Defining Gaps in Student Affect Research for Computer Science

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Abstract

Understanding what we know and what we need to know in the larger corpus of research studies is important if we want to grow the body of education research in computing. While in years past, it would be challenging to understand where the gaps in research are, the CAPE framework and Extended CAPE framework provide categories of factors that may influence student outcomes in computing education. In particular, affective factors, like interest in CS, attitudes towards CS, and interest in computing careers, have been shown to play a part in continued learning and learning outcomes. Thus, our research question for this study was: *What is the landscape of K-12 computer science education research related to affective aspects of students' experiences?* Leveraging data from a new set of data being used in a large-scale metasynthesis, our team analyzed data extracted from papers published in 2021 to mid-2024 (inclusive), which totaled 351 studies. Of these studies, we found that half (n = 175, or 49.9%) of the studies had at least one Affect related outcome. Other Affect subcategories appeared in fewer than 1% of papers (less than 4 papers): Anxiety (Computing), Attitudes toward Computers, Comfort, Curiosity, Enjoyment. And several Affect subcategories did not appear in any studies. While some Affect topics have good coverage, which is promising, the dearth of research studies on some affective factors suggests gaps in the research that may contribute to less optimal student experiences.

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1 Introduction and Background

Affective factors (e.g., attitudes such as interest in computer science (CS), attitudes towards CS, and interest in computing careers) play an important role in influencing students' experiences when learning CS. In turn, students are also influenced by their experiences in CS, especially for students who are traditionally less likely to study CS [8]. Some affective factors, like students' interest in CS, have been well studied and can often be used to measure an intervention's outcomes, particularly if the intervention is designed to engage students and drive student interest (such as summer camps).

The CAPE Framework [6] has become a useful tool for studying CS education interventions. The four CAPE categories (capacity, access, participation, experience) were decomposed into subcomponents, categories, and subcategories in the Extended CAPE Codebook (ECC) [11]. The Codebook is designed for researchers and evaluators to create a more comprehensive taxonomy of factors related to the CS education infrastructure and to understand how the the components interact. For example, the Experience component is decomposed in the Codebook into four major subcomponents: Content Knowledge, Learning Strategies, Social-Familial Influences, and Student Engagement. Student Engagement is further divided into three categories, Affect, Behavior, and Cognition, each of which are divided into their own subcategories.

This poster focuses on the Affect category of the ECF to better understand the landscape of research concerning this important factor in students' experience of CS instruction. Our research question is *What is the landscape of K-12 computer science education research related to affective aspects of students' experiences?*

2 Methodology

As part of a larger metasynthesis study, we compiled a dataset of research studies (i.e., excluding position papers and posters) related to K-12 CS education (defined broadly; e.g., including computational thinking), based on EBESCO and ERIC searches for related research. Our keywords were ("Elementary school" OR "primary school" OR "secondary school" OR "high school" OR "middle school" OR "K-12") AND ("computer science" or "computing" OR "computational thinking"). Our inclusion criteria for papers were:

- Include PreK-12 CS education?
- Have a methods section?
- Have a direct effect on students?
- Investigate student experiences while learning CS?

We used the subset of our dataset that included studies published from 2021 to mid-2024 (inclusive), which totaled 351 studies. Using

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Table 1: Common Affect Subcategories in the Dataset

Subcategory	Percent	Count
Interest (Computing)	10%	35
Collaboration	9%	33
Enjoyment (Learning CS)	8%	29
Attitudes toward CS/CT	6%	21
Perceptions	5%	19
Attitudes toward Programming	4%	15
Satisfaction	4%	15
Belonging/Stereotypes (in CS)	4%	13
Identity (Computer Science)	4%	13
Interest (Computing Careers)	4%	13
Attitudes toward Collaboration	3%	11

the ECF of 23 Affect factors, four researchers coded each study's outcomes according to which aspects of student affect (if any) were part of the study. For example, one study in the dataset explored the impact of introductory programming lessons on young Swedish students' attitudes toward programming [9].

3 Results

Half ($n = 175$) of the studies had at least one outcome related to some aspect of student affect. Some Affect subcategories did not appear in any studies in the dataset: *Attitudes toward Academic Success*, *Empathy*, *Friendship*, and *Social Value*. Other Affect subcategories appeared in fewer than 1% of papers ($n = 4$): *Anxiety (Computing), Attitudes toward Computers, Comfort, Curiosity, Enjoyment (Computers), Excitement, Relevance*, and *Support*. The other Affect subcategories appear in Table 1.

4 Discussion and Conclusion

Given the importance of affective factors in students' CS experiences, it is encouraging to find that half of recent relevant studies explored at least one affective factor. A robust research base concerning students' attitudes, identity, interests, perceptions, and so forth sets the groundwork for implementing CS education in a manner that promotes positive experiences for K-12 students.

At the same time, the dearth of studies on some affective factors suggests gaps in the research that may contribute to less optimal student experiences. It is particularly concerning that many of the least commonly studied topics are often traditionally construed as the concerns of girls and of women, including empathy [10], friendship [3], and social value [5]. Empathy has also been identified as a key component of effective software design [4, 7], pointing to the importance of studying empathy within CS education.

Other research shows that friendships help women of color navigate their CS studies [12] and that whether students are friends influences their success when pair programming [13], suggesting that future research into the impact that friendships have on students' CS experiences is warranted. Similarly, research suggests that student interest and positive attitudes increase when the social value of the discipline is made clear to them [1, 2], including among students who are traditionally less likely to study computing.

In sum, the aspects of student affect that are the least likely to be included in research outcomes in our dataset are often related to gendered concerns, and these topics also have evidence of being important to student learning outcomes. Thus, expanding CS education research to yield a better understanding of these affective factors has the potential to result in substantial improvements in CS education.

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