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A User Study on "Programming Education for Young Children" in China

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Abstract

In the rapid development of the Internet industry, the demand for related technical talents is increasing. The cultivation of technological talents is progressing towards a younger age. Because programming language learning is regarded as a fundamental skill for future talent development, the children's programming industry has emerged as one of the education industry's emerging hotspots in recent years. This study was conducted against the backdrop of Chinese preschool education and domestic programming education, with a focus on programming education and a target audience of parents and teachers, in order to investigate the status quo of programming education users and to investigate the impact of science and technology education on children.

Keywords

Graphical Programming; Stages of Child Cognitive Development Theory; Technology Education; Multiple Intelligences Theory.

1. Introduction

With the increasing influence of computer science on human society, more and more attention has been paid to science and technology education. In recent years, the trend of science and technology education in early childhood has been raised in China, and programming education is gradually popularizing. In 2017, the State Council, in its development plan for a new generation of artificial intelligence, explicitly required that courses related to artificial intelligence be offered at the primary and secondary school levels, so as to promote and popularize programming education. The state has vigorously promoted the development of programming education through policies, the trend of low-age programming education has emerged, children's programming courses emerge in endlessly, user groups continue to expand. But children are at Piaget's theory of cognitive development (2-7 years old) and Piaget's theory of cognitive development (7-12 years old), and they are still tied down by concrete thinking, so their ability to understand abstract concepts like programming is controversial, the necessity and feasibility of infant programming are questioned.

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Foreign countries, such as LOGO, Tangible Programming, KIBO, Scratch and other child Programming tools. There is no separate programming education in China's official education system, and the quality of commercial programming education is uneven, so the effectiveness and suitability of teaching content can not be guaranteed. The motivation of parents and the instruction of teachers determine whether children learn programming or not. Therefore, this research is carried out in the background of Chinese preschool education and domestic programming education, focusing on programming education, aiming at parents and teachers, to investigate the status quo of programming education users, and to explore the impact of science and technology education on children.

2. Review of the Literature

In the past two years, with the promotion of consumer upgrading and national policies, programming, a skill that once seemed to have nothing to do with children, seems to have become a hot topic in the education market overnight. When computers, cell phones and iPads have long been the standard for the "touch screen generation", parents who want their children to become successful are no longer satisfied with letting their children learn OU and English. The last two years, with consumer upgrading and national policies, programming, a skill that once seemed unrelated to children, seems to have become a hot topic in the education market overnight. When computers, cell phones, iPads have become the standard for the "touch screen generation", parents who want their children to become a dragon are no longer satisfied with letting their children learn OU, learn English, children's programming seems to have entered the eve of the explosion. (2) The "technology anxiety" of parents is increasing. With the ambition of "not letting children lose at the starting line of human intelligence", one after another children's programming classes are getting hot (3).

Psychological research shows that the law of cognitive development of children follows a specific process, namely, four irreversible developmental processes of action perception, preoperations, concrete operations and formal operations, the latter being based on the former. (6) Formal operation stage refers to the stage of cognitive development of adolescents above the age of eleven. When cognitive development reaches the level of formal operation thinking stage, it represents that the individual's thinking ability has developed to a mature stage, and later on the adder will only increase his knowledge from life experience, and will not enhance his way of thinking again, therefore, it is crucial to develop a way of thinking in adolescence. There are many programming software on the market today, such as Scratch, which is a tool and platform for children all over the world to learn programming and communicate with a graphical interface that encompasses the basic skills needed for programming - modeling, control, animation, events, logic and operations, etc. (7) These basic skills are in line with children's cognitive development, and are particularly useful for training reversible thinking and correcting perceptual focus in the pre-school and early school years.

Programming involves dividing a large and complex object, sorting and simplifying it into smaller problems, and then solving them one by one. So in this process, children need to consider how to divide the things in a reasonable way, that is, how to program these small codes, so that the program can be executed as the child expected, so this process is very helpful for children to analyze things logically and think.

Programming also helps children's creativity because it is a more abstract subject, and children need to use their imagination and hands-on practice to express their ideas with the program and the computer in order to make the program execute as expected.

