PROMOTING SITUATIONAL INTEREST IN COMPUTER SCIENCE CLASSROOM: A UTILITY INTERVENTION APPROACH

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Abstract

Mastery of computer science and computational reasoning emerges as an essential skill for every student. Experts recommend increasing the focus on computer science studies due to their crucial role in the future, recognizing its pivotal role in early learning. The present study aimed to evaluate the impact of a utility-based intervention on enhancing middle school students' interest in computer science. This study adopted a utility value intervention method to improve students' situational interest in computer science within a formal setting. The study investigated how a utility intervention changes students' interests in the content, employing a pretest-posttest control group design. For convenience, random assignment to experimental and control groups was administered at the classroom level. The study used surveys to explore students' individual and situational interests and their plans in computer science both before and after the study. The sample included 149 middle school students attending a public school. The intervention, designed within the interest development theory, incorporated weekly informal writing tasks to prompt students to reflect on class topics and their practical applications. The goal was to explore the capacity for encouraging interest development within the context of Hidi and Renninger's (2016) theoretical model. Using repeated measures ANOVA, the analysis showed significant changes in situational interest within the intervention group and an increase in individual interest across both control and intervention groups, while future plans remained stable. The findings support previous research on the role of prior knowledge and its relationship with situational and individual interests. The paper elaborates on the implications of these outcomes.

Keywords: computer science education, utility intervention, situational interest, four-phase model, middle school students

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Chapter I: Introduction

Interest is a potent motivator. It generates motivation and commitment (Azevedo, 2011; Linnenbrink-Garcia et al., 2013; Kim et al., 2015; Sansone et al., 2019). When people develop an interest in content, they build competency to concentrate, engage, comprehend, maintain goals, and gain domain knowledge (Reninger & Hidi, 2016). Interest indicators include voluntary involvement, intense engagement, planning for the task, determination, and diligence. A person's passion for academic work benefits later endeavors. Interest might help foster motivation to achieve, the skill to establish objectives, and the acquisition of crucial knowledge and adaptable skills for different scenarios. In addition, a passion for scholarly work may foster a keen interest in independent learning, which can be conducive to any situation (Azevedo, 2015).

Some students reengage with a topic without encouragement. They increase their learning and value learning (Burhl & Alexander, 2009). Others participate in math or science competitions outside of school hours. They interact and identify with the content or object for a long time. How do they develop a durable interest in content? They experience enjoyment. This enjoyment transpires as interest (Eccles et al., 2015). When students like a subject, they get more involved and learn more about it. Their desire to learn increases as their knowledge gap closes (Rothans & Schmidt, 2018).

According to research, a prevalent issue among students in classroom settings is insufficient motivation toward learning activities (Potvin & Hasni, 2014). Encouraging participation through evidence-based strategies and systematic teaching approaches, teachers foster attention, productive engagement, and improved academic results by considering motivational factors such as student interest while designing and delivering instruction (Canning & Harackiewicz, 2015). However, further study is necessary to determine the most effective intervention approaches for optimal engagement using student interest (Cleary & Zimmerman, 2012; Mahatmya et al., 2012).

This chapter emphasizes interest as a crucial component of the learning process, which can inspire individuals to delve deeper into topics and ideas. It mainly concentrates on interest as a psychological construct and evaluates literature defining and conceptualizing it. Furthermore, it highlights how interest can be measured and its correlation with other motivational factors.

What is Interest?

The definitions of interest tend to differ depending on various factors, including the context, the researcher involved, and the specific research field under consideration. It has been associated with emotions (Silvia, 2006), meaningful engagement (Durik & Harackiewicz, 2007; Renninger, 2010), curiosity (Berlyne, 1978; Loewenstein, 1994), and conscious attention experiences (Krapp et al., 1992). It is described as both the cause and the outcome of heightened attention (Ainley, 2017). The concept of interest is subjective and depends on the individual learner's perception of a phenomenon. In general, a phenomenon can be considered interesting when the learner finds it attractive, exciting, or engaging and feels motivated to pursue further learning opportunities related to that phenomenon (Asher, 1979).

Interest is a multifaceted psychological phenomenon that has been examined for decades (Hidi & Reninger, 2006). It is generally considered a positive emotion or attitude that motivates individuals to explore and engage with objects, activities, and ideas. Some researchers defined interest as a component of the primary emotion, emotional schema, appraisal of understanding, disposition, potential, deliberate commitment, or passion (Silvia, 2005; Schraw & Lehman, 2001; Hidi & Reninger, 2006). Interest can be framed as an influential drive people need to accomplish their objectives. Allport (1937) suggested that interest motivates a person's activity and pursuit of interaction with a particular object once it has evolved from a functionally independent dynamic system.

Interest is a feeling state determining which behaviors are congruent with values (Silvia, 2006). People value particular activities because they are interesting and it gives them direction for their future conduct. It is a subjective evaluation of an activity, which causes decisions to be made based on personal preference. On the other hand, interest is evoked by an object. The experience is dynamic and evolves depending on internal and external factors. Interest reflects the value assigned to an object or activity (Betts, 1906; Silvia, 2006).

This chapter contains information on interest as interest development and how interest mediates motivation and educational outcomes. The second chapter will inform interest development models and studies in specific domains, indicating future research areas. The third chapter of the paper will present the quantitative research design to test how interest can be manipulated to increase interest and educational outcomes in an academic domain.

Definitions of Interest

Interest was conceptualized differently because of the way research questions were formed (Renninger & Hidi, 2019). It was conceived as a mental state that a person experiences when deeply immersed in a topic. It is intertwined with consciousness, attention, learning, determination, and aptitude (Allport, 1937; Betts, 1906; Dewey, 1913). Pyle (1917) defined interest as: "the aspect given to experience or thinking by attention and pleasure" (p. 226). Being interested in something implies a desire to learn more about it actively. For instance, someone who is deeply absorbed in reading a book would be described as having an interest in the activity of reading that book. Interest manifests as an intense need to know (Biederman & Vessel, 2006), which increases attention, effort, and affect toward an object. It entails a long-term reengagement proclivity and a dynamic connection between an individual and a domain (e.g., undertaking, subject, or field) marked by concentrated attention and deep involvement (Durik & Harackiewicz, 2007). It reflects "involvement" and "feeling like it" (Sansone & Smith, 2000, p. 344). The person is more interested in pursuing activities they are skilled at or find intriguing. According to psychometric studies, ability and interest are linked. People strive to advance their skills and knowledge even when the initial drive dissipates. An external element is not required for the concerted efforts to evolve. The drive to improve becomes inherent and can motivate people to do things they may not ordinarily do (Allport, 1937).

Interest is grounded in specific situations, falls into patterns (similar activities), and is stimulating and transformative. Experiencing interest may directly increase learning by enhancing and redirecting attention to the source of information (diSessa, 2000; Schallert & Reed, 1997). Information seeking is a behavioral indication of interest in a particular topic. When the content appeals to the learner, they become engaged and pay attention to the subject (Hagay & Baram-Tsabari, 2015). The vivid colors and distinctive brushstrokes of a famous artwork may capture a student in an art history class, grasping their attention. If that interest deepens with support, the learner is likelier to return to the content and study it without assistance. Hence, enjoyment of one's work for its own sake may predict the quality of future tasks and academic performance (Eisenberg & Aselage, 2009; Harackiewicz et al., 2016).

Interest is associated with pleasant emotions and value-related characteristics. Schunk (2008) noted that interest is satisfaction felt during interaction with a task. It is a fundamental positive emotion expression that typically happens in reaction to novelty, change, a circumstance of particular relevance, and the potential to learn new information and skills (Hidi & Baird, 1986; Izard & Carroll, 2007; Schiefele, 2009). According to Hidi and Reninger (2006), interest is "a psychological state that is characterized by an affective component of positive emotion and a cognitive component of concentration" (p. 460). Silvia (2001) distinguished between interest as an emotional reaction and interest as self-sustaining reasons that compel a person to participate in specific activities or subjects to engage in them. The eccentric emotion of interest encourages learning, discovery, and inquiry (Eisenberg & Aselage, 2009).

Social interaction affects a person's ambitions. Boekaerts and Boscolo (2002) defined interest as engagement with a specific item or domain within a particular context. Thus, interest can be described as a person's engagement with their learning environment. Therefore, to some degree, it is a situated phenomenon, with the social climate mediating the quality and meaning of the interesting subject or task. The topic of the lesson, the delivery method, the environment, and the delivery time are all features that can affect the interest (Dohn, 2013).

Conceptualization of Interest as a Psychological Construct

Interest is classified into situational and personal (Schiefele, 2009). Individual interest is a long-term desire to learn about a subject. It is an affective and cognitive quality that crosses disciplines. Situational interest is a short-lived, context-dependent attraction that appears as quickly as it is triggered (Alexander & Grossnickle, 2016; Linnenbrink-Garcia et al., 2010; Schiefele, 2009; Schraw & Lehman, 2001). It is an instantaneous emotional reaction toward specific situations and environmental stimuli (Mitchell, 1993; Schraw et al., 2001). Situations become psychologically meaningful after the individual processes them. They are a person's mental representation of the object, content, and persons. They construe meanings based on what they receive. The information is processed through intuitive bottom-up and bottom-down information processing, depending on the previous experiences or stimuli induced by external factors (Rauthmann et al., 2015). The cognitive choice of cues is determined by person factors (traits and characteristics). A person forms concepts, feelings, and behaviors based on situational cues. This process can be experienced unconsciously (Rauthmann et al., 2015). Individual interest represents an enduring tendency that develops gradually, frequently accompanied by enhanced knowledge, enjoyment, and value appraisal (Krapp et al.,1992).

Frick (1992) makes a distinction between interestedness and interestingness. Interestedness is a feeling of interest that emerges before learning the end of an act. Interestingness, on the other hand, is a feeling of interest that occurs after an event and is exclusive to that event. The interestingness of a statement is determined by its propositions. As a result, supplying more information increases the chances of augmenting interest.

Interest has been associated with high academic outcomes, knowledge gains (Durik & Harackiewicz, 2007; Durik et al., 2015; Hulleman & Harackiewicz, 2009; Schiefele et al., 1992), ability to seek out support (Marchand & Skinner, 2007), positive feelings (Renninger & Hidi, 2016), and effort (Trautwein et al., 2019). Researchers found that academic competence can be supported by promoting interest in developing academic efforts and skills (Jansen et al., 2016; Lee et al., 2014; Marsh et al., 2005). In this connection, interest and competence are closely related and mutually reinforcing. The growth depends on knowledge, use of strategy, and interest level. Interest drives engagement, efforts to pursue knowledge, and learning strategies (Alexander & Grossnickle, 2016). Students learn the fundamentals of school subjects; however, most still need advanced domain knowledge that requires active and independent learning. Interest can stimulate the desire for education, which generates competence, performance, and concentration (Ainley, 2017).

The nature and development of interest have cognitive and affective characteristics, including attention and values. Interest stimulates and coordinates attention, emotion, and engagement due to the desire for understanding and learning (Reeve et al., 2015). Previous encounters and interactions of variables are progressive and determine how new experiences will be appraised. Past experiences with the content and future aspirations determine the content and structure of interest schema comprised of cognitive, affective, and utility judgments and goals. The existing interest schema's content and design change through interaction with substantive information from the environment and its analysis (Ainley, 2017; Izard, 2007).

Interest as Attention

Interest is multidimensional; it cannot be reduced to a personality disposition level. It comprises a person, object, and content. It operates at the interplay of object and person and demands meaning generation (Hidi & Reninger, 2011). It forms a "psychological state" when a student interacts with a particular material. When interested, the person actively seeks novel information. Their questions reflect increased intrinsic motivation. Perseverance increases. Information search leads to a more profound understanding of the topic. Those with even latent interest show discernible engagement and endurance even when encountering challenges (Hidi & Reninger, 2006).

Individuals are more likely to comprehend a subject if they are interested. Their interests predict later learning, feelings of success, positive emotions, involvement, dedication, and academic self-concept. They develop self-control and value. Students who are interested in a subject delve into the study and pose questions. They pay attention to what their interest determines how much they should pay attention to (Locke, 1880). Increased attention can lead to the development of memory and improved processing ability (McDaniel et al., 2000).

Certain environmental hallmarks trigger interest. External stimuli such as originality, unpredictability, uncertainty, and complexity arouse interest, curiosity, and attention. For example, students find novel activities interesting. Pyle (1917) asserted that attention moderates learning, and teachers have long-term impacts on students' attention, interest, and feelings. Students can stay focused on the material. It can also help students understand how the subject relates to other areas of knowledge and how it can be used in the real world. Finally, it can also enable students to think more critically and to develop their ideas and theories related to the topic.

Interest is often seen as the primary factor in determining attention. Attention drives us to focus and direct our cognitive resources toward a particular task, object or thought. On the other hand, interest can motivate people to pay attention to something in the first place. Therefore, interest and attention can be seen as interconnected and intertwined, with interest often playing a prominent role in the attention devoted to a particular subject (Shirley & Reynolds, 1988). Interest can create a state of heightened attention and focus, allowing humans to be more productive and effective in their work. On the other hand, a lack of interest may cause a deficiency in focus, leading to disengagement from the current task. In conclusion, interest and attention are closely intertwined and essential in directing and maintaining our attention.

Interest as Affect

Interest is an essential component of motivation. It impacts personal growth, emotions, values, and personal satisfaction. It can be both an outcome or a result of positive feelings. It is the mental state in which a person tries to engage (Hidi & Reninger, 2011). For example, people are inclined to sustain and deepen their engagement if they experience positive emotions when engaging in an activity. Conversely, if they feel unpleasant emotions during an activity, they are less inclined to maintain getting involved in it.

Emotions can also influence the decision-making process and how we prioritize specific interests. For instance, if a person experiences excitement and anticipation when considering a particular activity, they may prioritize it ahead of other interests. In contrast, if they feel anxiety or uncertainty while contemplating a specific action, they may avoid it altogether.

According to theories of emotions, interest is the primary mechanism for human learning. Interest is an emotion that orients the body to respond to the situation or an external stimulus. Humans are born without preexisting knowledge and react similarly to the stimuli at younger ages. The mind is wired with the ability to seek information needed to function (Silvia, 2017). The desire to acquire novel information generates interest. Interest is a human characteristic that cannot be taught. It is activated by environmental antecedents grounded in biological basis. It is manifested through facial expressions and feelings (Reeve et al., 2015).

Silvia (2015) explained that physiology and behavior produce coherent expressions. A person likely feels excitement and anticipation when they encounter novel information. Facial expression changes when they achieve or discover new knowledge (Silvia, 2005). The focus of the encounter shifts in the desire to learn more in-depth. A person manifests active agency and develops positive feelings. Their mental state becomes more dynamic. The experience is composed of the dynamic nature of developing a mental state due to the interaction between components (psychological variables) and the complex schema in the mind. As a result, a novel advanced mental representation is generated using the new object or content (Ainley, 2017). Like other emotions, interests are complex systems that evolved to guide behavior. They are innate- everyone is born with the capacity to be interested in something, yet that does not determine the specific interests one could have. Unlike other animals, humans need to learn skills for personal development. Similarly, Hidi and Reninger (2019) made a distinction to clarify the concept, proposing that genetics does not play a role in the types of interests. Interests are not inherited. However, interest is innate. It will exist even when a person is not conscious of the state.

Interest and curiosity are distinct constructs, often interchangeably (Silvia, 2006). Interest implies a commitment to learning more, while curiosity is usually satisfied by closing a knowledge gap. Hidi and Reninger (2019) concluded that human beings are designed to seek information to construct knowledge. Interest and curiosity share common elements, such as finding new information. However, the psychological experience and outcomes differ in nature. Curiosity is a trait. It occurs when someone suddenly wants to fill knowledge gaps, such as searching for the most luxurious items or populated towns online. Interest and curiosity are demonstrated in task engagement, a frequent behavioral manifestation (Durik et al., 2017).

Furthermore, individual interest necessitates the possession of basic understanding. Interest continues to develop, whereas curiosity extinguishes after new information is found. Curiosity could launch interest in early situational phases when the engagement is less profound and external support is still needed. Neuroscience researchers are invited by Hidi and Reninger (2019) to examine the distinction between the two constructs. Findings from neuroscience suggest that curiosity and interest are distinct psychological states that involve different underlying brain mechanisms and lead to other learning outcomes (van Lieshout et al., 2018). Additionally, there exists a necessity for additional studies on the emotions and motivational mechanisms underlying curiosity and interest, aiming to gain a more profound comprehension of these phenomena and to offer recommendations and strategies for practical application (Pekrun, 2019).

Overall, interest is a general disposition for which attention becomes necessary. However, the feeling is crucial to paying attention. The child's character, both genetic and learned, influences their feelings. Thus, Emotions significantly influence our interests and shape our decisions on how we allocate our cognitive resources.

Interest as Value

Some researchers conceptualized interest as a belief linked logically to their values (Hidi & Renninger, 2016). They consider interest to be a component of emotions. As in expectation value theory, these attempts may be connected to emotional evaluations or value appraisals. Linnenbrink-Garcia et al. (2010) proposed that value-related beliefs are essential for creating interest, inspiration, and curiosity. According to Schiefele (2009), interest is a collection of valences that guide behavior. He argued that defining interest as an emotion is more reasonable than characterizing it as a psychological state. Valence beliefs are closely related to attitude, a person's overall evaluation of a particular object, person, or experience. Valence beliefs profoundly affect an individual's perception and reaction to external events and stimuli.

Perseverance, pleasant feelings, awareness, and passion are all characteristics of individual interest. It activates behaviors and inspires them to discover complex and unknown territories. As students go through developmental phases, their perspectives toward learning, beliefs on task value, and intrinsic motivation tend to change. A mismatch between students' general interests and school curricula causes a decline in interest in the topic. However, the loss of interest may vary by topic and subject. In secondary school, students often display less interest in science, technology, and computer classes. This is because the instruction fails to assist in developing a real-life connection. Students who build value beliefs tend to engage in activities relevant to real-life experiences, even under limited life circumstances. Students may establish real-world relationships, make judgments, and select topics that appeal to their general belief system with adequate support (Schiefele et al., 1992).

Interest can be understood as how people value themselves as competent in a particular domain, experience a sense of achievement in their efforts, and believe in self-ability. Sense of competency refers to people's opinions regarding their capacity to complete an assignment (Eccles et al., 2015), often related to their experiences. For example, a student who competes in athletics may develop a sense of competency, which may influence how they choose to improve their talent in the future. On the other hand, a person who performs below standards may need more sense of competency in similar disciplines, which may reduce their desire to enhance their associated abilities (Eccles et al., 2015; Schiefele, 2009). In conclusion, individuals' perception of their competency significantly influences their inclination and drive to enhance their skills in a specific field.

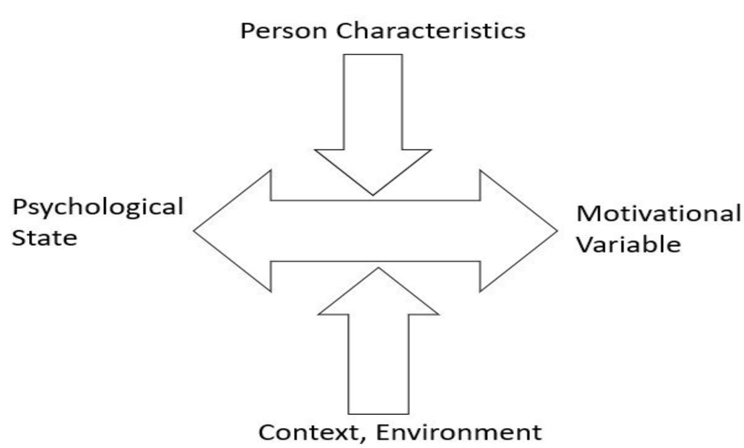
Interest and Engagement

A task that is meaningful to the individual promotes the performance of the study, which would result in satisfaction and lead to a change in behavior. Thus, the probability of participation in a task increases when individuals are involved in the job or are satisfied with the task's outcomes. If the individual is not satisfied with the products of a study, the possibility of future engagement will decrease (Ainley, 2017; Hidi & Reninger, 2006).

