intricacies of text-based coding. The blocks are designed to fit together in a way that visually represents the flow of the program, making it easier for users to understand how different components interact with one another (Hu et al., 2020).

1.2 Block Based Visual Learning and Self efficacy

The integration of block-based visual programming environments, such as Scratch and Block, has been increasingly recognized as a powerful tool for enhancing self-efficacy among learners, particularly in the context of computer programming education. Self-efficacy plays a crucial role in determining motivation, persistence, and performance in learning environments. Research has shown that engaging with visual programming languages can significantly improve students' self-efficacy perceptions and attitudes towards programming, thereby fostering a more positive learning experience. Yükseltürk and Altıok (2016) conducted a study that highlighted the positive effects of programming with Scratch on preservice IT teachers' self-efficacy perceptions. Their findings indicated that the use of Scratch not only facilitated the development of programming skills but also enhanced the participants' confidence in their programming abilities. This is consistent with the work of Çoklar and Akçay (2018), who emphasized the importance of self-efficacy in the context of inquiry and problem-solving skills in teacher education. They found that students with higher self-efficacy were more likely to engage in programming tasks and demonstrate better problem-solving capabilities.

Moreover, the gender differences in self-efficacy perceptions towards programming have been explored by Günbatar and Karalar (2018). Their research revealed that middle school students exhibited varying levels of self-efficacy based on gender, with implications for how programming education is delivered. This suggests that block-based programming environments can be tailored to address these differences, thereby enhancing self-efficacy across diverse student populations. The findings align with the notion that self-efficacy can be influenced by contextual factors, including the type of programming environment utilized.

The relationship between self-efficacy and programming success has been further supported by Özmen and Altun (2014), who noted that students' beliefs in their programming capabilities directly correlated with their success in writing program codes. This reinforces the idea that enhancing self-efficacy through effective educational interventions, such as block-based programming, can lead to improved learning outcomes. Additionally, Li et al. (2022) found that visual programming languages could reduce the perceived difficulty of programming tasks, thereby increasing students' self-efficacy in programming.

In a practical application, Kahramanoğlu et al. (2019) investigated the impact of the EBA Coding module on secondary school students' self-efficacy beliefs regarding programming. Their results demonstrated that students who engaged with the EBA Coding module exhibited significantly higher self-efficacy compared to those who received traditional instruction. This suggests that the interactive and user-friendly nature of block-based programming environments can effectively enhance students' confidence in their programming abilities.

Furthermore, the concept of mastery experiences, which refers to the successful completion of tasks, is a critical component of self-efficacy theory. As articulated by Abdunabi et al. 2019, providing students with opportunities to engage in successful programming experiences through visual programming can lead

to increased self-efficacy. This aligns with Bandura's assertion that mastery experiences are one of the most influential sources of self-efficacy.

2.0 Systematic Review Process

Inclusion	Exclusion
The research subject and the scope of the study must be pertinent to the topic at hand.	The research subject and the scope of the study are not related to the topic at hand.
The relevance of concepts and definitions of terms is significant to the development of research questions.	The relevance of concepts and definitions of terms is not significant to the development of research questions.
Only empirical studies will be included, such as experimental, quasi-experimental, longitudinal, or case studies. The research must provide data-driven findings regarding the impact of BBVP on self-efficacy	Opinion pieces, editorials, literature reviews, and theoretical articles will be excluded as they do not provide empirical data on the effects of BBVP on self-efficacy
The target population only focus on students, particularly those identified as gifted or high-achieving.	Studies involving other populations will be excluded unless they provide comparative insights relevant to gifted students
Articles published till 2020	
Articles that include clear self-efficacy measurement	Studies that do not measure self-efficacy

This systematic review aims to synthesize findings from various studies to provide a comprehensive understanding of how BBVP effect self-efficacy among gifted learners. The steps taken were as follows: (1) identify inclusion and exclusion criteria for article selection, (2) identify the relevant work (search strategy), (3) data extraction and quality appraisal of the selected studies, and (3) summary, synthesis and interpretation of the findings

Table 1. Inclusion and Exclusion Criteria.

The inclusion and exclusion criteria outlined below will guide the systematic review process, ensuring that only relevant, high-quality studies are considered. This review will only focus on block-based visual learning studies and must explicitly investigate block-based visual programming environments, such as Scratch, Blockly, or similar platforms. Research that discusses the principles, methodologies, or outcomes associated with BBVP will be prioritized. Other than that, self-Efficacy Measurement must be included as a clear measurement of self-efficacy. This can be assessed through validated self-efficacy scales, surveys, or qualitative assessments that provide insights into participants' perceptions of their abilities. As for the target population, the research must focus on students, particularly those identified as gifted or high-achieving. Studies involving other populations will be excluded unless they provide comparative insights relevant to gifted students.

2.1 Search Strategy

To gather relevant citations, a variety of published articles were searched in several electronic databases, including ProQuest, EBSCOhost and SpringerLink. All articles published up to 2020 were considered, and the search was limited to those written in English. This process yielded 06 articles, from which relevant studies were chosen for the review. The potential relevance of these studies was assessed, leading to the exclusion of 381 articles deemed unrelated. The search will utilize a combination of keywords and phrases such as "self-efficacy "block-based visual programming," " gifted students," "Scratch". Boolean operators

(AND, OR) will be employed to refine the search results. The search was conducted on 222 articles on the ProQuest database.

