Exploring Computational Thinking: The Impact of Age, Gender, and Socioeconomic Status

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Background

In China, family education plays a crucial role in children's development and academic achievement. Parents' educational expectations and approaches significantly influence their children's cognitive, emotional, and social development [1]. With the rapid advancement of technology, computational thinking has become a key competency, regarded as one of the essential skills of the 21st century [2]. Computational thinking goes beyond programming and involves problem-solving, systematic thinking, and understanding complex systems. Integrating computational thinking into education can better prepare students for future challenges.

Gender equality in education is discussed a lot in today's society. There are some study shows that traditional gender roles limit women's opportunities, such as a lot of people still have the opinion that men can do better than women in some engineering fields [3]. Gender differences also exist in computational thinking education. Therefore, promoting gender equality and computational thinking education in family education can improve education quality and advance social equity and progress.

Socioeconomic status (SES) also significantly impacts educational opportunities and achievements. Research indicates that families with higher SES are more likely to provide quality educational resources and support, thus fostering their children's computational thinking abilities [4]. Therefore, exploring the impact of age, gender, and socioeconomic status on computational thinking abilities in the Chinese context is essential for achieving educational equity and comprehensive development.

Methods

- **Participant Recruitment**
  - 290 children from grades 1 to 4 in primary schools in Hangzhou and Hohhot, which are both second-tier cities from three different provinces and can represent the educational development levels of different areas, participate in the study;
- **Data Collection**
  - Using Children's Computational Thinking Assessment Tool [5] to measure participants' computational thinking
    - Seven Dimensions in Computational Thinking: Variables, Control, Modularity, and Algorithms;
  - Children's Computational Thinking Skill Test:
    - Get the basic data about children's computational thinking skills based on four different testing models;
  - Parents' Basic Information Survey
    - Get basic background information about the child participants based on their parents' basic information from five dimensions;
  - Community Information Survey
    - Some additional related information is collected from this survey, such as the impact of different school environments on the participants.
- **Data Analysis**
  - IBM SPSS Statistics is used for data analysis
  - The relationship between gender and computational thinking, the relationship between socioeconomic status (SES) and computational thinking, and the relationship between age and computational thinking, are analyzed individually.

Results

Table 1: The Relationship Between Age, Socioeconomic Status, and Children's Computational Thinking

Variables	Age	Father's Education Level	Mother's Education Level	Household Income
Assign	.306**	.201*	.232**	.264**
Type	.286**	.201*	.244**	.337**
Condition	.245**	.299**	.300**	.407**
Loop	.330**	.258**	.278**	.275**
Decomposition	.324**	.159*	.159*	.199*
Function	.332**	.126	.107	.166
Algorithm 1	.209*	.214**	.246**	.214*
Algorithm 2	.163*	.107	-.043	.006
Algorithm 3	.303*	.198*	.255**	.265**
Overall	.443*	.376**	.413**	.427**

Table 2: Differences in Computational Thinking Performance Between Male and Female Children

Variables	Male		Female		Difference of Mean
	Case Number	Mean	Case Number	Mean	
Assign	110	16.209	92	15.799	.410
Type	113	13.673	91	13.637	.035
Condition	115	15.870	94	15.489	.380
Loop	121	11.264	100	11.100	.165
Decomposition	111	18.405	89	16.876	1.53
Function	108	16.241	85	15.847	.394
Algorithm 1	109	6.165	79	6.335	**.170**
Algorithm 2	110	6.027	82	6.488	**.461**
Algorithm 3	101	6.485	82	5.915	.571
Overall	79	121.506	63	115.024	6.483

Discussion

Based on the previous tables, which are generated from the original collected data, age is a significant factor influencing children's computational thinking, with older children demonstrating better overall performance. The overall computational thinking score shows a high positive correlation with age (0.443), indicating that as children grow older, their skills improve. Specific components like function and loop skills also show strong correlations with age (0.332 and 0.330, respectively).

Socioeconomic status (SES), including parental education levels and household income, significantly affects children's computational thinking. Higher SES provides more resources and opportunities for engaging in activities that enhance these skills. For instance, the father's education level and household income have strong positive correlations with overall computational thinking (0.376 and 0.427, respectively), indicating the broad impact of SES on these abilities.

Conclusion

Children's computational thinking skills improve with age, with a notable correlation of 0.443 for overall skills, highlighting the importance of developmental stages in cognitive abilities. Higher socioeconomic status, evidenced by correlations such as 0.376 for the father's education level and 0.427 for household income, provides the necessary environment and resources for enhancing these skills.

Gender differences in computational thinking are relatively minor, with males showing slightly higher scores in some areas, such as decomposition, where the difference in means is 1.53. However, both male and female children have the potential to develop strong computational thinking skills, given the right support and opportunities.

References

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