According to Hidi and Reninger (2011), interest is not a trait or a stable personal characteristic. It has a dual meaning (see Figure 1). They proposed that "interest is both a psychological state and a motivational variable." It has two interrelated phases: "situational and individual interest." Hidi and Reninger (2006) classified interest phases using behavior markers better to understand the mechanisms of interest and their educational implications. Behaviors that are repeated, deliberate, voluntary, and conscious mark interest. They hypothesized that interest develops in interrelated phases (Trautwein et al., 2019). The length and features of the phases may vary due to varieties in the person and environment characteristics. Lack of instructional material and an external supportive environment may result in inadequate engagement or domain knowledge. Interest encompasses cognitive and affective constituents, invariably associated with a specific entity or subject matter. There should be contact between the individual and their surroundings (Reninger & Hidi, 2011). External factors give learners the resources they need to succeed and give them the confidence to take on more challenging tasks. A supportive environment can help learners stay motivated and increase their engagement in their learning process.

Figure 1

The Dual Meaning of Interest: A Psychological State and a Motivational Variable.



Adapted from Hidi and Reninger (2016)

Interest and Motivational Constructs

Interest orients self-efficacy, self-regulation, and utility value (Hidi & Renninger, 2016). It is linked to values and goals. Self-efficacy represents a learner's confidence in their ability to execute a task (Schunk, 2008). Self-regulation involves managing one's feelings and actions. Utility refers to a learner's estimation of the value of a particular event. Students are motivated to learn about topics that interest them. When individuals are drawn to a specific endeavor or task, their inclination toward completion increases. The possibility of future involvement in a task improves when there is interest or satisfaction in an activity (Hidi & Reninger, 2006; Ainley, 2017). Values are learned from others, and the person establishes their own goals.

Self-Regulation

Self-regulation encompasses managing one's behavior, emotions, and cognitions to attain desired objectives (Zimmerman & Schunk, 2008). Self-regulation is the control an individual exerts on cognitive and motivational affective traits while pursuing a goal. Motivation is regulated and monitored based on cognitive and contextual feedback. The process allows for making strategic decisions that might be modified based on contextual conditions and individual cognitive architecture. The method includes monitoring, judging, and altering behavior (Winne & Hadwin, 2008). The general framework of self-regulation in the academic context suggests that individuals engage motivationally, metacognitively, and behaviorally to control and monitor their thoughts and feelings to attain a specific goal. Emotional regulation implies effectively managing and governing one's emotions in reaction to various internal and external stimuli. This ability is necessary for academic success. Individuals may self-regulate their interests under specific circumstances: First, when the activity is not enjoyable, then when they need to complete a tedious task, and lastly, to make it more pleasurable by varying activities. Interest is ingrained in self-regulation operations. Insufficient interest can diminish motivation and effort, ultimately hindering progress or success. Additionally, it may prompt sensations of boredom, indifference, and discontent. Furthermore, lacking interest can engender destructive behaviors, including procrastination and avoidance (Sansone et al., 1992).

An individual endowed with proficient self-regulation will effectively manage their emotions. This ability is related to interest, as Individuals with sufficient interest are more prone to participate actively in their academic endeavors, similar to those with superior educational results (Sansone et al., 2019).

Feelings of relevance, self-regulation, and interest are closely related. Students who perceive a topic as applicable are more prone to developing an interest in it. This interest leads to further exploration, engagement, and learning. Harackiewicz et al. (2016) discovered that providing students with information regarding the potential advantages of their course material influenced their behavior. Consequently, students exhibited heightened attention in science classes and demonstrated increased motivation toward learning. The authors inferred that student are more inclined to engage with the material when informed of a course's relevance to their prospective career paths and its potential impact on their lives. Consequently, informing students about the potential benefits of the course content emerges as a compelling strategy for enhancing interest and fostering active engagement.

During self-regulation, the person engages in a series of events such as identifying the task, setting a goal based on the perception of the study and the context, selecting proper strategies before they are carried out, and evaluating the entire process to judge current performance and future tasks using information filtered through preceding stages and existing metacognitive knowledge (Butler & Winne, 1995).

Detachment is a potential outcome for the individual when insufficient psychological resources are available. People in a state of detachment often feel disconnected from their environment, like outsiders looking in. They may also need more motivation and help to form meaningful relationships. Interest can lead to the generation of motivational states required to exert conscious control over emotions and actions to cease detachment and withdrawal (Sansone et al., 2019). Engaging in activities that stimulate interest, providing positive reinforcement and rewards, creating an environment for self-expression, and forming supportive connections may support interest and purpose, which can help reduce detachment and withdrawal (Thoman et al., 2017).

Internal and external sources of motivation emerge when mastery of a skill, developing knowledge in an academic topic, or a desire to acquire proficiency in a specialization is pursued. For example, a student who aims to work as a programmer develops an interest in programming and may enroll in related courses starting secondary school. In this scenario, the student's attraction to the subject matter and willingness to obtain additional knowledge serve as intrinsic motivators. Their personal and academic goals may include increasing knowledge, skills, and class standing. The student may need self-motivation to sustain engagement and overcome internal and exterior barriers.

Self-Efficacy

Previous research has highlighted the significance of examining interest and its connection to other self-related motivational factors (Renninger & Hidi, 2016). The literature suggests a robust association between interest and self-efficacy (Ainley & Ainley, 2015; Ahn & Bong, 2019; Bong et al., 2015; Hay et al., 2015; Glynn et al., 2015). Self-efficacy relates to a person's confidence in their capability to handle tasks (Bandura, 1977). Bandura (1986) proposed that interest emerges due to the sense of attainment from meeting demanding measures and self-perceptions of efficacy obtained through achievements and other forms of efficacy representations. This theory suggests that interest is increased by exposure to activities that provide a sense of achievement from various sources, including feedback, rewards, and accomplishments. In turn, exposure to these activities can serve as a mechanism to increase self-efficacy, further increasing interest in the activity. When individuals are exposed to activities that provide a sense of achievement, they become more interested in the subject, which increases their exposure to the knowledge and creates a positive feedback loop. Self-efficacy, as a cognitive construct, is a motivational factor and impacts learning and achievement. Hay et al. (2015) identified a positive association between self-efficacy, interest, and outcome variables in mathematics. Students with a positive attitude towards mathematics and believe they can do well in the subject experience improved performance results. Similarly, enhanced performance in mathematics can boost a student's interest and self-efficacy. Thus, these three elements are positively interconnected and can mutually reinforce one another. According to Hidi and Reninger's developmental model, interest and self-efficacy support each other during the interest development phases.

A neuroscientific study confirmed the two constructs' interdependence. Reeve and Lee (2016) utilized neuroscientific evidence to explore the link between motivational factors such as intrinsic motivation and self-efficacy. Their research aimed to understand whether a particular part of the brain is related to a specific motivational construct. In a laboratory setting, they observed active neural activity in the brain when an individual experienced intrinsic motivation. They reported that the anterior insular cortex was stimulated during intrinsic motivation experiences. A later fMRI study showed that intrinsic motivation is related to striatum activity and anterior insula-stratum intercommunication. The implication is that the striatum activity involves processing rewards and generating interest and pleasure. Therefore, intrinsic motivation and self-efficacy are indeed interdependent and have a shared neurobiological basis, suggesting that they are linked in more than just a psychological sense. (Reeve & Lee, 2016).

Multiple strands of research indicate a bidirectional relationship between self-efficacy and interest. These factors show a positive correlation, especially when controlling for students' domain-specific interests, self-concept in math, and gender. Notably, students exhibiting high self-efficacy tend to perform better in the early phases of a task. This effect increases in the later stages of persistent effort (Nuutila et al.,2020; Bong et al., 2015). However, a study conducted by Carmichael et al. (2010) revealed that proficient students witnessed a decline in interest despite possessing high self-efficacy within a statistics classroom setting. The study suggested that competence in statistics could decrease interest in the subject. This may be because competent students may feel they have mastered the subject and need more motivation to continue learning.

Similarly, Bong et al. (2015) examined the interactions among gender, interest, and self-efficacy. Specifically, they investigated the variations between this relationship and motivational variables across language arts, science, and mathematics domains. They report that students needed consistent interest and self-efficacy levels for language arts. The correlation between science and math was higher than the efficiency for language arts. The longitudinal study showed that students maintained their interest in Math. Interest in math and self-efficacy were predictors of subsequent interest and achievement. Bong and colleagues (2015) documented a positive relationship between interest and self-efficacy, particularly within Math and Science. An enhancement in self-efficacy was observed to foster increased interest and self-belief over time. A mutual positive correlation was identified between interest and self-efficacy, suggesting that as individuals experience an upsurge in self-efficacy, their interest in specific tasks or activities similarly escalates. This effect is likely because higher self-efficacy supplies individuals with solid confidence to engage successfully in activities, amplifying their interest in these endeavors. Additionally, having self-efficacy can help individuals overcome any potential challenges they may face in completing a task, resulting in increased interest and motivation (Bong et al., 2015).

Hay et al. (2015) examined the interaction between domain-specific interest and self-efficacy on statistics literacy achievement in a related study. They reported that self-efficacy and interest were closely associated, and they both predicted achievements. Their proposition suggests that previous investigations into self-efficacy have predominantly focused on achieving success in mathematics and science. These research findings indicate that self-efficacy and interest are interconnected, and individual variances and contextual elements jointly shape behavior when situational interest is stimulated.

In sum, beliefs in one's self-efficacy are linked with enhanced motivation, perseverance, and self-regulation, crucial determinants of academic success. Furthermore, programs aimed at developing self-efficacy have been shown to elevate achievements in mathematics and science and overall academic performance. This body of research emphasizes the critical role of self-efficacy in educational processes and proposes that augmenting self-efficacy is an essential strategy for advancing academic achievements.

Utility Value

Utility value refers to the significance attributed to a task's usefulness and its perceived influence on various aspects of life. Eccles and colleagues discovered variations among individuals in the importance they assign to a task, influencing their motivation to accomplish it.

Their study underscores the importance of assessing an individual's subjective perception of task value and their preferences for activities to motivate them effectively (Renninger & Hidi, 2016).

According to Eccles et al. (2015), the two elements of task value are “interest value” and “utility value.” Interest value is concerned with emotions of enjoyment. In contrast, utility value is concerned with the worth of an activity in terms of its usefulness in accomplishing a desired end or objective. There is a correlation between individual interest and utility value, as an individual's attraction to a particular task stems from its perceived utility value. By understanding the utility value of a specific course, students can determine how much they are willing to commit or whether it is worth their time and effort to master it (Eccles et al., 2015). As such, individual interest and utility value are closely intertwined.

Utility interest can increase an individual's interest in learning a topic. This occurs because when people appreciate the potential outcomes of learning a topic, they tend to be more inclined to engage with the material. The utility value of learning a topic can increase if the individual sees it as a way to achieve their goal or to gain some benefit. For example, if someone wants to learn a language for a job, the utility value of learning that language is higher than it would be for someone who wants to learn it for fun. Therefore, utility interest can increase interest in learning a topic by providing motivation and a reason to pursue it.

The more interesting an activity or object is perceived to be, the more motivated a person is likely to be in pursuing it. The higher a person's level of motivation, the greater the likelihood of them completing a task or achieving a goal, consequently increasing the probability of experiencing a positive outcome. Likewise, the greater the perceived utility value of an action or object, the more likely a person will be motivated to pursue it and experience a positive outcome.

Interest, motivation, and utility value influence people's behavior decisions. Together, they affect a person's decisions about what to do and how to do it, as well as their overall satisfaction with the outcome. These elements are critical in shaping individuals' choices and ultimately contribute to their well-being and fulfillment.

Measurement of Interest

Academic interest is typically measured through surveys, interviews, or focus groups. Researchers may ask students about the topics they are interested in studying or what motivates them to pursue a particular field. Observational methods may also measure academic interest, such as noting the time a student dedicates to a specific course or subject. Results from these measures can help educators and administrators understand and design more effective learning environments. Other measures of academic interest may include standardized test scores, grades, and attendance records. These measures are often used to track student performance and progress over time.

A common approach to evaluating motivation and learning in research is to use self-report tools. Self-report is a method of collecting data in which participants provide information about themselves through surveys, questionnaires, or interviews. Researchers devised Likert or other rating scales to measure motivational constructs (Linnenbrink-Garcia et al., 2010). Self-reporting questions may contain questions that supplement other data sources, and surveys may feature questions about typical behavior. For example, a survey might include asking about their interests outside the school to explore individual interests. Interest is usually assessed by the extent to which a learner demonstrates an interest in the content, the extent to which they experiment with novel experiences, and the extent to which they are persistent and persevere when working towards goals

(Renniger & Hidi, 2016). The fundamental method in the discipline is self-reporting (Ainley & Ainley, 2019).

Some research methodologies incorporated a personal essay or interview format, where researchers prompted students to elaborate on their motivation for learning. One method involves having people rate various topics and discussing their interest level. The assessment of interest was beneficial when measuring development, diagnosis of situational interest, preferences, and estimating their level of knowledge. Researchers have also developed questionnaires to assess interest. Some best-investigated interest questionnaires include the Study Interest Questionnaire (SIQ, Schiefele et al., 1988) and the Situational Interest Scale (SIS, Linnenbrink-Garcia et al., 2010). The surveys were used to identify areas where the students could be given additional support or resources to help them succeed (Lou et al., 2019).

In their review, Renniger and Hidi (2016) found that researchers used conventional and innovative methods such as facial expressions, brain scans (novel neuroscientific tests), texts, films, questioning, interpreting test results, and tracing online behavior to collect data. Some evidence utilized to estimate interests relied on the duration of engagement in a specific activity and the frequency of participation (Hulleman & Harackiewicz, 2016; Ko & Davis, 2017; Renninger & Hidi, 2009; Sansone et al., 2011). Ainley et al. (2002) employed rating scales and online monitoring of students' behavior during reading to assess situational interest.

Students' interests were investigated extensively using descriptive, interpretative, semi-structured observations and self-report surveys (Dohn, 2013). Some researchers utilized case studies to understand the multifaceted nature of the construct. Other scholars employed web-based surveys to collect demographic information, individual interests, computer engagement, and future career plans to investigate interest development (Ko & Davis, 2017). Tapola et al. (2013) used a single item to estimate students' perceptions of their level of interest in a given event during the simulation of electrical circuits. It was developed from the Niemivirta and Tapola (2007) Scale, assessing students' current motivational assessments.

When using a self-report question to assess interest, the researchers considered psychological, demographic, and environmental characteristics such as the content and setting. Researchers have also used diaries and interviews to determine interest in the content. In these methods, students describe their interests, goals, and feelings. Text is analyzed using interest descriptions (Reninger & Hidi, 2011; Krapp & Prenzel, 2011). An analyst can gain insight into a person's personality by looking for specific language patterns. The analysis of the text is used to identify motivational factors. For example, certain words or phrases may indicate a person's level of interest, self-efficacy, aggression, or extroversion. Text analysis can also be used to identify specific types of emotional states, such as anxiety, depression, or happiness. By scrutinizing specific affective terms or expressions, an examiner can comprehend the prevailing emotional state of an individual at a particular moment.

Conclusion

There is currently no consensus regarding the definition of interest. Interest is defined as an emotion, engagement, and psychological state. See APPENDIX A for various interest definitions. Prior studies present alternative conceptualizations of interest. Interest is linked to cognitive (e.g., attention) and affective and motivational factors (e.g., effort and perseverance). Self-efficacy, self-regulation, and utility value are all motivational elements related to an individual's interest. The literature on interest has highlighted several advantages for learning, such as sustained engagement and higher educational attainment. Increased use of accessible cognitive tools promotes understanding (Reeve et al., 2016). When interested, students demonstrate increased intrinsic motivation and agency. Interest is associated with searching for procedures, focus, effort, goals, intention, planning, and effective time management.

Interest can inform individualized or differentiated instruction to capture attention and meaningful engagement. Hidi and Reninger (2019) postulated that interest predicts academic achievement, which must be triggered at school. Students with high interest in a field achieve higher than students with low interest (Reninger & Hidi, 2019).

Key Findings

The definition of interest is not universally agreed upon, with varying interpretations among researchers. However, it is widely acknowledged that interest can be cultivated through different means. Moreover, it can be viewed as a central motivator that directs other motivational factors towards a specific object of desire. The impact of learning interest is notable, with research indicating that it can enhance cognitive engagement and attention and promote academic achievement. Developing an interest in a specific domain necessitates a foundational level of prior knowledge and familiarity with the subject matter. Furthermore, interest is known to be specific to particular domains and may not generalize to other areas.

While there has been notable progress in comprehending the impact of interest on fostering motivation and facilitating learning within classroom settings, further research is necessary to explore its nuanced effects in different contexts and populations. Specifically, it is required to investigate how interest can be effectively fostered and sustained over time and how it can be integrated into pedagogical approaches to optimize students' learning outcomes across various disciplines and educational levels.

Chapter II: Literature Synthesis

This section presents a comprehensive review of three prominent theoretical frameworks that aim to explain interest development, along with a detailed analysis of the empirical studies conducted using the four-phase interest development model suggested by Hidi and Reninger (2006). The review elucidates these theories' key assumptions, constructs, and propositions and their implications for understanding the mechanisms underlying interest's emergence, maintenance, and transformation in diverse learning contexts. Furthermore, the empirical research is examined regarding the methodological approaches, the samples and measures employed, and the main findings and implications for advancing our knowledge of interest development processes in middle school.

Fostering Interest

Humans are not born with innate or pre-determined interests in specific topics, activities, or domains. However, humans can develop interests through exploration, experimentation, and exposure to different activities and experiences. This can be seen in how people develop hobbies, passions, and career paths. Research suggests that children are more predisposed to develop an interest in something when exposed to it and encouraged to explore it. It is hypothesized that the greater the exposure to an activity, the higher the likelihood of developing an interest in it. Additionally, a person's unique personality, experiences, and environment contribute to developing interests. A temporary interest might result in permanent ones. This is true because when people are exposed to something that sparks their curiosity or brings them joy, they are more likely to pursue and become passionate about it. For example, if a child is exposed to a particular type of music at a young age, they might become more interested in that genre and work to become more knowledgeable about it. This interest can then develop from a momentary trigger into a long-term passion. In addition, if a person is exposed to something related to or builds upon something they are already passionate about, it can further develop and strengthen their existing interests. For example, suppose a student is passionate about science. In that case, they may be exposed to a particular scientific concept that sparks their curiosity and leads them to explore more in-depth related topics. This can foster and nurture the student's curiosity toward science, possibly motivating them to explore more challenging and complicated subjects. Thus, specific triggers that occur at a certain point in time can lead to the emergence of more persistent personal interests (Watt & Eccles, 2008).

Interests are not innate traits but rather motivational dispositions (Renninger & Hidi, 2006). They are shaped by the individual’s environment, experiences, and traits. They emerge and develop when promoted (Krapp, 2005; Krapp & Prenzel, 2011). Interest development is dynamic and influenced by existing knowledge, background, and goals. Hidi and Reninger (2006) posited that interest development results from the interplay of student and instructional settings. They posited that the teacher's instructional strategies and style influence interest development. The classroom environment should be stimulating, engaging, and safe. It is a compound of psychological state and motivational dispositions.