In the process of programming, there will be problems, large and small, that they need to rely on their own strength to solve independently, so over time, they will have the ability to solve their own problems when they encounter problems in daily life. (5)

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3. Study Design

3.1. Research Questions

Nowadays, with the widespread development of children's programming education, some questions have been intensely discussed, such as whether there is a need for children's programming education? How useful is it for children to learn programming education? Are parents pushing their children to take up programming education? What role does the teacher play in this? Based on the rapid development of children's programming education, this study discusses the following questions.

1) The relationship between teachers' and key stakeholders' awareness of programming education and its significance for the development of children's programming education.

2) The relationship between teachers' and key stakeholders' reasons for enrolling children in programming education and their level of awareness of programming education.

3) The relationship between the age of teachers and key stakeholders and their awareness of programming education for children.

3.2. Study Population

An online questionnaire was used to survey a sample of teachers and parents involved in children's programming education across the country from 14 July 2021 to 26 July 2021. The participants were aged 18 years and above.

3.3. Research Tools

Questionnaires were released using Questionnaire Star and data analysis was conducted using SPSS version 25. The questionnaire was divided into a teacher questionnaire and a parent questionnaire, where each questionnaire was divided into the following dimensions. The reliability of the questionnaires was checked and the reliability coefficients of some questions were low $r < 0.75$ because the survey was mainly focused on teachers and parents related to children's programming. $r > 0.75$ for the teachers' questionnaire.

Table 1. Parent and teacher questionnaire

Teachers' Edition		Parents' Edition	
Dimensionality	Title number	Dimensionality	Title number
Gender, age, student age group	Questions 1-3	Gender, education, occupation, location of kindergarten, type of kindergarten	Questions 1-5
The teacher's knowledge of programming for children	Questions 4-9	Parents' knowledge of children's programming	Questions 6-12
Reasons, significance of programming for children	Questions10-31	Reasons, significance of programming for children	Questions13-15
Key Stakeholders' Perceptions of Children's Programming Education	Questions32-35	Key Stakeholders' Perceptions of Children's Programming Education	Questions16-24

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4. Data Analysis

4.1. Teacher Questionnaire

4.1.1. Age Distribution of Questionnaire Respondents

Table 2. The numerical characteristics of the demographic variables

Variable	Options	Percentage	N
Gender	Male	44.9%	49
	Female	55.1%	
Age	18-22 years old	8.2%	
	23-28years old	20.4%	
	29-35years old	10.2%	
	Over 35 years	61.2%	
Student age group	3-6years old	2%	
	6-8years old	10.2%	
	9-12years old	63.3%	
	Other	24.5%	

The numerical characteristics of the demographic variables can be seen according to Table 1, reflecting the distribution of the respondents to this teacher questionnaire. The proportion of males was 44.9% and the proportion of females was 55.1%; the majority of teachers were over 35 years old accounting for 61.2%; the majority of students taught were aged 9-12 years old, accounting for 63.3%.

4.1.2. Analysis of Variability in Questionnaire Results

This questionnaire was tested for differences by independent samples t-test as well as one-way ANOVA and the results are shown in Tables 2 and 3.

①gender

Table 3. Gender analysis of the differences between the dimensions

Analysis of the differences between the dimensions in terms of gender							
Variables	1. What is your gender?	Number of cases	Average	Standard deviation	Standard error mean	t	Sig. (bobtail)
The teacher's knowledge of programming for children	Male	22	21.9091	3.61095	0.76986	1.472	0.148
	Female	27	20.4074	3.47805	0.66935		
Reasons, significance of programming for children	Male	22	78.6364	9.83456	2.09674	0.049	0.961
	Female	27	78.4815	11.68619	2.24901		
Key Stakeholders' Perceptions of Children's Programming Education	Male	22	15.8182	2.15222	0.45885	-0.359	0.721
	Female	27	16.1111	3.29724	0.63455		

*. t-values are independent sample t-tests, sig. is the level of significance

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Based on the above independent samples t-test, it is possible to see how teachers' awareness of children's programming education differs by gender. There were no significant differences between the three dimensions of teachers' knowledge about children's programming, the significance of the reasons for conducting children's programming, and the awareness of key stakeholders about children's programming education in terms of gender.