2.2 Data Extraction

Once relevant studies are identified, the next step is to extract data systematically. This involves creating a data extraction form that captures essential information from each study, such as the authors, year of publication, sample size, methodology, and key findings related to self-efficacy. For example, Koray's study on the integration of Scratch activities into science lessons provides insights into how such activities can influence students' self-efficacy perceptions towards block-based programming (Koray, 2023). By systematically extracting this information, we can create a comprehensive database that facilitates comparison and synthesis across studies. The quality of the studies included in the review must also be assessed. This involves evaluating the methodological rigor of each study, including the design, sample size, and data analysis techniques employed. For instance, Tsai's research on the effects of a programming course using the GAME model demonstrates how incorporating structured instructional models can enhance students' self-efficacy in programming (Tsai, 2023). Assessing the quality of studies ensures that the findings of the systematic review are based on robust evidence, thereby increasing the credibility of the conclusions drawn.

3.0 Results

The review was done based on several aspects which is the year that the articles were published, countries to which the articles published, the sample size and the research design used in the study. Reviewed articles suggest that from the total of 25 articles, 13 of the articles, were published from USA, which has the highest number of articles published relating to self-efficacy and block-based programming. It was then followed by the Turkey which published 6 articles. The remaining articles were from Taiwan, China, Georgia and Malaysia. Looking at the year of publication, there was an increment in the number of articles published

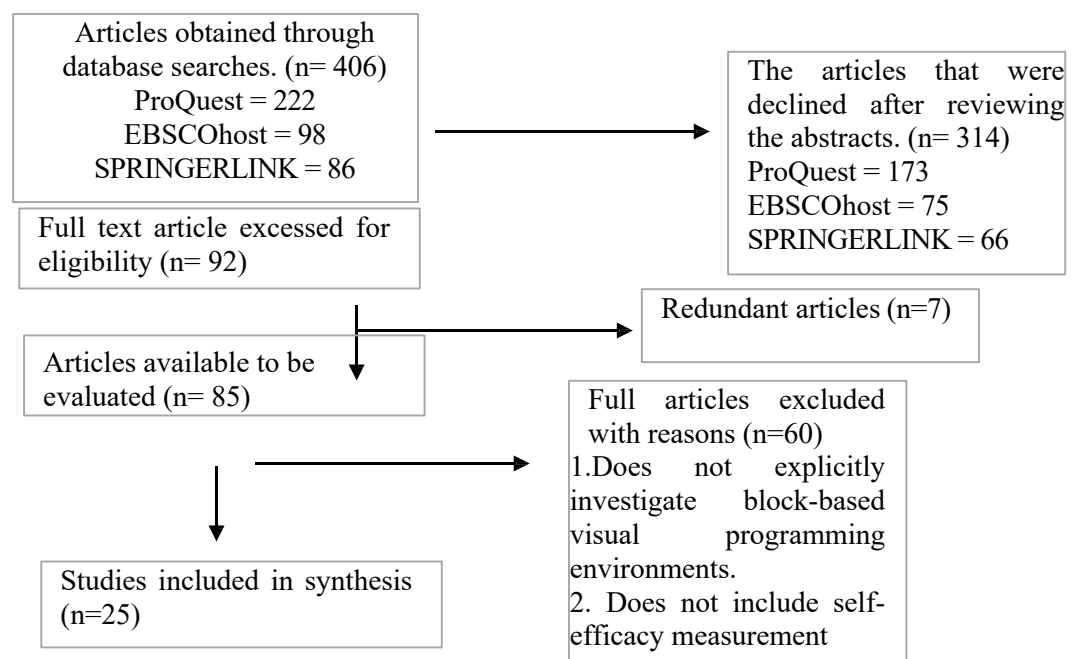


Figure 1. Flow chart of stages of literature search.

starting from the year 2020 until 2024. In 2022 however, less articles were published as compared to the previous years. The following years in 2021, shows the highest number of articles published within the period of 5 years the articles being reviewed. Fairly low numbers of articles published in 2024 maybe because at the time this review was made, it was still in the early October of year 2024. Through the review, it was

found that numerous studies used a large number of samples, which are more than 100 participants. This indicated that and was evidenced from reviewing these articles, researchers mostly opted with Quantitative methods. While there were few articles that used mixed methods, quantitative methods were used several self-efficacy measurement tests as instruments.

4.0 Research Gaps and Research Priorities

Research on self-efficacy in block-based visual programming among gifted students in Malaysia has seen little attention in recent literature. This can be proven right based on this research findings whereby only one research has been done in Malaysia in the field of self-efficacy and block based visual programming. Nonetheless, countries such as United States and Turkey have excelled in this field of study which can be proven right with the finding. Studies such as those by Öztuzcu et al. 2022 and Koray (2023) have explored students' self-efficacy perceptions related to block-based programming and computational thinking skills, showing significant improvements with the integration of Scratch-based activities.

5.0 Conclusion and Future Directions

The implications of these findings extend beyond individual programming skills; they suggest that fostering self-efficacy through block-based programming can have broader educational benefits. For instance, students with higher self-efficacy are more likely to pursue further studies in computer science and related fields, thereby contributing to a more skilled workforce in the technology sector. This is particularly relevant in light of the increasing demand for programming skills in various industries. In conclusion, the integration of block-based visual programming environments has the potential to significantly enhance self-efficacy among learners. The evidence from various studies indicates that these environments not only improve programming skills but also foster a positive attitude towards programming, which is essential for long-term engagement and success in the field. As educators continue to explore innovative teaching methods, the role of self-efficacy in learning outcomes will remain a critical area of focus. By pinpointing the factors that influence self-efficacy, educators can design instructional approaches that promote a growth mindset, resilience, and a positive attitude towards learning and problem-solving. This, in turn, can enhance gifted students' interest in programming, boost their confidence, and foster their long-term engagement in STEM fields. On the whole, Block-based visual programming can serve as an innovative tool for future-ready education by enhancing self-efficacy of gifted students, thereby equipping them with essential competencies for a technology-driven society.

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