Psychological states are responses to stimuli. An engaged student's mental state is alert, engaged, directed, and satisfied during the experience. External stimuli inform interest as a motivational variable comprising short-term and long-term interest. The two interrelated variables constitute the motivational disposition. External support aids in the transition from transient situational interest into enduring individual interest (Hidi & Reninger, 2006).

The home environment, early experiences, and interest theories are critical in developing an interest in art, music, language, math, and science (Renninger & Hidi, 2016). Some students establish long-term deep connections with a subject by acquiring new experiences and skills. Others have low success expectancies and low performance (Harackiewics & Hulleman, 2009). Therefore, interest development is not linear for all individuals. Dewey (1913) stressed the relationship between interest and learning, parsing out the complex and dynamic relationship between knowledge and effort. He suggested that education's function is to help learners develop the skills necessary for later academic life. He emphasized the need to establish an engaging learning environment and teach topics relevant to the learner's life to promote interest and motivation. Dewey's ideas spurred discussions about interest as a distinct phenomenon (Krapp & Prenzel, 2011).

On the other hand, people's perception of their interests impacts individual interest development. When individuals perceive their interest level to be low, they are prone to experiencing further declines in interest. Students begin with implicit theories of interest when encountering new content at school. Their implicit beliefs and previous experiences may determine their perception of the school subject. They may set limits if they possess a fixed idea of their interests. They may even only engage and inquire if they are interested. Over time, their persistence level will be lower or lag behind others. A fixed theory of interest will decrease motivation to learn new content because thinking that they are not interested results in disengagement. Students with a fixed idea of interest need more synthesis, analysis, and evaluation skills (O'Keefe et al., 2018).

Fostering interest in a particular domain can facilitate academic advancement. In addition to domain knowledge and specific strategies, students should be provided with tools to set goals, alter self-judgments, learn independently, and identify personal interests through feedback (Kitsantas & Cleary, 2016). O'Keefe et al. (2018) postulated that students could be guided to be more open to new ideas and challenges. They can learn to persist and cope with challenges. As a result, they will be engaged in activities and motivated to develop their knowledge base. Recommending students to find their passion can be misleading. They might feel that their interest is limited to a certain number of objects or content. Thus, presuming that interest is latent and requires exploration may undermine academic motivation.

Interest can be improved independently of the former experience of individual traits in a school setting. According to developmental theory, interests have universal characteristics. They are domain-specific and have cognitive and affective dimensions (Gogol et al., 2017). When experienced, they influence behavior without conscious awareness (Hidi & Reninger, 2011).

Interest can be restored, changed, and expanded through external factors as dispositions function independently of demographic characteristics such as race, gender, or income level. Interest has educational implications (Hidi & Reninger, 2019). In addition to material and activities, parents' and teachers' roles have been reported to cultivate interests (Alexander et al., 2019).

Theories of Interest Development

Silvia's Appraisal Theory of Interest Model

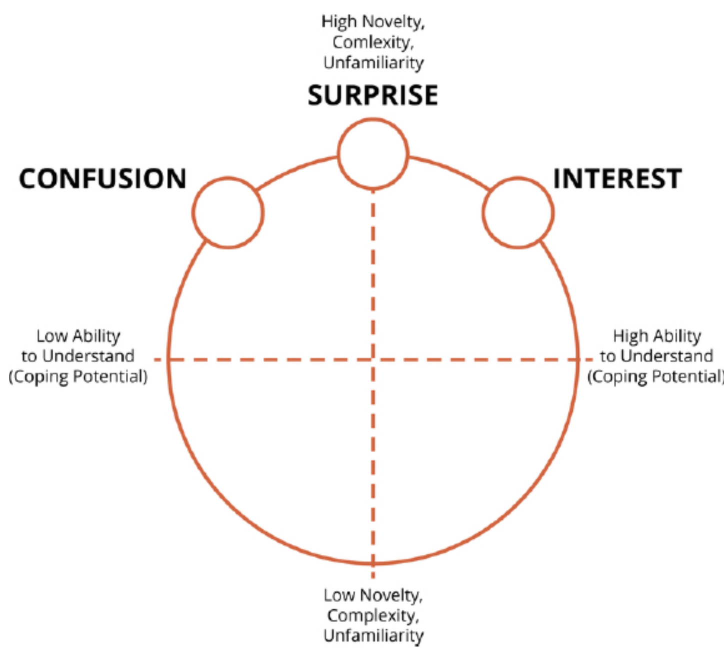
Silvia's interest model uses two cognitive appraisals based on emotion theories. It is predicated on the premise that attractions, like emotions, are formed by cognitive assessments. Individuals react differently to the same stimuli because they assess them differently. Interest, in this approach, comprises judgments of novelty (aspects associated with unfamiliarity and complexity) and appraisals of coping capacity (the ability to understand the knowable, unknown, complex thing) (Figure 2) (Silvia, 2008). Individuals will learn a new subject when they feel they can. In this model, interest is conceived as an emotion that motivates one to seek novel and challenging information and gives one a sense of control, confidence, and competence. Pictures and videos portraying the lives of professional astronauts, for instance, can lead someone to believe that astronomy is a complicated affair. In response, this person might employ the following mechanisms: assessment (appraisal), comprehension, setting expectations, and acting (Ainley, 2017). Searching for websites with further information on the subject will be one of the steps taken after the viewing session. The interest will motivate additional effort, catalyzing learning and discovery. At the same time, the interest in this example encourages the person to pursue knowledge about coping with the unknown, intricate specialty. In this case, curiosity supports interest in astronomy. In an educational setting, increasing students' interest in new content may be accomplished by introducing complicated material while manipulating their judgments of their competencies. Their perceptions of coping potentials can be influenced to support their learning.

An essential component of the concept is prior knowledge. It assists in assessing coping capacity, which evaluates available intellectual resources and the assessment of novelty-complexity. Reaching a specific threshold of success is necessary to enhance the perception of intellectual ability, resulting in improved academic performance (Connelly, 2011). Past accomplishment and students' judgments of the complexity positively influence their desire to continue studying a subject (Murphy & Whitelegg, 2006). However, this might have limitations. Background information may have only a limited and indirect effect on the novel situation depending on the affordances of external factors (Frick, 1992).

The critical premise of interest theory is that interest emerges when new knowledge is demanding, original, and unrecognized, provided a person believes they can interpret and overcome setbacks. The idea that emotion is the basis for interest is part of the appraisal theory of emotion and can be altered (Silvia, 2008; Lazarus, 1991; Connelly, 2011; Ainley, 2017; Thoman et al., 2017). Silvia (2008) notes that the appraisal theories of Berlyne (1960) and Csikszentmihalyi (1990) were used to inform his appraisal model.

Figure 2

Silvia's (2022) Appraisal Model



In Silvia's (2006) view, interests connect the emotional and behavioral aspects of one's personality. In line with this viewpoint, Ainley (2017) documented that a person's emotional knowledge and meta-emotional experiences alter the process of creating dispositional interests and psychological makeup. Individuals may utilize this information to generate inferences about the sources of emotional experiences and associated projections about the expected emotional implications of future behaviors.

Silvia (2008) proposed that interest is experienced as a fleeting sensation within the current moment. It can reorient a learner to seek new information and endeavor to comprehend the unknown when experienced regularly. On the other hand, repetition alone does not generate interest. The fundamental structures of antecedents and premises are instrumental in nurturing interest via meta-emotional mechanisms, particularly by addressing the emotions felt within the cognitive setting. Thus, they significantly contribute to developing interest within the specific context (Ainley, 2017). As an individual's knowledge base grows, their potential for information searching expands. Previously unknown data will reveal perspectives that are not immediately apparent to the ordinary person. With increasing engagement, they learn to forge additional inquiries. Accordingly, the domain becomes more complex and cryptic. Understanding the details instills the desire to exert further effort. Increased concentration improves both the quality and speed of understanding. Later, interest contributes to acquiring essential knowledge and information for comprehending complicated concepts. Students will become more engaged in their education due to positive cognitive appraisal of ability and repeatedly experiencing the feeling of interest (Connelly, 2011).

Emotions influence perception and motivation. Learning new things helps a child make connections between their emotions and further information. As a child matures, they connect feelings to specific thought patterns. An emotion schema is charged by biological (genetic), psychological (personality and values), and social antecedents (culture) and ascribed to an appropriate cognition. Later experiences in comparable circumstances contribute to the overall evaluation of the emotion framework. Adolescence is when a child corresponds to more multidimensional knowledge and emotions; hence, more extensive mental representations are generated. Feelings can redirect motivation and interest. In this view, the appraisal process begins with early emotion schema and new experiences. It expands as knowledge and expertise are constructed. The new emotion schemas, as developed and dynamic, serve as means for making meaning necessary to adapt to the context. It is a component of the personality formed by the environment. A particular emotion may be generated for the same appraisal (Izard, 2007; Lazarus, 1991; Learner & Keltner, 2000).

Despite metrics, the appraisal model of interest has yet to be validated as a motivation-generating model for all academic areas except drawing polygons, making artwork, music, and reading poetry (Silvia, 2005; Yoon et al., 2012). According to Silvia (2005), the interest model might be used in education to support career counseling, behavioral psychology analysis, text analytics, and emotion research.

Krapp's Person-Object-Theory of Interest (POI) Development Process

According to the Person-Object-Interest (POI) theory, interest is a dynamic relationship between the individual and the object, manifesting as a characteristic or outcome. Interest has cognitive (attaching personal meaning) and affective features (positive feelings during engagement). Krapp (2005) defines interest as "a specific kind or quality of person and object relationship" (p. 382). The connection between an individual and an object is characterized by the correlation between the individual's interest in the object and their level of commitment to it. People's interests stem from their attitudes, values, emotions, and objectives. An individual might find a specific object, concept, or idea intriguing. In this context, interest is linked to intrinsic motivation orientation. Regarding intrinsic motivation, interest is the motive for pursuing a specific activity (Deci & Ryan, 1985). Intrinsic motivation coordinates interest and other motivational orientations, preferences, and goals. Intrinsic motivation prompts individuals to pursue a particular action for the ingrained satisfaction and fulfillment it brings. From this perspective, intrinsic motivation affords a person to implement extant interests. For example, one may be interested in learning to play the flute, and intrinsic motivation gives one the desire to spend time and energy learning the instrument.

Krapp (2002, 2005) proposed a "dual regulation system" comprising “cognitive-rational” and “subconscious emotional control mechanisms.” When a person interacts with an object, their cognitive and emotional regulatory systems collaborate to develop interest, sensations, intentions, goals, and interpretations about the thing. The regulation system consists of mental processes that generate and evaluate plans and affective processes that regulate the emotional response during goal-related actions or thoughts. The two processes are assumed to be mutually dependent. The cognitive function provides the opportunity to experience and evaluate emotions and evaluate and modulate the emotional response during goal-related actions. The affective process regulates the emotional response during goal-related activities by allowing the experience and control of the affective response. The importance of this mechanism becomes apparent when a person must employ purposeful effort to coordinate their actions to overcome challenges during a meaningful engagement or accomplish an unappealing but essential activity. The interaction of both systems is necessary for interest development. According to POI, interest is generated through the collaboration of rational and cognitive input filtered through emotional control processes (Ainley, 2017; Krapp & Prenzel, 2011).

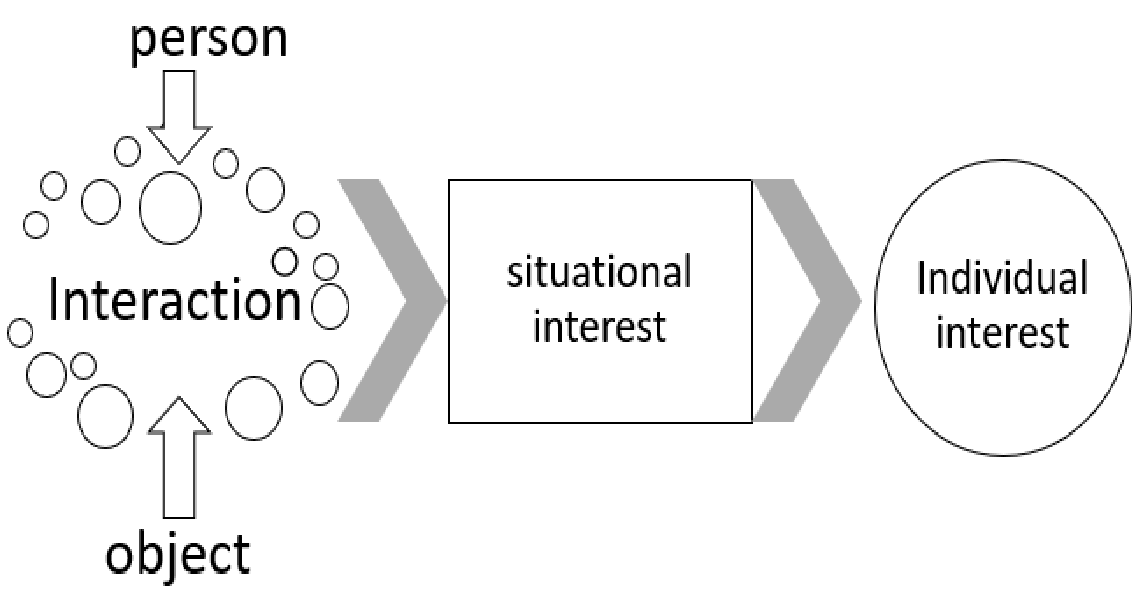
Krapp's theory of interest converges with the principles of intrinsic motivation theory, indicating a synergistic relationship. The portrayal of interest as enduring and concentrated involvement in tasks exemplifies the intrinsic motivation theory's emphasis on self-motivation and autonomy in pursuing inherently satisfying activities. Individuals participate in activities that fulfill their fundamental psychological needs for competency, autonomy, and social connectedness (Deci & Ryan, 1985; Ryan & Deci, 2000). Fulfilling these needs generates the motivation to continue learning and experiencing activities related to those needs. It becomes the source of motivation to search for more knowledge, creating a pattern of behavior focused on acquiring a specific experience, resulting in experiencing interest. Later, it becomes a conscious decision, and the experience may become the basis for developing a personal practice. If needs are unmet, motivation will decrease, and the learning will stop. These experiences include bodily sensations when you experience a need arises. These may be manifested in different emotions, such as urgency, happiness, frustration, irritation, impatience, and unease. Although the experiences are short-term, the feelings may be enduring. They can be persistent when they become chronic or continue over time. This may result in the development of interest, which forms the desire to learn more about or encounter "need-related experiences or feelings" (Krapp, 2005, p.391), converting to the motivation for learning. This may not be a conscious decision, and understanding may be unintentional.

Krapp's (2002, 2005) proposed that "need-related experiences" are pivotal in shaping domain-specific motivational tendencies, such as interest or related motivational orientations. His interest development model distinguishes three stages: (a) the emergence of situational interest, initially prompted by environmental stimuli; (b) a sustained situational interest, which endures throughout a specific (limited) learning phase; and (c) an individual interest, indicating a relatively enduring inclination to engage with a particular subject area (Figure 3). According to Krapp (2005), the first two phases are transitional yet necessary for the individual interest stage, which departs fundamentally from the previous stages characterized by curiosity and attraction.

An appealing learning setting or activity is the primary factor in developing situational interest at the initial stages of a learning experience. This is called the quality of interestingness. Auditing attention after this catch stage is essential and serves as a hinge. For academic learning, the move from a more initial stage of development to a more enduring one is instrumental for interest development (Ainley, 2017).

Figure 3

Krapp's (2006) POI Model.



The Four-Phase Model of Interest Development

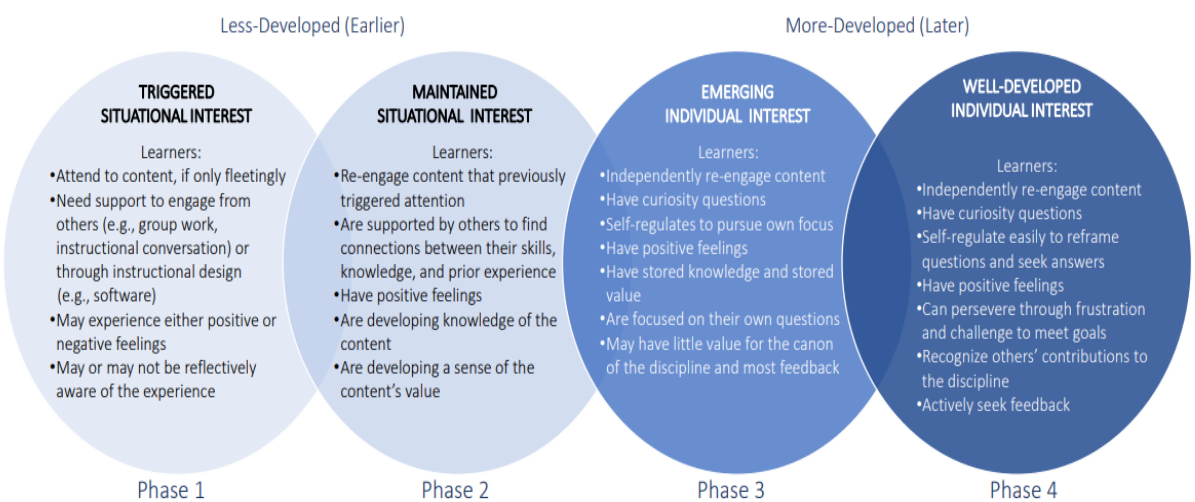
The developmental perspective of interest theory suggests that interest must be activated to seek information for a more extended period. Interest is a process of seeking new information.

Interest evolves in four phases with distinctive qualities (See Appendix B) (Renniger & Hidi, 2019). Interest can be developed through course design and working with others. Instructional design should align with the interest development phase. Otherwise, the outcome will vary. Theoretically, learning will be optimum when material and complexity match the interest phase. This model describes the process by which interest in a specific subject evolves.

Hidi and Reninger (2006) introduced The Four-Phase Model of Interest Development (FPM) to describe interest development within academic domains. In this framework, interest evolves through discrete yet interconnected phases of "Triggered Situational, Maintained Situational, Emerging Individual, and Well-developed Individual Interest" (p.114). Distinctive qualities mark each interest phase. Quality and quantity of engagement determine the type of interest phase (see Figure 4) (Hidi & Reninger, 2011; Renninger & Su, 2012).

Figure 4

Hidi and Renninger's (2006) Phases of Interest Development.



Note. Taken from Renninger & Hidi, 2022 (p. 25)

The FPM provides a framework that aids in comprehending the role of interest within instructional settings. Interest develops in phases, and a certain level of external support is needed in each four-phase. It also defines the quality of the instructional material needed to create individual interest. The dynamic development may not align with human growth and development stages. Growth needs support and instructional design and transpires in continuous engagement sequences (Ainley, 2017).

Situational Interest

Much of the current literature on interest pays particular attention to situations. Rauthmann et al. (2015) argued that situations become psychologically meaningful after the individual processes them. The psychological importance of situations begs perception and interpretation. A situation will have meaning if at least one person experiences it. According to the processing principle, the situation will go through information processing attention, filter, evaluation, meaning-making, and organization. How they perceive the information from experience is connected to cognition, behavior, and motivation changes.

Situations influence perceptions, affect, and academic learning. Students with a positive attitude about an activity or subject are likelier to attend it. The student may then learn and retain information and skills more effectively. It is a positive force that people need to achieve their personal goals. Situations are changeable, adaptive, flexible, accessible, and uncontrollable. Objects are grounded in situations and create different impacts on different individuals. Cognitive interpretation is perception-bound. It is rooted in objects processed by the individual. The temporary state's qualities vary—the degree of influence changes. On the other hand, there is no agreement on what elements form psychological situations. The nature and the length of time vary when interest is induced, and objects may render short-term or long-term interests (Knogler, 2017).