②Teacher age

Table 4. The age of the teacher affects children's programming education

Multiple comparisons								
Dependent variable		1. What is your gender?	1. What is your gender?	Mean Difference (I-J)	Standard Error	Significance	95% Confidence interval	
							Lower limit	Upper limit
Reasons, significance of programming for children	LSD	18-22 years old	23-28 years old	-11.95000	6.14097	.058	-24.3185	.4185
			29-35 years old	-10.95000	6.96320	.123	-24.9746	3.0746
			over 35 years	-14.28333*	5.52524	.013	-25.4117	-3.1549
Key Stakeholders on Children's Programming	LSD	18-22 years old	23-28 years old	-4.00000*	1.61369	.017	-7.2501	-.7499
			29-35 years old	-3.20000	1.82975	.087	-6.8853	.4853
			over 35 years	-3.00000*	1.45190	.045	-5.9243	-.0757
*. The level of significance of the difference in means is <0.05.								

The above use of a one-way ANOVA shows how teachers' knowledge of children's programming education varies by teacher age. Under the LSD approach, there was no significant difference in teachers' knowledge of children's programming across teachers' ages.

On the dimension of reasons and meaning of conducting child programming, there was a significant difference between the ages of teachers aged 18-22 and those aged 35+ p=0.013, SD=5.53. Teachers aged 18-22 scored lower on reasons and meaning of child programming than those aged 35+.

On the dimension of key stakeholders' perceptions of children's programming education, there was a significant difference between the ages of teachers aged 18-22 and 23-28, p=0.017, SD=1.61, and between the ages of teachers aged 18-22 and 35+, p=0.045, SD=1.45. Teachers aged 18-22 scored lower on this dimension than scores for teachers aged 23-28 and teachers aged 35+.

③The age of the students taught by the teacher

The results using a one-way ANOVA showed no significant differences between the three dimensions for the different age groups of students taught by the teachers.

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4.1.3. Related Analysis

Table 5. The relationship between teachers' programming knowledge and children's programming

Relevance				
		The teacher's knowledge of programming for children	Reasons, significance of programming for children	Key Stakeholders' Perceptions of Children's Programming Education
The teacher's knowledge of programming for children	Pearson Correlation	1	.165	.318*
	Sig. (bobtail)		.257	.026
	N	49	49	49
Reasons, significance of programming for children	Pearson Correlation	.165	1	.750**
	Sig. (bobtail)	.257		.000
	N	49	49	49
Key Stakeholders' Perceptions of Children's Programming Education	Pearson Correlation	.318*	.750**	1
	Sig. (bobtail)	.026	.000	
	N	49	49	49
*. Correlation significant at 0.05 level (two-tailed).				
**. Correlation significant at 0.01 level (two-tailed).				

According to the results of the table above, there is a significant relationship between teachers' knowledge of children's programming and key stakeholders' awareness of children's programming education p=0.026, but the correlation is generally $0.2 < r < 0.4$.

There was also a significant relationship between the dimension of reasons and meanings for doing children's programming and the dimension of key stakeholders' awareness of children's programming education p=0.00 and the correlation was also strong r>0.7; however, there was no significant relationship between teachers' knowledge of children's programming and reasons and meanings for doing children's programming and the correlation was not strong.

4.2. Parental Questionnaire

4.2.1. Distribution of Occupational Types of Respondents

Table 6. The respondents' distribution

Variable	Option	Percentage
Sex	Male	26.8%
	Female	73.2%
Education	Junior College and below	26.8%
	Undergraduate	55.4%
	Mater	17.9%
	Doctor and above	0%
Occupation / Major Type	Skill	7.1%
	Research	35.7%
	Art	7.1%
	Social Contact	8.9%
	Management	14.3%
	Affair	5.4%
	Others	21.4%

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It shows the distribution of the respondents according to the above table, including 26.8% men and 73.2% female, more than half of the parents have the bachelor's degree, which is the occupational / professional types, so the largest proportion is the research, that is, 35.7%.