Hidi and Renninger (2006) asserted that situational interest manifests when individuals engage with the environment. Situational interest comprises two phases: “Triggered Situational and Maintained Situational interest.” In the triggered situational phase, a trigger from the environment summons individual attention. A person seeks information for a short period. The trigger might have characteristics such as being unexpected, novel, or provoking; it often has some personal relevance. This initial spark is personally related; attention resources are used to explore the content. Both positive and negative feelings can be observed in this phase. The required knowledge level should be adequate to add newly found information. Interest growth does not occur in discrete stages. When there are changes in the interest's condition of development, encouragement or a novel environmental stimulation is demanded. Ending interest without consequence is possible (Hidi & Reninger, 2019).

During the maintained situational interest phase, individuals exhibit interest in a subject if they receive support or external stimuli that sustain their engagement with the topic. The structure of a task, activity, design, and mentor may support interest development. Group work, hands-on science activities, teamwork, simulations, and games will help sustain interest. Among the characteristics of this phase is the refinement of domain knowledge and value. In this phase, a person will experience interest, gain more content knowledge, and apprehend engagement value. An increased commitment will be observed (Hidi & Reninger, 2019).

Students’ progress through different phases of situational interest, indicating that their level of interest in a subject is not static but dynamic. As they engage with the material and interact with their learning environment, they may transition from initial triggered interest to a maintained level of interest, depending on factors such as the support available, their level of engagement, and the perceived relevance of the subject matter. Linnenbrink-Garcia et al. (2010) conducted self-report methods and observation to collect data to measure students' situational interest in academic domains. They proved that the two types of interest complement each other, with situational interest catalyzing individual interest development and individual interest providing a foundation for deeper engagement and continued interest in the subject matter. They found that promoting situational interest can lead to sustained advantages for students' overall interest. Through engineered activities, personal interest will improve (Linnenbrink-Garcia et al., 2010). Other studies provided empirical support for the idea that students progress through phases of interest development and that contextual personalization can positively impact academic performance, particularly in subjects like math. Harackiewicz et al. (2008) observed that students' patterns of interest development aligned with the phases described in their theoretical model. This suggests that the theoretical framework accurately captures how students' interest evolves, further validating its relevance in understanding students' engagement with academic subjects. Bernacki and Walkington (2018) sought to determine if tailoring the educational experience to individual student's needs and preferences would lead to better outcomes in mathematical learning. They found a positive correlation ($r = .91$) between triggered and maintained situational interest. Their findings suggested that students who initially experienced interest (triggered interest) and maintained this interest over time showed improved performance in mathematics.

Individual Interest

Stable thoughts, actions, and emotions for an object and content mark individual interest. Individual interest is domain-specific and rooted in situational interest experiences. (Ainley, 2017; Krapp, 2002). The stages of individual interest are marked by two distinct phases: "emerging interest" and "well-developed interest." In the emerging interest phase, the individual will have more control over their learning. This phase is marked by individual information-seeking and beginning to learn about the content of interest independently—a noticeable shift to a more agency-oriented learning process. Individuals will need support from experts to maintain their interest level. Experts will provide opportunities for more in-depth learning as they have a high level of domain-specific knowledge. A person will express value for the endeavor. The change in the source of motivation is observable. Now, it is more intrinsic than earlier phases of interest development. Feelings about the content are positive when facing challenges. Individuals continue to benefit from experts' encouragement to discover and use strategies to overcome affective and task-related challenges. It is critical to maintain interest in acquiring new material and progress to the highest interest development phase (Hidi & Reninger, 2019).

During the phase of well-developed individual interest, the origin of this interest lies within the self. This phase features a thorough understanding of content commitment, dedication to learning, engagement, attention, and constant research. The person will work efficiently. Uninterrupted data processing occurs. The person is committed to comprehending the material and searches for sophisticated, complex content that requires careful examination. They will endure even after several failed efforts. They will acquire a person-specific repertoire of strategies and cognitive resources to find detailed information to satisfy queries (Hidi & Reninger, 2016).

The environment influences the developmental process, including its objects and content. Hidi and Reninger (2006) argued that the need for an external stimulus diminishes in developed phases. The need for help will lessen in the individual interest phase. A person will need instructional design, novel activities, and constant support in situational interest phases.

The emotion appraisal approaches do not account for the evolution of individual interests over time. However, the provisional type of interest that leads to discovery can be described as 'interest as in-the-moment experience' where a particular aspect of the event or object attracts attention. Students will engage with the material and attain the motivation to persevere. Consequently, enhanced motivation will lead to effort and a more profound understanding. Temporary interest could predict a more durable and personal interest. Therefore, investigations should focus on the provisions resulting in situational interest, which could evolve into more enduring interest (Ainley, 2017; Linnenbrink-Garcia et al., 2010).

The FPM model has been utilized and validated in several research (Harackiewicz et al., 2008; Lakanen & Isomöttönen, 2018; Renninger& Hidi, 2020; Rotgans & Schmidt, 2017). The model is recognized for its ability to encompass cognitive and affective aspects of interest development, making it a comprehensive framework for understanding how interest evolves. This indicates that Hidi and Renninger's model can guide educators and curriculum developers when creating engaging middle school curricula (Abbott, 2017).

Interest and Prior Knowledge

Tobias (1994) proposed that interest and prior knowledge are related, indicating that a strong interest in a subject tends to align with extensive expertise in that field. This connection implies that an individual's preference for specific topics or activities naturally leads to increased engagement and, consequently, an accumulation of knowledge. However, a lack of interest typically results in minimal knowledge due to limited interaction with the subject matter. This concept is further illustrated by the initial challenges that learners face, which often expose critical gaps in expertise essential for problem-solving. This situation can ignite situational interest, driving the learner to generate interest-driven inquiries and self-initiated questions. Such efforts deepen interest and compel new knowledge acquisition and organization, enhancing interest and knowledge acquisition, as supported by Harackiewicz et al. (2016) and Renninger & Hidi (2016).

Witherby and Carpenter (2021) demonstrated that prior knowledge significantly influences learning new, domain-relevant information, with curiosity mediating factors in this relationship. It highlights the significance of previous knowledge as a predictor in acquiring new information, signaling a departure from the traditional view of prior knowledge solely as a variable to be controlled. Instead, it recognizes its significant role in facilitating new learning endeavors. This perspective is reinforced by Simonsmeier et al. (2022), who, through a comprehensive meta-analysis involving 8776 effect sizes, recognized prior knowledge as a reliable indicator of instructional results. Their findings highlight the crucial role of previous knowledge in enhancing performance, further solidifying the interconnectedness of interest, prior knowledge, and learning. This study demonstrates that previous knowledge engages learners, facilitates learning, and improves results.

Studies on Interest in Learning STEM Subjects in Middle School

Interest development strongly influences achievement (Hay et al., 2015; Kim et al., 2015; Renninger et al., 2015; Sansone et al., 2015; Schiefele et al., 1992). Motivation plays a critical role in success beyond high school in STEM research. A plethora of literature emphasizes the significance of motivation in acquiring STEM subjects (Hinojosa et al., 2016). Few studies on middle school math, science, and computer science learning provided key findings regarding cognitive, motivational, and emotional consequences. This section reviews experimental studies that used interest as a psychological variable.

Interest in Math and Science

In a randomized experimental design with 188 secondary school students and their parents, Harackiewicz et al. (2012) used self-reports, transcripts, and survey methods to distribute information on the benefits of school and parental support over a 15-month. They additionally provided more details, including representative examples, on why learning math is important and exciting. The training materials also offered conversation strategies for parents. The intervention was complemented with an online platform that contained a broad range of material. Parents were asked to deliver the material link to their children. They discovered that teaching parents the usefulness of math and science courses facilitated parent-child discussions regarding the importance of STEM courses. Students took additional STEM classes as a result. The study's findings indicated that educating parents about the value of making proper educational choices impacts their future coursework selections, profoundly affecting academic and professional paths (Harackiewicz et al., 2012). The findings suggested that parents' educational level profoundly influenced their children's academic success. Educated and literate parents demonstrated a greater tendency to direct and help their children navigate their scholarly work, build positive feelings, and achieve higher educational outcomes. Additionally, highly educated parents will likely encourage their children to take more challenging courses and pursue higher-level educational opportunities to deepen their interests.

Other researchers highlighted the importance of parental support as an essential factor in math and science interest development. Researchers found that when parents set high expectations and support their children's academic pursuits, it can positively influence their attitudes toward mathematics and science. (Alexander et al., 2019). Developing an interest necessitates a partnership with parents and interaction with content in a supportive social context. Parents may help their children develop and refine their interests by fostering an environment that promotes inquiry and learning (Hidi & Reninger, 2006). Middle school students are predisposed to develop more interests. This can be achieved through encouragement and support. Interest development among middle school students can be triggered and sustained through collaboration that fosters engagement between mentors, parents, and learners (Turner et al., 2015).

Additional studies examining the correlation between interest and science education found that students exposed to such activities exhibited moderate interest in science-related subjects. Early opportunities predicted later domain interest. For example, Alexander et al. (2012) examined how parents could create opportunities for kids to learn about scientific concepts. Learning opportunities included discussing the value of scientific phenomena, museum trips, science-oriented books, and electronic and traditional toys. Children acquire foundational knowledge, basic concepts, principles, and common vocabulary, which are beneficial factors for future learning of similar, more complex ideas. In a later study, they highlight pivotal moments in developing a person's interest. There was a high correlation between positive self-concept and perceived value. The increased interest is attributed to early career awareness and discussions about math and science's value and relevance in the development trajectory.

In a longitudinal experiment, Turner et al. (2015) investigated the impact of four motivational principles on cultivating interest in mathematics and science. These motivational principles are "supporting student competence, autonomy, belongingness, and making learning meaningful." The students who made connections were more interested in the subject. In this experiment, teachers used inquiry to provide a rationale for learning and showed enthusiasm during interactions with students.

Hay et al. (2015) studied how interest and self-efficacy correlate and influence statistics literacy achievement among secondary school students. Their path model illustrated a relationship between interest, attention, self-confidence, and math achievement. They emphasized the importance of cultivating situational interest in educational settings to facilitate interest development. Students better understood when they valued activities and when activities appealed to their interests. These findings support the four-phase model of interest development theory that Hidi and Renninger (2006) described.

Research into the conceptualization and promotion of interest in science courses indicates that individual interest can be cultivated intermittently by encouraging situational interest. The recurrent stimulation of situational interest initiates the developmental progression of a particular interest. For example, Rotgans and Schmidt (2017) reported a complex association between personal interests and situational interests that was reinforced. This association was demonstrated through experimental design manipulations and the resulting interest changes. Their study findings implied that fostering situational interest could improve student outcomes, irrespective of their initial level of interest. Rather than focusing primarily on the potential role of talent and ability, promoting situational interest can improve student outcomes regardless of their starting ability.

Research has shown that solving problems is a mechanism that captivates students' attention. For example, a problem-solving approach to eliciting situational interest improved individual interest levels (Rotgans & Schmidt, 2017). In an earlier study, Rotgans and Schmidt (2011) investigated the impact of "problem-based learning" activities in which students collaborate in an active classroom setting on their interest in the situation. They analyzed the progression of situational interest and its correlation with learning outcomes within a dynamic instructional context. Students were assigned real-world problems and collaborated in a student-centered approach. They were trained to work individually on individualized projects. The problem-based intervention lasted one day and included five interest growth assessments. The findings demonstrated a considerable rise in situational interest when students worked on a relevant problem. Situational interest fell progressively but eventually grew again. Fluctuations in interest were attributed to environmental factors.

Similarly, Bong et al. (2015) noted that some students naturally judged math as complex. They did not even attempt to learn the subject as they thought it hard to understand. They needed additional support to foster feelings of competency. Interest in maintaining the engagement must be regularly stimulated. If the learner is just briefly attracted, they will feel unmotivated and withdraw. In contrast, if the subject is interesting, the student will continue exploring it (Rotgans & Schmidt, 2017).

Experimental studies draw attention to the manipulation of learning contexts. A learner's perception and attitude in a particular circumstance are closely related to how individuals position themselves within the social environment and how they are encouraged by their superiors. From this perspective, learning is limited by internal and situational factors. Both people and tasks are necessary to help learners connect to content about which they possess positive affect. The development of interest relies on the caliber and regularity of external support. The support can be encouragements or provisions of an engineered environment that contains relevant activities that foster interest. The context is designed in a certain way to allow access to core and specific knowledge and overcome barriers emerging from knowledge gaps

(Renninger & Hidi, 2019; Shaby et al., 2021). In general, interest can be positively influenced by access to suitable resources, support, and guidance and by an engaging and effective learning environment. Fostering empowerment, involvement, and autonomy in the learning experience can also contribute significantly to interest development. On the other hand, interest development can be influenced by feeling overwhelmed or unsupported, having limited resources, or being unable to control the learning process.

Interest appears in social structures when the learner engages in task design, testing, exploration, and teamwork. Simulations augmented motivational factors (individual interest and goal orientation) through situational interests. For example, Tapola and his colleagues (2013) performed research in which students' attention was stimulated by task features while learning about the basic operations of electrical circuits. The design influenced students' initial motivational dispositions, which generated situational interest and achievement. This finding is supported by Dohn (2013), who states that task characteristics and design can increase interest while dealing with a particular piece of material for an extended period.

Several studies reported that interest in academic topics develops early before high school. Students exposed to a specific discipline in their early years are more likely to adopt more enduring interests in academic subjects (Crowley et al., 2015; Hecht et al., 2019; Maltese & Tai, 2010).

Interventions that Promote Utility Value

The development of interest is closely intertwined with acquiring knowledge and values. As individuals gain new knowledge and experiences, their interests may shift or become more refined, and as they reflect on and internalize their values and beliefs, these may also influence the topics and activities they find interesting and engaging. Consequently, interest development emerges as a continuous and dynamic process influenced by cognitive, affective, and environmental elements (Shin et al., 2019). According to Eccles and Wigfield (2002), another strategy for engaging and keeping learners' attention is to assist them in finding value and importance in their studies. Several empirical studies have emphasized the significance of value-related perceptions, which are associated with how an individual considers things vital and advantageous (Harackiewicz et al., 2016). Other empirical and repeated observation studies (Durik et al., 2015; Harackiewicz et al., 2012; Hulleman & Harackiewicz, 2009; Rozek et al., 2016) found that utility value beliefs and bridging content knowledge with real-life applications elevated interest in learning mathematics and science. According to the expectancy-value framework, behavior is motivated by three value perceptions: intrinsic, attainment, and utility. Relevant learning activities may help individuals identify with them (identification), concentrate and inspire (involvement), and form a stable interest in the subject (involvement). The utility value of an activity implies that individuals are more inclined to participate in it as it aligns with their interests (Eccles & Wigfield, 2002). Interpreting data from 33 field studies and 12,478 participants, Hulleman and Harckievicz (2019) reviewed intervention studies on utility as a motivational tool, revealing remarkable outcomes. They discovered that students' grades and domain interests improved due to utility interventions. Middle school teachers felt that students' perception of content influenced motivation. Students are motivated to study when they believe the information they obtain will benefit them personally. This could include the prospect of getting a high grade or the knowledge they are gaining to gain a career in the subject or field they are studying. Additionally, helping students find the utility of a topic encourages them to draw connections between their lives and the subject through utility manipulations that foster active classroom learning. Students who established links between curriculum and real-life received higher grades and studied more effectively (Hulleman & Harackiewicz, 2019).

Interventions centered on individual significance suggested significant benefits to students experiencing disengagement from school due to diminished self-esteem (Priniski et al., 2018). Students will become interested if they think they are proficient in science and can effectively complete classroom assignments. These findings align with expectancy-value theories of motivation, which propose that a person's belief in their capability to succeed and the perceived importance of the activity directly impact their engagement (Eccles & Wigfield, 2002). According to expectancy-value theory, anticipating success at a task result in persistence, competence, performance, and interest in academic pursuits (Eccles et al., 2015). Students who feel they can handle classroom tasks are more likely to accomplish them. Students feel motivated to study when they think that the material will be helpful in their lives. Increasing the perception of the value increases students' engagement and academic performance (Hulleman & Harackiewicz, 2009).

Academic interest is critical to achieving long-term results such as educational and professional aspirations. Hulleman and Harackiewicz (2009) found that interest orientations may predict success in math and science. Students who have low self-esteem in mathematics may not consider themselves successful in the subject. They may need help connecting with the course content or acknowledging the value of their efforts. Activities that increase students' views of a topic's utility stimulate cognitive ability in students with moderate performance expectations. (Harackiewicz et al., 2016). The research suggests that individuals are more inclined to maintain interest when they presume the activities to be relevant and beneficial. Students may anticipate the material's content and context being relevant enough to persevere. They may form a personal rationale for persisting in it. In both cases, the learner creates a mental representation of a personal connection to the content.

Personal values help students take charge of their learning rather than just following the information in the textbook or passively attending to the instructor's discourse. This emotional connection allows students to actively participate in their academic progress and emerge as self-directed learners (Hulleman & Harackiewicz, 2009). The study's findings reaffirmed the importance of teachers. They proposed that teachers could aid students in making connections by incorporating activities that are personally significant (Harackiewicz et al., 2016).

Confident students require external assistance because their effort and commitment to schoolwork are already established. These students may need less additional support to fulfill their academic potential. Still, they are more likely to succeed with the right amount of encouragement and to become role models for other learners (Hulleman & Harackiewicz, 2009).

In sum, utility-value interventions aim to affect students' conceptions of usefulness through tasks relevant to the academic topics (e.g., an essay on how a parent or relative may apply a scientific fact to their job). Students understand the links between course subjects and real life, allowing them to comprehend the relevance of their education and creating a higher degree of commitment to it (Eccles & Wigfield, 2002). The goal is to encourage students to continue to seek out and discover the utility for themselves. The idea is to enable them to find their values. Suppose a utility-value intervention is used to generate situational interest. The topic may become more relevant and appealing, developing into more enduring personal interests. Researchers suggested that self-generated utility-value perceptions outperform externally offered utility-value information (e.g., when adults discuss why the subject is essential or helpful) (Durik et al., 2015; Harackiewicz et al., 2016).

Interest in Computer Science

Developing a predisposition towards academic subjects can be decisive. Students interested in computer science jobs are inclined to engage in relevant activities (Hinojosa et al., 2016). Additionally, students who engage with computer-related subjects during middle and high school are more likely to seek and achieve a degree in a science, technology, engineering, or mathematics field in college (Wang, 2013; White, 2014). Middle school students' academic interests may predict post-secondary achievement (Wang, 2013). In many middle schools, students study the Scratch coding software. Students exposed to programming are more prone to develop an interest in computer-related courses in college (Polat et al., 2021).

Computer science interest is associated with vocational plans and future career goals (Dou et al., 2020). However, further studies are necessary to investigate interest in computer science thoroughly. Several studies have demonstrated that male students with a robust self-concept are more inclined to excel in computer science studies than their female counterparts. Some researchers resent that computer science is not diverse (Dou et al., 2020; Lakanen & Isomöttönen, 2018; Pietri et al., 2021). This is because girls have many misconceptions about computer science while studying it at school. Girls assume that pursuing computer science requires superior intelligence (Spieler et al., 2020). However, students generally have self-doubt and fear getting low grades in science and computer courses in middle school (Bystydzienski et al., 2015).

The interest development through intervention has been the subject of a few investigations. In a longitudinal study, Lakanen and Isomöttönen (2018) explored if interest developed over time after participating in a programming workshop. They used questionnaires and survey tools to collect data. Their findings showed that 57% of students were interested in computer science. Their findings indicated that the effectiveness of the workshop significantly influenced their motivation. Students gained considerable programming skills that they could improve later. Ko and Davis (2017) reported a substantial correlation between interest in computers and the content. According to the study's design, engagement with computer education and a mentor would assist in initiating and keeping interest in computers. Like Lakanen and Isomöttönen's (2018) study, students built their unique websites and were allowed to choose particularly relevant projects. Results illustrated no correlation between gender, income, or interest in the subject. Students experienced conceptual shifts and acknowledged the development of significant competencies after interacting with a professional tutor. They could set challenging but reachable goals, work independently, and manage their time well. Students could recognize their areas of interest and strengths in problem-solving and subsequently leverage those strengths to master complex concepts. This study reconfirmed the value of external support. Interest interventions may contribute to expanding an adolescent's interest in computers.

The literature review on motivational factors and interest development underscores that several techniques, including problem-solving, mentoring, fostering personal relevance, early exposure to computers, participation in computer-related extracurricular activities, utilization of role models, games, and scaffolding, all of these factors contribute to the formation of interest and engagement in the domain (Spieler et al., 2020; Turner et al., 2015). These strategies allowed learners to apply their emerging understanding and talents, enhancing their comprehension of the material beyond what a purely passive learning experience could offer.

Students' interest in specific areas has been measured through tools developed by several scholars. For example, Rihtarsic et al. (2016) and Nugent et al. (2016) developed instruments to calculate the interest in robotics. Scientists collaborated with computer engineers to develop tools for assessing middle school students' comprehension of domain-specific concepts, variables, loops, conditions, and algorithms (Rachmatullah et al., 2020). In the literature, definitions of “computational thinking” and computer science concepts need more clarity. They are used interchangeably because of the growing evidence linking math and computer science competence. However, further research is warranted to explore methods for sustaining and assessing interest in computer science. (Hinojosa et al., 2016; Polat et al., 2021; Rachmatullah et al., 2020; Shute et al., 2017; Wang & Degol, 2017)

Conclusion

In this part, interest development models and experimental studies conducted with middle school students have been examined. Research findings show that interest, as a driving force, can develop with proper support in any subject, including computer science. The four-phase model of interest development has ramifications in terms of educational research. Initial model predictions include a slow development through external assistance (e.g., engineered lessons, utility value intervention). The explanation is that student interest may cease if not stimulated. Additionally, students may need a range of alternative assignments depending on their interest development phase (Harackiewicz et al., 2016).

Interest in advanced academic subjects emerges in middle school or adolescent years. Students concentrate on specific topics and determine their course preferences. Throughout middle school, they develop the ability to articulate their goals and ambitions. This age is significant for developing academic interests and forming a solid foundation for future education choices (Krapp & Prenzel, 2011).

The literature review shows a pressing need to conduct experimental studies to identify strategies to promote students' motivation and domain interest (Dohn, 2020; Grover & Pea, 2013; Jakos & Verber, 2017; Ko & Davis, 2017; Torsten et al., 2017). Such studies would help examine the emergence of situational interest that may provide valuable understanding into managing and sustaining an adequate degree of student interest in the content. Past research has primarily been interested in the potential applications of this phenomenon in particular academic subjects such as science and math (see APPENDIX C). The existing literature review shows a need for more studies on the effect of triggering situational interest in computer science classes.

Chapter III: Utility Intervention Study to Promote Interest in Computer Science Class

Purpose of the Study

This study aimed to contribute to the existing literature in multiple aspects. The goal was to improve students' situational interest in computer science (CS) by implementing a utility value (UV) intervention. Prior research has often concentrated on specific domains, posing challenges in drawing overarching conclusions about the impact of interest on achievement in other domains. There was evidence that interest improves engagement and motivation when supported, particularly in areas such as STEM and reading, and that it may be more important in younger students. Additional research was warranted to find relevant evidence and evaluate the impacts of interest on achievement across various domains (Jansen et al., 2016).

Several researchers have argued that additional study of situational interest is warranted due to the crucial role it plays in the learning process (Ainley, 2017; Renninger & Hidi, 2019; Wang et al., 2022). Situational interest may be utilized to cultivate long-term interests at school (Durik et al., 2021). Promoting situational interest can enhance student engagement and motivation, ultimately resulting in learning (Bong et al., 2015; Hidi & Renninger, 2006; Rotgans & Schmidt, 2017). The value of relevant studies in education has been proved in only a few studies. Most research findings are in similar contexts and subjects (Hulleman & Harackiewicz, 2019).

Interest can be triggered and developed by encouraging students to connect ideas and their lives. If this is constantly made through meaningful and stimulating activities featuring relevance, value, novelty, and surprise, interest can be maintained long-term (Harackiewicz & Hulleman, 2010; Hay et al., 2015; Hidi & Reninger, 2011; Rotgans & Schmidt, 2017; Turner et al., 2015). UV studies proved that when students found the material relevant, they achieved high motivation and learning. Interventions using utility value (UV) can establish a dynamic and personalized learning atmosphere, tapping into students' intrinsic motivation for acquiring knowledge. Students feel more engaged in the course material. They are more driven to study when they know about the potential benefits.

Previous study findings suggest UV interventions effectively bridge learning gaps by improving school achievement and interest (Canning et al., 2018; Hidi et al., 2019; Hulleman & Harackiewicz, 2009). UV interventions afford personalized learning experiences. Furthermore, generating and sharing one's utility value experiences reinforces situational and individual interests. On the other hand, the call for additional research in relevance and UV investigations has been addressed in the literature (Dohn, 2020; Grover & Pea, 2013; Jakos & Verber, 2017; Ko & Davis, 2017; Tapola et al., 2013; Torsten et al., 2017).

Computational literacy should be a fundamental part of education, akin to reading and writing, because it enables individuals to engage with and understand the world in new ways (diSessa, 2000). Because of the increasing demand for programming skills, there has been a growing interest in introductory courses, which can be taken at the middle school level. In the future, mastering computer science or the principles of computational thinking will become an essential skill for all students (Kaya et al., 2017; Nwana, 1997). It equips students with the problem-solving and critical-thinking abilities necessary for thriving in any educational or professional setting. It will help students access the information critical for their future careers. However, students' engagement with computer science or computing as an academic course has yet to be explored experimentally (Brinda et al., 2017; Jakos & Verber, 2017). Overall, computing skills are essential for cognitive development, as they help develop a range of important cognitive processes and skills critical for success in many areas of life.

The investigation into computer science instruction among middle school students is premised on the understanding that this educational stage is critical for later career plans (Almeda & Baker, 2020; Bleeker & Jacob, 2004; Kneztek et al., 2013). The literature review revealed that middle school students naturally develop diverse interests, which can be effectively nurtured through encouragement and support (Turner et al., 2015). This developmental stage is characterized by an enhanced capacity for students to reflect on their academic preferences and articulate their future educational and career aspirations (Krapp & Prenzel, 2011).

Students' perception of academic content plays a key role in their motivation. Hulleman and Harackiewicz (2019) noted that middle school teachers recognize the influence of students' content perceptions on their motivation levels. This implies that positive perceptions of computer science could enhance students' motivation to engage with the subject matter. Hinojosa et al. (2016) further emphasized the importance of developing a predisposition towards academic subjects. They noted that students interested in computer science careers were likelier to participate in related activities that support their engagement and success in these fields.

The course of interest development in middle school students is critically analyzed, with findings indicating that early exposure to computer-related subjects significantly contributes to students' likelihood of researching degrees in science and technology fields (Wang, 2013; White, 2014). Specifically, the study of Scratch coding software in many middle schools has been linked to an increased tendency among students to develop an interest in computer-related courses in college (Polat et al., 2021). This suggests that early exposure to computer science not only fosters immediate interest but may also predict post-secondary achievement in related fields (Wang, 2013). However, the literature also identifies barriers to engagement with computer science, including prevalent self-doubt and fear of inferior performance in science and computer courses among middle school students (Bystydzienski et al., 2015). This stresses the need for educational strategies that foster interest in computer science and address the motivation and confidence of middle school students in engaging with this subject matter. The literature underscores the significance of introducing content in middle school as a critical phase for cultivating and sustaining interest in academic domains (Crowley et al., 2015; Hecht et al., 2019; Maltese & Tai, 2010).

In sum, this research investigated whether a utility intervention could increase interest in computer science in middle school. See Figure 5 for a conceptual map. A study examining how middle school students' interest influences their computer science learning is warranted, as most investigations into student motivation have primarily addressed math or science education. Understanding the distinct motivational drivers in various subject areas is crucial for developing tailored instructional methods and fostering student success. Furthermore, more experimental investigations are needed into the role of interest in middle schoolers' computer science learning. Hence, an intervention study examining the effects of utility interventions on student engagement and performance in computer science can advance our understanding of this significant research domain.

Study Design

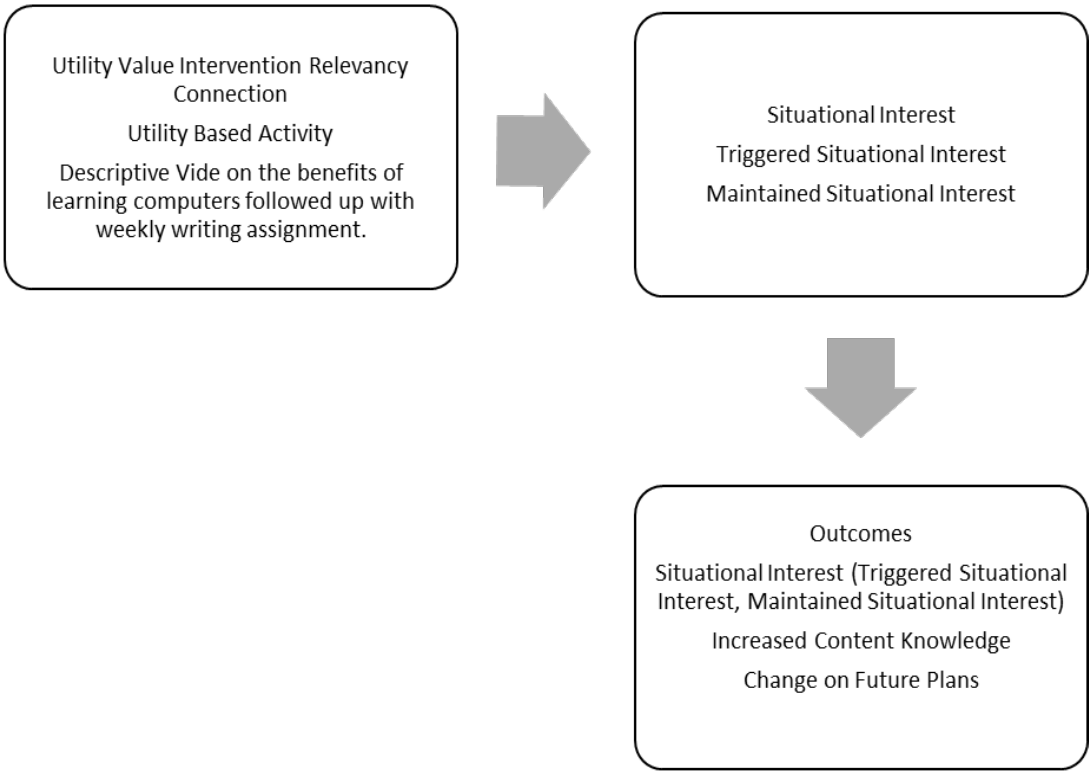
This quantitative study design investigated the relationship between individual interest, situational interest, and a utility value intervention. Specifically, it examined how situational interest (SI) can be triggered and maintained through a utility value intervention while learning a computer class in a public school. To this end, a pretest-posttest control-group design was employed to examine if utility intervention influences student interest in CS. In this 2X2 design, group differences [Experimental vs. Control] were examined at two-time points [Pre-test vs.

Post-test]. In this design, random assignment to experimental and control groups was conducted at the classroom level due to convenience. Students' individual and situational interests and future plans regarding CS careers were assessed in pre and post-test phases. Students in experimental and control groups participated in the present study as they enrolled in CS classes. The experimental and control groups followed the same content and learning objectives. The experimental manipulation of utility intervention was implemented through the use of information showing the usefulness of CS in our daily lives in various sectors. Instructional videos and writing assignments were used as utility interventions to manipulate interest in the treatment group (Harackiewicz et al., 2016; Rosenzweig et al., 2018).

Additionally, the relationship between interest in CS, prior knowledge of CS, and individual interest was investigated using a correlational design.

Figure 5

A Conceptual Map of the Utility Intervention Study.



Methodology

The quantitative study design had intervention and control groups with a randomized class assignment. Participants were drawn from a middle school (7th and 8th Grade) in the public-school system of the United States, ensuring a diverse demographic representation. A computer-generated random number sequence was used to facilitate the random allocation of classes to either the intervention or control group. Through this randomization process, each class was ensured an equitable opportunity to be allocated to one of the two conditions, reducing potential biases and ensuring the comparability of groups at baseline. Both groups received identical course content delivered through standard instructional methods to maintain consistency in educational exposure. The intervention group, however, participated in additional activities designed to enhance engagement and interest in the subject matter. These activities were integrated into the regular curriculum and tailored to complement the existing course content, ensuring the intervention was relevant and educationally enriching. Interest levels were quantitatively assessed using a validated interest inventory, administered before the intervention (pre-task) and after the completion of the course (post-task). This inventory was designed to measure various dimensions of student interest, including emotional engagement, perceived relevance, and future engagement intentions, providing a comprehensive understanding of the intervention's impact. Data analysis used appropriate statistical techniques to compare the pre- and post-task interest levels between the intervention and control groups. The researcher and classroom teachers managed the implementation of tasks and adherence to the study protocol. Teachers received training to maintain uniformity and fidelity in implementing the program. The two-hour training session included detailed explanations of the intervention's objectives and instructions on effectively performing it. Following this, teachers had the chance to practice the writing tasks either with their colleagues or under the guidance of a researcher, improving their skills in applying it. Teachers were responsible for monitoring student participation and ensuring the completion of tasks as outlined by the study's protocol, yet their professional backgrounds were in fields other than computer science. The study addressed the following research questions:

1. What is the relationship between prior knowledge in CS and situational interest?

2. What is the impact of utility intervention on students' situational interest in computer science programming tasks?
3. What is the impact of utility intervention on students' future plans in CS class?
4. What is the impact of utility intervention on students' individual interest in CS classes?
5. What is the relationship between situational interest and individual interest?

Procedures and Analytic Plan

Intervention

Rationale

This study utilized an intervention designed to strengthen student interest in computer science, informed by the utility value interventions conceptualized by Hulleman and Harackiewicz (2009, 2019) (see Appendix C). The foundation of this intervention is predicated on empirical evidence indicating that emphasizing the pragmatic applicability of content enhances appeal, motivation, and engagement. This approach assumes learners are more likely to actively participate with material they perceive as directly beneficial to their future goals and everyday lives.

Sample

The study focused on 264 middle school students in 7th and 8th grade at a public charter school in a western United States county. These students had a foundational understanding of Computer Science (CS) concepts, reflecting the school's curriculum in this area. Inclusion in the study was contingent upon completing all assigned tasks, a criterion the 149 students who formed the sample met. This approach ensured that the sample comprised individuals engaged with the subject matter and demonstrated a commitment to the study's requirements. The sample size was beyond the recommended minimum sample size from a power analysis. Using G*Power 3.1, the minimum sample was 54 with a statistical power of .95, a medium effect size, $f = .25$, and an alpha value of .05.

The school population comprises mixed ethnic groups: 26% White, 15% African American, 14% Hispanic, 29% Asian, and 16% multiracial. Additionally, the rate of students eligible for Free and Reduced Lunch (FRL) amounts to 51%, and there is an 18% population of students receiving Special Education (SPED) and 11% English Language (EL) services. Females make up 52% of the total population. The student body exhibits homogeneity in academic proficiency, with some granted access to advanced coursework predicated on performance metrics and personal proclivity. The school incorporated a computer science curriculum across all educational tiers. Teachers were using the computer science standards established by the state.

The middle school students receive instruction in a spectrum of computer science principles, encompassing software and hardware fundamentals, under the guidance of computer instructors. In the curriculum, students are assigned individual projects, and their performance is evaluated through task completion, skill acquisition, and active participation. It is noteworthy that this course does not have any prerequisites for enrollment.

Overview of the Intervention

The intervention incorporated informal writing assignments into a motivationally supportive curriculum, leveraging the expectancy-value theoretical framework to improve motivation. These assignments aimed to promote students' comprehension of the material by requiring them to establish associations between fundamental concepts and their practical executions. The intervention established a dynamic learning setting to encourage engagement and foster meaningful connections with the subject material.

Preparation and Methodological Approach

Before the intervention, teachers received a two-hour training session on the theoretical foundations, study methodology, and intervention resources. The program provided teachers with the essential skills to facilitate discussions and reflect on the subject, increasing the intervention's effects. The planning step ensured that the intervention was delivered efficiently over four weeks and divided into four sessions.

Implementation

An essential element of the intervention was the implementation of weekly writing assignments. Students were prompted to reflect on the topics covered in the lesson and write one to two paragraphs on how they implemented the knowledge. The reflective practice aimed to strengthen the importance of computer science by creating a meaningful connection between the content and concrete applications. It encouraged students to actively participate in the learning cycle, which made the theoretical content more relevant and understandable.

Comparative Analysis

A control group was included in the research, and they were given writing assignments that required them to summarize important instructional concepts. Both groups, comprising both the experimental and control groups, were granted access to a curriculum intended to offer motivational support, ensuring uniformity in material across both. Incorporating a control group enabled the comparison of outcomes and the assessment of the precise impact of the activity. The intervention's emphasis on weekly writing assignments was designed to assist students in perceiving the relevance of ideas in their lives, aspiring not only to advance motivation but also to kindle interest in specialized inquiry by integrating elements that underscored the practical utility of task, the intervention aimed to affect motivation significantly. This approach was pursued to emphasize the potential of applied learning strategies to bridge the division between theoretical knowledge and practical application, yielding a more holistic educational experience (Harackiewicz et al., 2016; Rosenzweig et al., 2018; Yu & Gao, 2022).

At the program's inception, students embarked on reflective work that supported their comprehension of the unit's central notions. They were tasked with writing and correlating a topic with personal experiences, emphasizing the exercise's focus on subjective relevance. This introspection demanded students to contemplate the suitability of these understandings, driving them to share their reflections through various modalities such as detailed narratives, conceptual maps, or illustrative sketches. The purpose was to ensure clarity and the efficaciousness of communication, specifically when employing visual aids to demonstrate knowledge.

Students engaged with the provided writing prompts as the program transitioned into its second week. The writing activity sought to link instruction with students' narratives further. Through reflection, students examined content integration into their spheres, connecting the curriculum and their proclivities. This work necessitated them to describe these associations, delving into the tangible consequences of the taught concepts. This procedure aspired to improve their analytical skills, increase self-awareness, and make the learning experience more engaging and relevant.

In the program's later stages, the focus shifted towards customizing the experience to align with specific interests. The purpose was to tailor the content to their intentions, thus sparking inquisitiveness and improving results. This strategy emphasized the significance of developing learning trajectories that cultivate continuing confidence for inquiry and knowledge acquisition. On the other hand, completing the assignments was considered adequate to generate the intended outcomes, suggesting that completing the task fulfilled the critical criteria to generate change. The view stressed that minimal compliance with the instructions was acceptable to produce an impact (Canning & Harackiewicz, 2015).