4.2.2. Difference Analysis of Questionnaire Results

The difference test are made and analyzed in this questionnaire by independent sample T-test and one-way variance, and the results are shown as follows:

① Sex

Table 7. Test of Independent Samples

Independent Sample Test						
	F	Significance	t	Freedom	Significance (Two-tailed)	Mean Difference
9. Do you know about the software, teaching aids or platforms generally used in Programming Education (such as Scratch, Scratchjr, Mata, LEGO Robot, Codemao, etc.)	1.433	.237	-.374	54	.710	-.119
10. What is your interest in programming?	.515	.476	.486	54	.629	.143
6. Have you ever heard of programming education for kids?	8.856	.004	1.401	54	.167	.341

According to the sex differences in parents' understanding of programming in the above table, Value P are more than 0.05. Consequently, the original hypothesis cannot be neglected. It is thus considered that there are no significant differences in sex in the three dimensions - understanding of programming software, whether they have heard of programming education and some interest in programming.

② Education

Table 8. Multiple Comparisons

Multiple Comparison LSD					
Dependent Variable	(I) 2 Your Education	(J) 2. Your Education	Mean Difference (I-J)	Standard Error	Significance
6. Have you ever heard of programming education for kids?	Junior college and below	Undergraduate	.488	.249	.056
		Master	.633	.324	.056
	Undergraduate	Junior college and below	-.488	.249	.056
		Master	.145	.288	.617
	Master	Junior college and below	-.633	.324	.056
		Undergraduate	-.145	.288	.617
12. What age group do you think children are better exposed to programming education?	Junior college and below	Undergraduate	-.877*	.360	.018
		Master	-.600	.468	.205
	Undergraduate	Junior college and below	.877*	.360	.018
		Master	.277	.417	.508
	Master	Junior college and below	.600	.468	.205
		Undergraduate	-.277	.417	.508

*. The significance level of the mean difference was 0.05.

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By one-way analysis of variance, we can get the difference of parents' understanding of children's programming education in parents' educational background. By means of LSD, there is no significant difference of parents' educational background in whether they have heard of programming education. In which age group do you think children are better exposed to programming education, there are significant differences between undergraduate and junior college and below.

4.2.3. Correlation Analysis

Table 9. Correlation between parents' attitude and programming education

		Correlation		
		6. Have you ever heard of programming education for kids?	8. Do you think it is necessary to carry out programming education?	10. What is your interest in programming?
6. Have you ever heard of programming education for kids?	Pearson correlation	1	-.359**	-.460**
	Significance (Two-tailed)		.007	.000
	Number of cases	56	56	56
8. Do you think it is necessary to carry out programming education?	Pearson correlation	-.359**	1	.659**
	Significance (Two-tailed)	.007		.000
	Number of cases	56	56	56
10. What is your interest in programming?	Pearson correlation	-.460**	.659**	1
	Significance (Two-tailed)	.000	.000	
	Number of cases	56	56	56

**. At Level 0.01 (two-tailed), the correlation was significant.

From the table mentioned above, there is a positive correlation between parents' interest in programming and their attitude towards the necessity of programming education. If P = 0, it's the significant correlation, and if R = 0.659 < 0.8, we consider that there is a moderate correlation.

5. Discussion

The analysis of the data revealed significant differences in the perceptions of teachers aged 35 and 18-22 about children's programming education, as reflected in the two dimensions of the reasons and significance of undertaking children's programming and the perceptions of key stakeholders about children's programming education. teachers aged 35 and above both scored higher in age than teachers in the lower age groups. This may be due to differences in experience due to differences in age, and therefore different perceptions of the same thing, and the different life contexts of the two age groups may also lead to differences in their perceptions, but overall this is consistent with the hypothesis. Moreover, the significant difference is related to the early stage of children's programming development in China, the policy of programming education in China needs to be improved, and the teaching system of teachers is not standardized. Children's programming development in the later stages of the relevance to the

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teacher will be reduced. Moreover, the understanding of children's programming is positively correlated with their cognition and support.

There is a moderate correlation between parents and Chinese children's learning of programming, which is related to children's understanding of programming at this stage. Due to the factors of age, children have less knowledge of programming and less possibility of independent choice. At this stage, children are in the pre-operational stage, and their thinking is visual. The level of understanding, awareness and support for children is difficult to support children to make independent and clear cognition of programming. Therefore, parents become the leading party for children to learn programming. And children at this stage may be in a vulnerable position in front of their parents.

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