All students learned identical content over four weeks, guiding them through progressively more complex topics and practical applications. During the first week of instruction, they were focused on HTML basics, introducing the concept of web technologies and the fundamental structure of HTML. Students learned to create simple web pages, starting with personal profiles and gradually advancing to linking pages through hyperlinks. During week two, they studied images in HTML, learning how to add and format images within web content. As the program progressed, students examined content organization through lists and tables in week three before receiving an introduction to CS in week four, where they learned how to style HTML elements using classes and IDs. During the fifth week, they delved deeper into advanced styling techniques, including text styling, background colors, borders, and positioning. In week six, they better understood CS classes, IDs, and their targeted applications. The final two weeks culminated in developing a personal homepage, where students combined all learned concepts to create a personal webpage, showcasing their abilities in content structuring, styling, and even incorporating basic interactivity with JavaScript elements. This lesson plan ensured that students gained hands-on experience and a foundation in web development, preparing them to create visually appealing and functional web content.

The intervention activities were designed with a commitment to inclusivity and representation. Teachers integrated historical contributions from marginalized groups in computer science, showcasing their pivotal roles in shaping the field. Writing activities and videos offered equal learning opportunities and encouraged all students to engage actively. Promoting an inclusive environment empowered student to express themselves and contribute meaningfully through writing activities, ensuring that the content reflected overlooked perspectives.

One example of how the curriculum was representative of historically marginalized groups was by including audiovisual material on the history of computing that highlighted the contributions of individuals from diverse backgrounds. For instance, the curriculum covered the story of a female mathematician and writer considered the world's first computer programmer. The curriculum showcased their significant contributions and addressed their obstacles by discussing such figures' work alongside their challenges in the field.

The writing activities served as a tool for fostering engagement and inclusivity among students from diverse backgrounds. By customizing its approach to resonate with individual experiences, they created a bridge between students' personal lives and academic content. The intervention strategically encouraged using culturally resonant examples and references, creating a learning atmosphere where students could forge meaningful and relatable connections with the subject matter. Writing activities created an inclusive classroom environment where students from diverse backgrounds participated in class.

The curriculum emphasized the utility of the content by presenting concrete instances of computer implementation by individuals from diverse backgrounds. This approach emphasized how technology had practical applications across different communities. Students were urged to participate in activities and explore the importance of computer learning in various contexts.

Material and Timeline

The needed materials included supplies for pre- and post-self-report surveys, essential classroom learning materials, and devices with internet access for each student. During the intervention study, students completed tasks through the school's established curriculum portals or utilizing paper materials distributed during class. The timeline for the survey was set at four weeks (see APPENDIX D).

Data Collection

Data collection adhered to relevant standards, regulations, and university protocols. Participant confidentiality was preserved by following strict ethical guidelines. Data was collected during regular school hours, with prior agreement from school officials, parents, and instructors. All students in the study were briefed on their rights and given a chance to provide informed consent before their involvement in the research. Additional demographic data was obtained from the school. For Situational (SI), Individual Interest (II), and Future Plans (FP), students rated themselves on a 5-point Likert scale ranging from 1 (not all true for me) to 5 (very true for me).

Prior Knowledge

Before the intervention started, a single tool was used to determine what the students already knew. A rubric was used to evaluate their initial knowledge before the intervention. A score based on their responses was assigned to each student.

Situational Interest Scale

The initial situational interest of students was assessed using a self-report instrument. These items were modified from the 12-item Situational Interest Scale (Linnenbrink-Garcia et al., 2010). After analyzing its psychometric properties, Linenbrink-Garcia et al. (2010) calculated the scale's Cronbach's alpha to be 0.90. The scale with such high internal consistency reliability has been used in several research (Leyva et al., 2022; Lou, 2019). Cronbach's alpha in their study score was about .95. Linnenbrink-Garcia et al. (2010) constructed and experimented with the Situational Interest Scale (SIS) in a classroom environment. They applied this scale in both secondary and postsecondary school environments. This tool was appropriate as it is based on Hidi and Renninger's (2006) conceptualization of interest and the interest development model (Lou, 2019).

The scale included items to measure affective (e.g., "I find the computer class interesting") and value-related components (e.g., "What we are studying in the computer class is useful for me to know"). The students rated themselves on a 5-point Likert scale ranging from 1 (not at all true), 2 (not true for me), 3 (neutral), 4 (true for me), to 5 (very true for me). Ball participants took the SIS pretest-posttest (see APPENDIX E).

Individual Interest Scale

Individual interest was assessed through the Individual Interest Scale, which was adapted from the Motivated Strategies for Learning Questionnaire Subscale (MSLQ-I) (Linnenbrink-Garcia et al., 2010). This scale comprises seven items with a reliability coefficient of .90 (see APPENDIX F). Researchers have utilized the Motivated Strategies for Learning Questionnaire (MSLQ) to explore psychological constructs such as academic self-efficacy, self-regulation, goal setting, academic control, and interest. In the Motivation section, six facets are identified, while the Learning Strategies section encompasses nine factors. The Motivated Strategies for Learning Questionnaire Subscale (MSLQ-I), derived from the MSLQ, specifically targets assessing interests. These subscales offer modularity and can be applied individually or collectively, depending on the research objectives (Duncan & McKeachie, 2005; Wolters, 2003; Harackiewicz et al., 2000; Linnenbrink-Garcia et al., 2010).

Future Plans Scale

The Self-report Survey, developed by Hulleman and Harackiewicz (2009), was utilized to gather information on future interests before and after for both groups. Comprising three questions, the scale required students to rate themselves on a 5-point Likert scale, with responses ranging from 1 (not at all true for me) to 5 (very true for me) (see APPENDIX G).

Data Inclusion Criteria

A rigorous data selection methodology was employed. Participants were required to complete pre- and post-intervention surveys online, with directions from teachers to maintain data integrity. The non-anonymous nature of the surveys facilitated a thorough tracking of individual student engagements over time.

Criteria for inclusion in the analysis were stringent to ensure the relevance and accuracy of the dataset. The study only included students who fulfilled the writing assignments and completed pre- and post-surveys. The dataset was refined by excluding responses that potentially compromised data quality. Specifically, entries where students uniformly rated all items with extreme values (1 or 5) were removed to prevent skewness. Subsequently, participants who failed to do the writing tasks were excluded, ensuring a focus on fully engaged students. This strategic approach to data selection, aligned with best practices in research methodology, was designed to optimize accuracy and reliability (Osborne & Overbay, 2008; Osborne, 2013).

Data Analysis

Before analysis, all quantitative data was analyzed and prepared. Statistical analysis was conducted using the Software Package for the Social Sciences (SPSS). The SIS, IIS, and FPS surveys retrieved ordinal data. Answers for each student and survey sub-scale were combined. As part of an analysis, scores for each measure factor and total scores for the complete scale for each student were considered. Calculated classwork scores were added to measure performance. Outlier analysis was conducted, and extreme scores were subsequently identified and removed. The initial step in analyzing the data involved generating descriptive statistics. This process included defining and arranging data. This section included details regarding specific data properties, such as the sample and population. A descriptive statistics table was created to present the mean, standard deviation, N, skew, and kurtosis values by experimental and control groups at pre-and post-test data. Internal consistency was examined via the alpha coefficient for each psychometric instrument utilized.

Below, research questions and analysis methods are provided:

Research Q1: What is the relationship between prior knowledge in CS and SI? Pearson correlation was used for analyses because both variables are continuous. The research question seeks a relationship between prior knowledge and situational interest. The linearity assumption was checked by inspecting the scatterplot.

Research Q2: What is the impact of utility intervention on students' SI in the CS Programming Task? This is a 2 (pre-post) X 2 (experimental control group) repeated measures design. The dependent variable is situational interest in CS.

Research Q3: What is the impact of utility intervention on students' future plans in CS class? 2 (pre-post) X2 (experimental control group) repeated measures design. The Independent variable is utility intervention, and the future plan is the dependent variable.

Research Q4: What is the impact of utility intervention on students' individual interest in CS class? 2 (pre-post) X2 (experimental control group) repeated measures design. The dependent variable is individual interest.

To test Research Questions 2, 3, and 4, a two-way 2 [Group: Experimental vs. Control] X 2 [Time: Pre-test vs. Post-test] repeated measures ANOVA test was conducted. The analyses examined assumptions of normality and sphericity. This analysis used situational interest as the dependent variable in the first analysis. The follow-up analyses used the same model, but they used different dependent variables: future plans and individual interests. In all of these analyses, a Time*Group interaction effect was examined.

Research Q5: What is the relationship between situational interest and individual interest? Pearson correlation was employed because both variables are continuous. The research question investigates this relationship. The linearity assumption was checked by inspecting the scatterplot.

Chapter IV: Results

A total of 149 students participated in this study. Table 1 shows the demographics of 149 participants, segmented into control (46 participants) and intervention (103 participants) groups. Ethnicities included Asian, Black, White, Hispanic, Multi, and Pacific Islander, with White being the most represented at 39.6%. Gender-wise, the study features 57% male and 43% female participants, showing a diverse yet male-dominated composition (See Table 2).

Table 1
Ethnicity Representation

Group		Ethnicity						
		Asian	Black	White	Hispanic	Multi-Racial	Pacific Islander	Total
Control Group	Count	7	11	16	12	0	0	46
	% of Total	4.7%	7.4%	10.7%	8.1%	0.0%	0.0%	30.9%
Intervention Group	Count	26	16	43	15	1	2	103
	% of Total	17.4%	10.7%	28.9%	10.1%	0.7%	1.3%	69.1%
Total	Count	33	27	59	27	1	2	149
	% of Total	22.1%	18.1%	39.6%	18.1%	0.7%	1.3%	100.0%

Table 2
Gender Representation

Group		Gender		
		Female	Male	Total
Control Group	Count	11	35	46
	% of Total	7.4%	23.5%	30.9%
Intervention Group	Count	53	50	103
	% of Total	35.6%	33.6%	69.1%
Total	Count	64	85	149
	% of Total	43.0%	57.0%	100.0%

Eight sections were randomly assigned, with four as the control group and the remaining four designated for the intervention group.

The analysis showed that the mean scores for situational interest, individual interest, and future plans all increased post-intervention, with situational interest rising from 37.41 to 39.19, individual interest from 21.85 to 23.23, and future plans from 7.90 to 8.09. The standard deviations indicate a range of participant responses but with a generally consistent spread pre- and post-intervention across the variables. Skewness values close to zero for pre- and post-assessments indicate a symmetrical data distribution. Furthermore, the kurtosis values are negative across all measures, indicating a relatively flat distribution, pointing towards a broad range of responses without extreme outliers (See Table 3). Correlations among the interest measures of this analysis are provided in Table 4.

Table 3

Descriptive Statistics for Interest Variables

	Situational Interest Pre	Situational Interest Post	Individual Interest Pre	Individual Interest Post	Future Plans Pre	Future Plans Post	Interest Total Pre	Interest Total Post
M	37.41	39.19	21.85	23.23	7.90	8.09	67.16	78.64
SD	15.07	12.99	8.26	7.53	3.86	3.47	25.40	17.31
Skewness	-0.36	-0.08	-0.22	-0.26	0.31	0.36	-0.24	-0.48
Kurtosis	-1.13	-1.20	-1.01	-0.81	-1.08	-0.81	-1.00	0.15

Note. N=149. Skewness and Kurtosis values provide insight into the data's distribution shape (normality), with values closer to 0 indicating a more normal distribution.

Table 4

Zero-Order Correlations and Descriptive Statistics for Interest Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Prior Knowledge													
2. Situational Interest Pretest	.39**												
3. Situational Interest Posttest	.24**	.35**											
4. Future Plans Pretest	.26**	.74**	.29**										
5. Future Plans Posttest	.26**	.46**	.36**	.57**									
6. Triggered SI Pretest	.38**	.94**	.32**	.65**	.38**								
7. Maintained SI Pretest	.38**	.99**	.36**	.75**	.47**	.87**							
8. Maintained SI Posttest	.21**	.32**	.98**	.29**	.38**	.27**	.33**						
9. Triggered SI Posttest	.26**	.39**	.93**	.26**	.30**	.38**	.370**	.85**					
10. Individual Interest Pretest	.28**	.78**	.3**	.84**	.46**	.68**	.80**	.29**	.27**				
11. Individual Interest Posttest	.28**	.52**	.49**	.59**	.72**	.43**	.54**	.50**	.41**	.63**			
12. Interest Pretest	.36**	.96**	.35**	.87**	.51**	.88**	.96**	.33**	.36**	.92**	.61**		
13. Interest Posttest	.31**	.52**	.85**	.54**	.72**	.44**	.53**	.85**	.77**	.54**	.86**	.56**	
N	149	149	149	149	149	149	149	149	149	149	149	149	
M	90.31	37.42	47.32	7.90	8.09	12.24	25.17	31.44	15.88	21.85	23.23	67.16	
SD	8.54	15.07	9.83	3.86	3.47	5.10	10.44	6.65	3.53	8.26	7.53	25.40	
Cronbach's α		.97	.95	.86	.85	.91	.96	.93	.89	.92	.92	.97	.94

Note. ** $p < .01$. Situational Interest Scale includes Triggered and Maintained Situational Interest. Interest includes Situational Interest, Individual Interest, and Future Interest.

Before testing the research questions, the experimental and control groups were compared in terms of prior knowledge. There was no significant difference, $t(147) = -.55$, $p = .59$, $d = -.10$, between experimental (M=90.57, SD=8.67) and control group (M= 89.74, SD= 8.30). Given that there was no significant difference in prior knowledge between the groups, this variable was excluded from the subsequent analysis, which aimed to assess the impact of the utility intervention.

Prior Knowledge

Research Question 1 inquired about the relationship between Prior Knowledge and SI Analysis of zero-order correlations between prior knowledge in computer science and post-intervention situational interest revealed a statistically significant positive relationship ($r = .362$, $p < .01$), indicating that as prior knowledge increases, interest tends to increase as well. Table 3 summarizes the zero-order correlations among the study variables. This table illustrates the relationships between students' prior knowledge, initial interest levels, and post-intervention interest.

Table 5

Pearson Correlations for Prior Knowledge and Interest Variables

	Prior Knowledge	
	Pretest	Posttest
Triggered Situational Interest (TSI)	$.38^{**}$	$.26^{**}$
Maintained Situational Interest (MSI)	$.38^{**}$	$.21^{**}$
Situational Interest (TSI+MSI)	$.39^{**}$	$.24^{**}$
Individual Situational Interest (II)	$.28^{**}$	$.28^{**}$
Future Plans (FP)	$.26^{**}$	$.26^{**}$
Interest (SI+II+FP)	$.36^{**}$	$.31^{**}$

Note. **. $p < .01$ level.

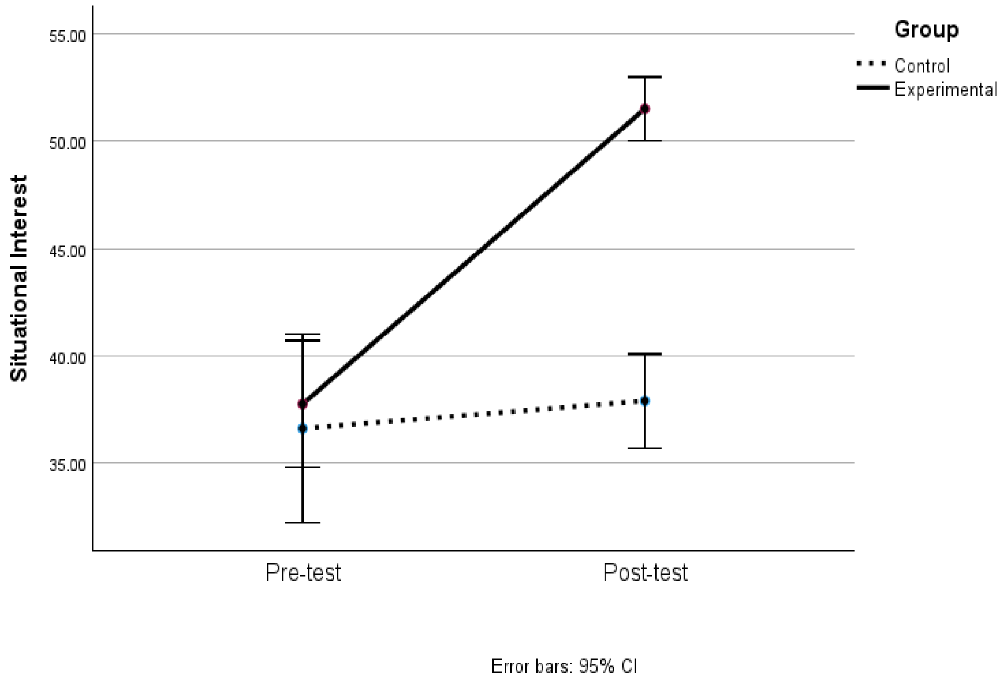
Situational Interest

To address Research Question 2, which aimed to evaluate the impact of an educational intervention on situational interest, a 2 [Group: Experimental vs. Control] X 2 [Time: Pre-test vs. Post-test] repeated measures ANOVA was conducted. This analysis specifically targeted situational interest as the dependent variable, intending to uncover any significant interactions between time (pre vs. post) and group (experimental vs. control) conditions.

Levene's test was non-significant in the pre-test scores, $F(1,147) = 0.984$, $p = .323$, whereas it was significant in the post-test scores: $F(1,147) = 123.757$, $p < .001$. Before conducting the ANOVA, assumptions of normality and sphericity were examined to ensure the validity of the analysis. Analyses showed that there was a significant change in situational interest between the pre and post-training, $\lambda = .793$, $F(1, 147) = 38.471$, $p < .001$, $\eta_p^2 = .207$) for the entire sample of participants (experimental and control group). Further, there was an interaction effect of training by group, $\lambda = .847$, $F(1, 147) = 26.460$, $p < .001$, $\eta_p^2 = .153$). This finding showed that the change in situational interest before and after the training was significantly higher in the experimental group than in the control group (see Figure 6).

Figure 6

Change in Situational Interest Between Pre- and Post-Test for the Intervention and Control Groups.



Future Plans

Research Question 3 was about the utility intervention's impact on the participants' future plans. Levene’s test was non-significant in both pre-test, $F(1,147) = 0.239$, $p = .626$, post-test scores: $F(1,147) = 0.002$, $p = .961$. The repeated measures ANOVA analyses showed that there was no change in students’ future plans between the pre- and post-training, $\lambda = .992$, $F(1, 147) = 1.175$, $p = .280$, $\eta_p^2 = .008$) for the entire sample of participants (experimental and control group). Further, there was no interaction effect of training by group $\lambda = .991$, $F(1, 147) = 1.319$, $p = .253$, $\eta_p^2 = .009$).

Individual Interest

Research Question 4 was concerned with the impact of utility intervention on individual interest. Levene's test was non-significant in both pre-test, $F(1,147) = 1.403$, $p = .238$, post-test scores: $F(1,147) = 0.038$, $p = .846$. A repeated measures ANOVA showed that there was a significant change in students' interests between the pre and post-training, $\lambda = .967$, $F(1, 147) = 4.960$, $p = .027$, $\eta_p^2 = .033$) for the entire sample of participants (experimental and control group). However, there was no interaction effect of training by group $\lambda = 1.000$, $F(1, 147) = 0.021$, $p = .885$, $\eta_p^2 = .000$). Thus, training was not effective in enhancing individual interest, although it increased over time for both control and experimental groups.

Relationship between Situational Interest and Individual Interest

Research Question 5 examined the correlation between Situational Interest and Individual Interest. Utilizing Pearson's correlation coefficient for analysis, the results (See Table 4) revealed a significant positive correlation between situational interest and individual interest, $r = .783$, $p < .001$.

Table 6

Pearson Correlations for Interest Variables

	1	2	3
Initial Situational Interest			
Initial Individual Interest	$.78^{**}$		
Situational Interest After	$.62^{**}$	$.54^{**}$	
Individual Interest After	$.52^{**}$	$.63^{**}$	$.79^{**}$

Note. ** $p < .01$ level.

Chapter V: Discussion and Conclusions

Summary and Interpretation of the Findings

The study's findings revealed a significant increase in both situational and individual interest between pre- and post-tests, while future plans remained unchanged. The intervention was effective only in enhancing the situational interest. The descriptive statistics and correlations demonstrated critical relationships between students' prior knowledge, situational interest, and future plans in the content.

Moreover, the analysis of correlation coefficients revealed a positive association between students' prior knowledge and their situational interests both before and after the intervention. This phenomenon can be interpreted through two distinct perspectives: A foundational understanding of computer science could impact students' interest in the domain, potentially leading to more engaged learners. On the other hand, the students' total interest in computer science may have acted as a catalyst, enhancing their academic performance in the subject.

The correlations (see Table 4) between various interest variables showed moderate to strong relationships that are indicative of substantial interdependencies among the interest variables. This highlights the varying degrees of association between different aspects of interest and related constructs such as prior knowledge. A strong correlation was observed between situational interest at the pretest and future plans at the pretest (r=.741, $p < .001$), which implies a significant relation between initial situational interest and students' aspirations. This suggests that initial interest in a subject could be a potent predictor of students' early intentions or plans related to that field of study. Moreover, the correlation between triggered situational interest at the pretest and maintained situational interest at the pretest was also high ($r = .866$, $p < .001$), indicating that initial triggers of interest were closely tied to the sustainability of that interest over time, at least in the short term.

Furthermore, the maintained situational interest from the pretest to the post-test exhibits a strong correlation (r=.982, p<.001), illustrating high situational interest stability over the studied period. This finding may point to the resilience of situational interest after it has been ignited. Additionally, the correlation between individual interest at the pretest and maintained situational interest at the pretest (r=.801, p<.001) highlights the critical role of personal interest in fostering a durable interest in the subject matter.

Lastly, the table reveals a correlation between interest at the pretest and individual interest at the pretest (r=.918, p<.001), signifying that general interest levels at the outset could be predictive of more specific, individualized interest. This correlation shows the interplay between broader interest constructs and their manifestations on a more personal level.

Understanding initial interest levels could be essential for effectively shaping learning trajectories and emphasizing interest's critical role in engagement.

The intervention's impact was limited to situational, with no observable changes in future planning or individual interest. This specificity suggests that while the intervention successfully engaged students in the class, it did not alter their broader long-term aspirations or personal interest in computer science. The implications for both research and practice are discussed in the next part.

Theoretical Implications

The analysis demonstrated increased situational and individual interest among students, confirming earlier studies that suggest interest can be enhanced through external stimuli. The observed shift in situational interest following utility-based intervention provides empirical backing for the stages of interest development proposed by Hidi and Renninger (2006). This study provides empirical validation for the effectiveness of utility interventions in stimulating the early phase of interest development, known as situational interest. The result supports the applicability of this theoretical framework in measuring how interest evolves in response to educational interventions.

On the other hand, the study did not demonstrate a statistically significant difference in individual interest and future plans between the intervention and control groups. This lack of a statistically significant difference points toward a theoretical implication that utility interventions, while adept at triggering initial situational interest, they may not alone be capable of engendering an enduring personal interest or solidifying future intentions. That is, the increase in student interest over time did not depend on the experimental manipulations but evolved naturally over the eight weeks. The lack of an interaction effect for individual interest concerning the interventions might suggest that the progression from situational to individual interest is not merely a function of external interventions but also significantly influenced by intrinsic factors and the maturation of understanding within the domain (Bruner, 1966). Considering the duration of the computer science class, one can argue that the students' experience, marked by their increasing knowledge and familiarity with the subject matter, might have contributed to a natural evolution of their interest. This progression aligns with the model's emphasis on deepening interest as learners collect knowledge and experience, transitioning from a shorter situational interest to a rich and enduring individual interest. Therefore, the absence of a significant difference between control and intervention groups may highlight the critical role of sustained engagement and accumulation of knowledge in the natural development of individual interest, independent of specific utility interventions. While interventions can initiate interest, the trajectory of interest development is inherently tied to the learner's continued engagement and deepening understanding of the subject matter, underscoring the significance of longitudinal exposure and interaction with the domain of interest. It is also plausible that the utility interventions employed were not sufficiently differentiated to evoke a distinct response between the control and intervention groups for individual interest. According to Hidi and Renninger's (2006) four-phase model of interest development, the transition from situational to individual interest requires sustained engagement and increasingly complex interactions with the subject matter. If the experimental and control conditions met the engagement threshold necessary to significantly influence this transition, this could account for the observed uniformity in interest development. Some students may have entered the study with a latent interest in computer science or related fields, which could evolve into a more potent individual interest, independent of the interventions, over time. This innate variability in interest could weaken the observable effects of the intervention, leading to a scenario where the natural maturation of interest across the classroom surpasses the differential impacts of intervention. The predisposition towards computer science may play a more pivotal role in the evolution of individual interest than the external manipulations designed to boost interest. This interpretation underscores the significance of considering learner variability in designing and evaluating educational interventions.

This insight reflects Renninger and Hidi's (2016) perspective, which views interest as a gradual, phased process, potentially extending over years. The implication here is that the duration of our intervention may have been insufficient for fostering a lasting interest in computer science, underscoring the complexity of interest development in the domain and suggesting a need for more extended or varied engagement strategies.

The findings emphasize the need for long-term studies to precisely track the evolution of interest over time, which questions the efficacy of short-term interventions. Enhancing the research methodology through integrating diverse data sources, for instance, conducting interviews with students who exhibited notable improvements in immediate and delayed posttest evaluations, could yield further information. Additional surveys may reveal potential reasons why the intervention did not work. For example, the intervention took place in the school environment, which is a formal setting. The program's possible impact may have varied in a non-formal setting to reduce potential negative attitudes that some students may have held. Further, they had a weekly writing task to solidify learning and ensure students acquired critical information. This structure makes the intervention quite formal, yet this could also be the reason for engagement due to the “burden” of such class assignments (Anderson et al., 2003; Boustedt et al., 2011).

Furthermore, delving into the environmental and social determinants that may shape interest development could clarify layers of complexity, highlighting the intricate relationship between motivational constructs and environment in the evolution of interests. A potential social determinant from students’ perspective is teachers’ capability to implement the program. Integrating the utility intervention into teaching requires teachers to change their regular course of teaching the subject, and such a change may require them to adapt to a new way of teaching. Research shows that there can be bias against novelty (Mueller et al., 2011), and integration of utility intervention may be considered a novelty when teaching a subject. The first opportunity to teach a class in a specific way may often be deemed “experimental,” and teachers’ level of ownership and capability to introduce the subject in this new structure may improve over time (Hattie, 2012). In this study, such an adaptation time was not feasible.

Studying the environmental factors influencing interests could uncover the complex interaction between motivation and the environment in shaping interests. Longitudinal research can be essential when seeking novel developments, factors affecting, and constraints to interest growth that short-term evaluations could have missed. This method enhances our understanding of the evolution of interests, guides the creation of educational interventions, and underlines the enduring impact of environmental and social influences on how individuals develop interests (Ainley & Ainley, 2019).

In conclusion, this research has highlighted the intricate nature of fostering interest development through educational interventions. While utility interventions show promising potential in igniting situational interest, their efficacy in sustaining this interest is constrained. To fully grasp and enhance the process of interest development, a comprehensive and integrative research approach is imperative. This study therefore calls for the embrace of long-term, multifaceted methodologies, underscoring the necessity to delve deeper into the mechanisms that underlie interest development and to devise interventions that effectively support lasting academic engagement.

Theories of Interest Development

The study verified previous research by demonstrating the interrelation between situational and individual interest, underscoring the role of prior knowledge in developing interest. When considered alongside Silvia's (2008) appraisal theory of interest, Krapp's (2002) person-object theory of interest development process, and Hidi and Reninger's (2006) four-phase model, these findings provide a multifaceted perspective on the dynamics of interest as a construct and the gradual evolution of interest from initial engagement to deep, sustained involvement.

Silvia's (2008) appraisal theory of interest explains the cognitive mechanisms underpinning interest genesis and progression. It asserts that individuals' assessments of stimuli, based on attributes such as novelty, complexity, and their perceived capacity to engage with these stimuli, are fundamental in surfacing interest. Interest arises from personal interpretations and appraisals of experiences. The correlations identified between situational and individual interests in the study echo Silvia's assertions, suggesting that continuous cognitive evaluations could have developed interest due to its dynamic, fluctuating nature.

The findings exemplify how individual interest, driven by personal appraisals of situational stimuli, fosters engagement and, consequently, situational interest. Silvia (2008) argued that the capacity to pursue information intensifies as an individual's knowledge base becomes more expansive. Thus, students exhibit interest in their educational endeavors due to positive cognitive appraisals of their abilities and the recurrent experience of interest (Connelly, 2011). The analysis of the total survey scores indicates that students maintained their interest after the intervention.

Krapp's (2002) POI development process analyzes the interaction between individuals and their environmental stimuli as a reciprocal and evolutionary process characterized by phases of emerging, stable situational, and well-developed interests. This model highlights the significance of setting and individual characteristics, such as prior knowledge, in modulating interest development. Prior knowledge enhances the triggering phase, facilitating a more favorable appraisal complexity and fostering sustained engagement and more profound interest development through the subsequent phases.

Hidi and Renninger's (2006) four-phase model detailed the stages of interest development. Their model provided a roadmap for understanding how interest evolves, synergizing with Silvia's and Krapp's theories and illustrating how cognitive appraisals, personal and environmental factors, and prior knowledge collectively influence the progression of interest development. The current study's findings can be situated within this model as evidence of how initial situational interests may evolve into deep, individualized interests over time. The model stresses the value of crafting learning spaces that cater to students' diverse intellectual and affective needs. This study showed that situational interest can be sparked and enhanced by particular scenarios in an educational setting.

Individual interest may respond to value interventions (Hulleman & Harackiewicz, 2009). However, the effectiveness of such interventions can be contingent upon several factors, including the specificity and relevance of the interventions to the student's pre-existing interests and the quality of implementation. However, the absence of a significant differential effect between control and intervention groups in the study suggests that while value interventions have the potential to influence interest, their impact may be moderated by other (external and intrinsic) factors, such as content perceptions and the inherent motivation of students (Ainley & Ainley, 2011).

The development of individual interest is not a static phenomenon but a process that unfolds over an extended period. It is influenced by sustained engagement and a deepening understanding of the subject matter, factors that educators and researchers can actively promote. The classroom environment, including exposure to curriculum and peer interactions, likely plays a significant role in nurturing this interest (Renninger & Hidi, 2016). Given the study's duration, it is reasonable that individual interest in computer science requires more than the observed short period to manifest significant differentiation in response to interventions, suggesting a gradual maturation that extends beyond immediate educational interventions.

The possibility that the lack of findings is an artifact of the measurement method cannot be discounted. Using surveys to measure interest changes may not capture the nuanced evolution of individual interest or the multifaceted nature of educational interventions' impact (Fredricks et al., 2019; Greene & Azevedo, 2010; Renninger & Hidi, 2016). This limitation underscores the urgent need for a more robust and multidimensional approach to measuring individual interest, which could include qualitative assessments and longitudinal tracking. By adopting such an approach, we can more accurately gauge interest development over time and enhance the validity of our findings.

In conclusion, the study's findings indicate that while individual interest can respond to value interventions, developing such interest is likely a complex interplay of factors, including external influences, intrinsic motivation, and the cumulative impact of educational experiences over time. The measurement method may also influence the observed outcomes, suggesting that future research should employ a multifaceted approach to capture the dynamics of interest development in educational settings accurately.

Educational and Practical Implications

The significant increase in students' situational interest as a result of the utility intervention underscores the potential of utility interventions in enhancing engagement. When students perceive the utility of their learning, their interest in the material can be significantly supported. This stresses the importance of incorporating practical applications and relevance into educational content. The absence of an interaction effect between training and group in future plans a personal interest implies that the utility intervention has a limited influence on student interests and thus such interventions could be broadly implemented in educational settings to promote student interest more effectively. On the other hand, although the intervention led to a significant increase in student interest, the small effect indicates that while utility interventions can enhance student engagement, they may need to be part of a multifaceted approach that includes other motivational and engagement strategies to have a more profound impact.

In educational studies, researchers classified interest into individual interest and situational interest. These classifications vary in terms of the duration and origin of the interest (Ainley et al., 2002; Alexander & Grossnickle, 2016; Hidi & Renninger, 2006; Schiefele, 2009; Schraw & Lehman, 2001). Krapp's developmental model of interest (2002, 2005) laid the foundation for understanding the evolution of interest, presenting a pathway that begins with an initial situational interest sparked by environmental stimuli and progresses toward a deeply rooted individual interest.

Krapp's (2002) work documented the transformative potential of early situational experiences in fostering a long-lasting individual interest, highlighting the importance of early engagement. Building on previous research, Hidi and Reninger's FPMI (2006) further outlined the advancement of interest through distinct, interconnected phases. The model emphasized the importance of the level and quality of participation in stimulating interest, delivering a comprehensive analysis of how situational interest evolves into enduring interest. Following these theoretical advancements, empirical research by Linnenbrink-Garcia et al. (2010) provided concrete evidence that situational and individual interests, though distinct, are mutually reinforcing. Their findings revealed that enhancing situational interest effectively promotes the growth of durable individual interest in academic disciplines, underscoring the correlative relationship between these interest forms. Moreover, the study by Rotgans and Schmidt (2017) on the complex interplay between personal and situational interests further enriched the understanding, indicating that the positive correlation between these two types of interest has a dynamic and multifaceted nature.

This investigation enhances our insight into the variability of interest by substantiating the connection between interest phases, aligning with examinations conducted by previous scholars, especially Krapp (2002), Hidi and Reninger (2006), and Linnenbrink-Garcia (2010). Additionally, the findings confirm earlier research, revealing a significant positive correlation between situational and individual interest. This agreement substantiates the theoretical proposition and highlights the crucial role of engaging contexts in generating situational interest. The results endorse the theory that supporting situational interest might strengthen other motivational constructs. It may also emphasize the importance of recognizing and leveraging this relationship to improve engagement in academic tasks.

This study's outcomes support existing research, which shows a correlation between pre-existing knowledge and interest. Shapiro (2004) emphasized that prior knowledge markedly affects learning outcomes. Previous knowledge is a scaffold for new information, enabling students to integrate what they already comprehend with the presented concepts. This connectivity facilitates comprehension and enhances the relevance of the latest content, making it more exciting and engaging for the students. When students see the connection between their prior knowledge and new concepts, it fosters a sense of competence and confidence, which are critical components of intrinsic motivation. Moreover, previous knowledge can help students identify personal relevance in the subject matter, increasing their interest and engagement (Simonsmeier et al., 2022; Tobias, 1994; Witherby & Carpenter, 2021). An essential element of appraisal theory is the influence of pre-existing knowledge. This knowledge is crucial in determining one's ability to cope by evaluating intellectual resources and understanding the complexity of new challenges (Connelly, 2011).

Integrating motivational principles into learning tasks in educational settings, especially in computer science, can profoundly enhance students' situational and individual interests. For instance, students can design their apps. This task incorporates the principles outlined by Turner et al. (2015). It fosters autonomy by allowing students to lead their projects. It supports competence through the establishment of gradual steps. Besides, peer reviews promote a sense of belongingness. Linking these projects to real-world applications could make learning meaningful and relevant. Similarly, Hay et al. (2015) emphasized the importance of aligning educational tasks with students' interests. A relevant computer science project could involve students in analyzing and optimizing video game algorithms, appealing to their existing interests while enhancing their attention and self-confidence.

Furthermore, Rotgans and Schmidt (2011, 2017) advocated for problem-based learning, which could be implemented in a computer science class through a collaborative project to develop a software solution for a local business's needs. Such real-world problem-solving increases situational interest and may help students see the impact of their skills, potentially nurturing long-term individual interest. As suggested by Tapola et al. (2013) and Dohn (2013), enhancing task design with stimulating features can further captivate students' attention; for example, creating a digital escape room requires integrating coding challenges that evoke creativity and critical thinking. Additionally, extracurricular activities like coding clubs focusing on technologies such as virtual reality or AI, as studied by Lakanen and Isomöttönen (2018), provide diverse possibilities for students with varying levels of prior experience to develop interest. Lastly, Ko and Davis (2017) highlighted the value of mentoring in teaching. This can be realized through semester-long projects or internships where industry professionals mentor students. Such arrangements provide personalized guidance and offer insights into the real-world applications of computer science.

In introducing a new coding module focused on developing simple applications, the emphasized impact of prior knowledge on interest can be observed through different students' experiences; a student who has engaged with basic coding through online tutorials may bring a foundational understanding of programming logic to the course. This prior knowledge facilitates their quick connection with the new material, making the content intriguing and relatable. As a result, the student will be motivated to explore more complex coding challenges, viewing them as an extension of their existing knowledge base. Conversely, a student lacking sufficient prior exposure to coding is more likely to struggle with understanding basic concepts. This absence of foundational knowledge could impede their ability to engage with the material, affecting their overall interest in computers. The struggle highlights the vital function of prior understanding within the process, particularly in engaging with and sustaining interest in new academic content. These outcomes collectively stress the critical role of previous experience and situational interest in guiding students' participation in computer science and their prospective plans in the discipline. The positive correlations suggest that educational strategies that recognize this factor may effectively promote sustained interest and commitment to computer science careers.

In sum, the study demonstrated that a motivationally supportive curriculum may guide students in establishing connections to the subject matter. Students who perceived computer science as relevant and essential exhibited higher interest levels due to the critical role of perceived relevance and value Students can be driven to sustain their interest by engaging in relevant activities such as self-generated utility tasks. The findings prompt further reflection on how different types of utility interventions might affect various aspects of student learning and engagement, particularly in subjects or areas where student interest is descending. This could help educators design curricula that cater to the interests of all students

Reflections on the Fidelity of Implementation

The study implemented a controlled experimental design method using writing tasks as self-generated utility interventions. However, the data analysis showed no significant changes in individual interest and future plans between the groups. While the intervention was theoretically grounded and aligned with Hulleman and Harackiewicz's (2009) interventions in other domains, the lack of observable effects suggests potential shortcomings in the execution or delivery of the intervention within the school setting. The observed outcomes may have arisen from deficiencies in implementing the program as per its intended design. This could have hindered the program's ability to fulfill its objectives and deliver the desired results. The results may suggest the complexity of translating research findings into practice. Further investigation into the factors influencing fidelity, such as teacher training, improved communication, student engagement, and contextual characteristics, is warranted to inform designs to measure motivation in middle school settings.

It is important to note that the participating teachers were not licensed specialists in computer science. Their primary expertise did not align with the content of the intervention, potentially leading to less effective delivery of the computer science curriculum. This situation mirrors a broader challenge within the educational system, where schools often hire non-licensed teachers to fill vacancies caused by a shortage of trained and specialized teachers. These practices compromise educational quality, as teachers may lack the essential pedagogical tools required for instructing in complex domains such as computer science (Fincher & Petre, 2004;

Mouza et al., 2018; Yadav & Berges, 2019; Yadav & Korb, 2012). Successful teaching demands content expertise and the skill to communicate this knowledge in ways that are both accessible and engaging for learners (Ball et al., 2008; Shulman, 1986). Consequently, the observed lack of significant changes in motivation among students might not necessarily reflect the intervention's ineffectiveness but rather the consequences of deploying educators without specialized content knowledge and pedagogical skills. This study underscores the critical need for educators knowledgeable in their subject areas and skilled in the pedagogical strategies tailored to their specific disciplines.

Limitations

Studying student motivational components is difficult since many contextual elements influence them. Interest, a complex phenomenon, is influenced by personal and environmental elements such as development, self-efficacy, family and peer support, and the classroom atmosphere, making it challenging to identify the effects of specific interventions (Deci & Ryan, 1985; Schunk et al., 2014). Addressing these variables in future studies could offer deeper insights into tailoring motivational strategies. Furthermore, interest is dynamic, evolving with academic challenges, personal growth, and changes in the educational setting (Hidi & Renninger, 2019). Conducting a longitudinal study may help understand how interest changes and develops over time. The subjective nature of interest complicates its assessment, with self-report methods potentially biased by social desirability or inaccurate self-evaluations (Fredricks et al., 2019; Greene & Azevedo, 2010; Renninger & Hidi, 2016). Given its multifaceted dimensions, including psychological states and motivational factors, existing measures may only partially capture the full extent of the construct. Using a combination of different research approaches might provide a more thorough understanding. Addressing these problems in future research is crucial to creating successful pedagogical techniques in computer science education.

Future Directions

In light of the intervention's short-term effects, future research is warranted to examine the sustained influence of motivationally enhanced curricula on computer science interest. Future studies could determine whether situational interest is sustained over time and how it influences students' choices in pursuing further coursework or careers in computer science.

Exploring the role of contextual factors on the efficacy of utility value interventions also presents a promising avenue. Examining these interventions across diverse geographical and demographic settings could illuminate the interplay between cultural contexts and the effectiveness of motivational strategies.

In light of these findings indicating that self-generated utility intervention study may influence situational interest in computer science, it becomes imperative for researchers and curriculum designers to reassess and expand their instructional strategies to foster situational interest. More personalized experiences, tailored to meet diverse interests and needs, may be used to promote inclusive and engaging conditions. Such customization could ensure that learning activities resonate with students' goals and interests, increasing their motivation.

Future research should consider the impact of individual differences among students and how these variations influence responses to specific interventions. Qualitative methods such as focus group interviews can provide essential insights into students' subjective experiences. Such qualitative data could specifically describe why specific interventions are more effective for different students. A mixed-methods approach, where these qualitative techniques complement traditional survey methods, could offer an understanding of intervention impacts.

Further investigation is also necessary in less formal learning environments. These settings, such as before and after-school clubs, voluntary undertakings, and internships, provide alternative educational contexts that might work differently with diverse student groups. They can also demonstrate how personalized teaching methods and teacher-student interactions influence learning outcomes, known as the 'teacher effect' (Blazar & Kraft, 2017). To gather this data, qualitative methods like surveys and interviews with teachers could uncover valuable perspectives on their instructional experiences and perceived student changes.

Lastly, research could investigate external factors. For instance, the availability of technology resources, peer influence, and community engagement in activities are significant external factors impacting student motivation and interest (Li & Xue, 2023; Schindler et al., 2017). Future studies should examine how these factors interact with educational interventions in both formal and informal educational settings. By understanding these dynamics, researchers can design interventions that are effective in diverse settings.

Conclusion

The present study showed that utility intervention can effectively enhance situational interest, whereas it fell short of enhancing personal interest and future plans. The positive correlation between pre-existing knowledge and situational interest suggests its potential influence on enhancing engagement and interest. However, future experimental research is needed to examine this correlational, hence the bidirectional relationship. The positive correlation between situational and individual interests may suggest that students already interested in a topic may demonstrate heightened cognitive and affective engagement when the learning environment is supportive. However, the direction of this link remains unclear.

This study advocates for a comprehensive strategy to enhance student engagement in computer science. By adopting evidence-supported methodologies, educators can prepare circumstances that accommodate and actively stimulate interest and motivation. Future studies are called for to examine the complex interactions between prior knowledge, individual interest, and intervention methods and to track the evolution of interest over time. More research is required to comprehensively comprehend the mechanisms of interest development, guiding more effective educational strategies.

Appendices

Appendix A: List of Definitions

Dewey, J. (1913)	Interest can boost learning. Interest generates learning and effort. The teacher must provide opportunities to promote interest, and the student should put in effort.
William, J. (1925)	"The moment a thing becomes connected with the fortunes of the self, it becomes interesting." Some objects or situations are interesting in themselves and originally.
Allport, G. (1937)	Once developed from a functionally autonomous dynamic system, interest drives a person's action and pursuit of engagement with a particular object.
Asher, S.R. (1979)	"Something is interesting when you like it and would like to find out more about it." (p. 687)
Bandura, A. (1986)	"Interest grows from satisfaction derived from fulfilling challenging standards and self-perception of efficacy gained through accomplishments and other sources of efficacy information" (Bandura, 1986, p. 242).
Hidi & Baird (1986)	"Interest is an affect which is created when a person responds to a situation of special significance." (p. 184)
Krapp et al. (1992)	"Situational interest: response to an environmental feature that catches one's attention and engagement. Individual interest is a stable disposition that develops over time and is usually associated with increased knowledge, positive emotions, and reference value." (p. 6)
Schallert & Reed (1997).	Interest is a trigger to attention deployment.
Sansone & Smith (2000)	"involvement" and "feeling like it" (p. 344)
diSessa, A. (2000)	Interest is contingent (depends on circumstances), falls in patterns (similar activities), comforting and generative (p.78-80)
Silvia, P (2001)	"Differentiates between interest as an emotional response and interests as self-sustaining motives that lead a person to engage with certain activities or topics for their own sake."
Schraw & Lehman (2001)	"Personal interest is an intrinsic desire to understand a particular topic that persists over time. It is a cognitive and affective quality that individuals carry with them from place to place.

	Situational interest is a kind of spontaneous interest that appears to fade as rapidly as it emerges and is almost always place-specific” (p.24)
Boekaerts, & Boscolo (2002)	Interest occurs when a person engages with an object or domain in the environment.
Hidi & Renninger (2006)	“a psychological state characterized by an affective component of positive emotion and a cognitive component of concentration" (p. 460).
Biederman & Vessel (2006)	‘‘hunger for information.’’
Ainley, M. (2007)	Interest is related to choices and decisions made during task engagement and students' disposition to tasks.
Izard, C. (2007)	A primary positive emotion expression that “occurs frequently in response to novelty, change, and the opportunity to acquire new knowledge and skills.” (p.264)
Durik & Harackiewicz (2007)	“Interest is a particular relation between a person and a content area (e.g., task, topic, or domain) characterized by focused attention and heightened engagement.”
Silvia, P. (2008).	“Interest is an eccentric emotion.” It promotes learning and discovery.
Schiefele, U. (2009).	“positive feeling- and value-related attributes (e.g., excitement)”
Eisenberg & Aselage (2009)	Interest is the enjoyment of one’s work for its own sake. (p. 96)
Renninger & Hidi (2011)	“Five characteristics define interest as a motivational variable (which involves focused attention and engagement): (1) it is content or object specific, (2) based on the interaction between a person and the environment; (3) it has cognitive and affective components and (4) a neurological basis; and (5) it may act on a learner out of their awareness.”
Dohn, N.B. (2013)	“Interest is, to some extent, a situated phenomenon, and that the content and meaning of the interesting object or activity in question is mediated by the social context” (p.2060)
Hagay & Baram-Tsabari (2015)	“Information seeking can be used as a behavioral indicator of interest” (p. 953)
Harackiewicz, Smith & Priniski (2016)	“Interest is increased attention, effort, and affect toward a particular object or topic and an enduring predisposition to reengage over time.”

Trautwein, U., Nagengast, B., Roberts, B. & Lüdtke, O. (2019)	"Interests describe "what individuals want to do." (p. 360)
Pekrun (2019)	"Intrinsically motivated engagement with any specific object, content, or activity."

Appendix B: The Four Phases of Interest Development

	Less-Developed (Earlier)		More-Developed (Later)	
	phase 1 – triggered situational interest	phase 2 – maintained situational interest	phase 3 – emerging individual interest	phase 4 –well-developed individual interest
Definition	Psychological state resulting from short-term changes in cognitive and affective processing associated with a particular class of content.	Psychological state that involves focused attention to a particular class of content that reoccurs and persists over time.	Psychological state and the beginning of relatively enduring predisposition to seek re-engagement with a particular class of content over time	Psychological state and a relatively enduring predisposition to reengage a particular class of content over time
Learner Characteristics	Attends to content, if only fleetingly May or may not be reflectively aware of the experience May need support to engage from others and through instructional design May experience either positive or negative feelings.”	Reengages content that previously triggered attention Is developing knowledge of the content Is developing a sense of the content’s value? Is likely to need to be supported by others to find connections to content based on existing skills, knowledge, and prior experience Is likely to have positive feelings.	Is likely to independently re-engage content Has stored knowledge and stored value Is reflective of the content Is focused on their questions Has positive feelings”	Independently reengages content Has stored knowledge and value Is reflective of the content Is likely to recognize others’ contributions to the discipline Self-regulates easily to reframe questions and seek answers Appreciates and may actively seek feedback Can persevere through frustration and challenge to meet goals

(Taken from Hidi and Renninger, 2019)

Appendix C: Sample Interest Intervention Studies

Study	Intervention Type	Domain	Sample, N, Country	Method	Instruments	Result
Hulleman & Harackiewicz, 2009	utility value, relevance	Science	262 HS Students	randomized field experiment	Self-report	increased science interest Improved performance Low success expectations No race interaction No gender interaction
Canning & Harackiewicz, 2015	perceptions of utility value, directly communicated and self-generated utility value	Math	134 Undergraduate Students	random, experimental	Self-report	Students with low self-confidence benefit from indirect instruction more than direct instruction.
Durik, Shechter, Noh, Rozek, & Harackiewicz, 2015	utility value, the directly-communicated utility of a novel math technique	Math	62 Undergraduate Students	random, experimental	Self-report	Students who learned about the strategy's benefits were more interested and learned more.
Sansone, C., Thoman, D., & Fraughton, T. (2015).	Strategy usage-effective self-regulation of interest	Science	Undergraduate		Self-report	Strategy use and self-regulation increase interest and performance.

Harackiewicz, Rozek, Hulleman, & Hyde, 2012	the utility value of STEM Parents talk to the student	Math	188 HS Students	random experimental	Survey, Self-report	Increased interest
Sansone, Fraughton, Butner, and Zachary (2013)	utility value information added	(HTML) programming	Undergraduate students	controlled experimental study	survey	increased interest, spent more time on the topic, and interested students spent more time on optional tasks. Increased engagement: Although students do other tasks, they are still engaged and working.
Knogler, Harackiewicz, Gegenfurtner, & Lewalter, 2015	strategies for problem-based instruction	Environmental Science, climate change	327 HS Students (9th and 10 Grade Gymnasium students) Germany	experimental	Survey	situation-specific effects could generate situational interest
Linnenbrink-Garcia, L., Durik, A. M., Conley, A. M., Barron, K. E., Tauer, J. M., Karabenick, S. A., & Harackiewicz, J. M. (2010)	shifts between phases of situational-individual	Study(S) I: Psychology (College S2&3: Math (Secondary)	SI: 858 Undergraduates S2: 282 7-12 Grade Students S3: 246 7-12 Grade Students	experimental	Survey, Self-report	Confirmatory findings for “the four-phase model of interest development.” A correlation between “triggered situational interest and maintained situational interest” was found.

Lakanen and Isomöttönen (2018)	extra-curricular computer workshop, lecture, intensive course	Computer, Game Design	197 12–18-year-old students. MS and HS Students from Lithuania	longitudinal study	Survey, retrospective questionnaire, Qualitative inspection	More than half of the students (57%) developed an interest in Computer Science (CS); however, 46% experienced students did not experience higher increase or their interest level decreased.
Ko and Davis (2017)	mentoring	Computers	44 14-18-year-old students' Low income, immigrant	experimental	survey, self-report	Mentoring proved effective in increasing interest. Students benefitted from the process. Race, gender, and type of programming were not found to be significantly related.
Sansone, Fraughton, Zachary, B., & Heiner, (2011)	utility value	Computers (HTML Programming)	108 Undergraduate	experimental	survey, self-report	Individuals with well-developed interests did not receive additional value.
Bong et al. (2000)	self-efficacy	Math and Science	7000 Korean Secondary School Student	Cross-sectional and longitudinal Study	survey, self-report	Interest precedes self-efficacy, and gender differences account for interest and self-efficacy in math and science. Girls have low interest and a poor perception of competency in Math. Math instructors should revise course design and appeal to interest.

Kim, Jiang, and Song (2015)	utility value, engagement	Math	18907 students in 6th, 9th and 10th grade		survey, self-report	Interest predicted engagement and achievement. In higher grades, the effect of interest increased interest should be facilitated instead of stressing the benefits
Durik and Harackiewicz, (2007).	utility value	Math	S1: 96 College Students S2: 145 College Students	experimental	survey	Students with higher interest achieved higher scores, and they underscored the importance of interest in learning math.

Appendix D: Intervention Activities

ACTIVITY A: Writing Prompt

Connecting Classroom Learning to Your Life Think about why what we are learning in class matters to you. Can you find a link between what we are studying and something important in your life? Please write a few sentences below about how the things we are learning in Computers connect to things that matter to you.

Adapted from Hulleman et al. (2018).

ACTIVITY B: Writing Prompt

Reflecting on Your Purpose for Learning

Now that we have reviewed this unit's main topics and ideas let us consider one specific topic or idea.

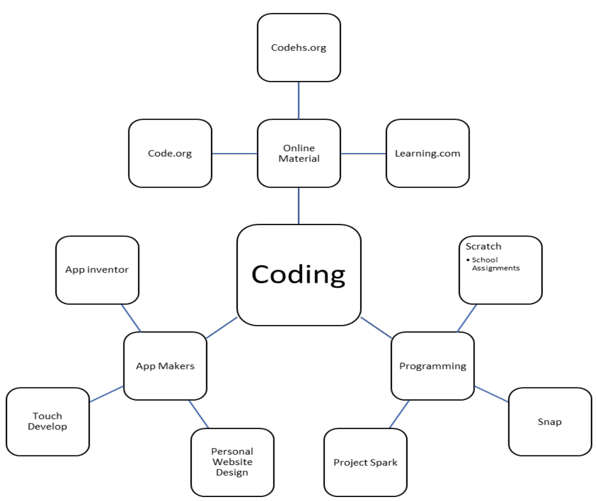
Part A: Choose one of the topics or ideas we learned in this unit and briefly explain its main parts.

Part B: Consider how this topic or idea relates to your life or the life of someone you know. How could learning about this topic be helpful in everyday situations? How might understanding this topic affect your plans?

You have three options for responding:
1) Write about it in at least five sentences.
2) Create a concept map with a description.
3) Sketch with a description. If you choose to draw, explain it well enough so others can understand it.

For example, if you were studying or learning coding, think about programming, tools, and resources you could use to learn. Then, you could write about how this applies to your own life. For example,
Learning coding could help you create innovative designs that you have thought of before.

You could also draw a concept map of how your coding knowledge applies to your life. An example is provided below. Remember that you would also need to add a brief written description with a concept map or diagram.



Adapted from Hulleman and Harackiewicz (2009)

Activity C: Writing Prompt

What do you like to do for fun? What are your hobbies? Do you have any goals you want to achieve?	What have you been studying in class lately? What subjects or topics have you been learning about?
1	2
Think about things you like in Box 1 and things you have learned about in class in Box 2. Draw lines to connect anything you think is related.	
Complete the sentence by describing how something you like or have experienced connects to what you have learned in class: ______________________________and ______________________________ (*interest from Box 1)* (*topic from Box 2)* are connected because____ ____ ____ ____	
4. Think more about how what you like or know relates to what we have learned in class by finishing this sentence: ______*(Topic from 4)*________could be necessary to my life because (it might help)	

Adapted from Character Lab Material by Hulleman and Harackiewicz (2019)

BUILD CONNECTIONS FOR CLASSROOMS: FACILITATION GUIDE

"How to use: Before using Build Connections, students should understand the purpose and unpack examples. We recommend this sequence:

1. Prep Activity: Includes student stories, or you could develop your own.
2. Animation: www.characterlab.org/build-connections
3. Examples (Student + Teacher)
4. Student Activity

How should I prepare to lead this activity?

Before you lead it with students, try the activity yourself. While you practice,

reflect on your process and the thinking you use. This will help you model the activity and coach students.

What helps students build the most vital connections?

Students will grow from practice. However, if they seem stuck, keep in mind these tips:

1. Students might feel "locked in" to their first connection. Please encourage them to branch out and be creative.

2. Connections can start with personal interests OR class content. Please encourage students to approach it from both sides.

3. Connections might be necessary now or in the future. Consider both when brainstorming.

What should I do after the activity?

Reviewing student responses is a great opportunity to learn more about students and to see what content is meaningful for them. If you give feedback on their connections, focus on helping students elaborate or clarify. Going forward, you could use student connections in lesson openers and examples.

How can this activity be extended?

These student connections are great starting points for individual research and project-based learning. Encourage students to pursue and deepen their connections. You can also deepen connections by having students write a letter to someone else who would benefit from the connection.

What is most important as I adapt this for my classroom?

The core of Build Connections is making space for students to reflect on how school can connect to their own passions. Details might change, but at the end of the day, if students make school meaningful on a personal level—or even just start this process—this activity will be a success. Not every student will make a connection every time, but just offering the activity can benefit students.

Appendix E: Situational Interest Scale

T1	My computer teacher is exciting.
T2	When we do computers, my teacher does things that grab my attention.
T3	My computer class is often entertaining.
T4	The computer class is so exciting it is easy to pay attention.
M5	What we are learning in the computer class is fascinating to me.
M6	I am excited about what we are learning in computers.
M7	I like what we are learning in computers.
M8	I find the computer class interesting.
M9	What we are studying in the computer class is useful for me to know.
M10	The things we are studying in the computer class are important to me.
M11	What we are learning in the computer class can be applied to real life
M12	We are learning valuable things in the computer class.

Note. T represents triggered interest, while M represents maintained interest.

Adapted from Situational Interest Scale developed by Linnenbrink-Garcia, Durik, Conley, Barron, Tauer, Karabenick, and Harackiewicz (2010). Rated on a 5-point Likert scale ranging from 1 (not all true for me) to 5 (very true for me).

Appendix F: Individual Interest Scale

II1	Computer Science is practical for me to know.
II2	Computer Science helps me in my daily life outside of school.
II3	It is important to me to be a person who is competent at using computers.
II4	Having computer skills is an important part of who I am.
II5	I enjoy the subject of computers.
II6	I like computers.
II7	I enjoy learning about computers.

Note. II stands for Individual Interest.

Adapted from Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1993). Rated on a 5-point Likert scale ranging from 1 (not all true for me) to 5 (very true for me)

Appendix G: Future Plans Scale

FP1	My experience in this class makes me want to take more computer courses.
FP2	I want to have a job that involves computer science someday.
FP3	I plan on taking more computer courses even when I do not have to.

Adapted from Self-Reported Survey (Hulleman & Harackiewicz, 2009)
Rated on a 5-point Likert scale ranging from 1 (not all true for me) to 5 (very true for me)

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Education

Bachelor of Arts - *Education, English Language Education*
Boğaziçi University

Master of Arts- British Studies
Multi/Interdisciplinary Studies Master's program: Management, Economy, Law, Political Systems, Cultural Studies, Literature, History
Dissertation Title: *From Quality to Excellence: A Comparison of Quality Management Models.*
Humboldt University

Licenses & Certifications

Psychology - Nevada Department of Education
English As a Second Language Teacher - Nevada Department of Education
English - Nevada Department of Education
School Administrator - Nevada Department of Education