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# Evaluating Kindergarten Parents' Acceptance of Unplugged Programming Language Courses: An Extension of Theory of Planned Behavior

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**Abstract:** The changing economic environment in Taiwan has led to an increase in the structure of double-income families. To compensate for the lack of time to take care of their children and the regret of their learning process, parents will send their children to kindergarten early. Parents choose to expose their children to better education and learning models because they do not want their children to get behind at the starting point. The newly introduced unplugged programming language curriculum can develop children's logical and computational thinking skills to face future learning and employment skills in information and communications technology-related industries. The purpose of this study is to examine the parental acceptance of unplugged programming language courses and to analyze the relationship between the variables in the study framework to understand influencing factors. The theoretical basis of the study is the planned behavior theory. This study replaces behavioral intention with parents' acceptance and establishes a basic framework of attitude, subjective norm, and perceived behavioral control. The study framework is established by combining the factors of expectation and compensation as antecedent variables of attitude. An online e-questionnaire is distributed to parents of children aged 5–6 years old in Taiwan to collect data. The structural equation model is conducted on 489 data points. Results of the study reveal that expectation and compensation have a significant effect on attitude. Attitude, subjective norm, and perceived behavioral control have a significant positive effect on family acceptance of unplugged programming language. Furthermore, the expectation and compensation psychology affect the parental acceptance of unplugged language programs through attitude. Finally, practical applications and future research directions regarding the promotion of unplugged programming language for young children are provided.

**Keywords:** expectation; compensation; unplugged programming; theory of planned behavior; information and communications technology manufacturing industries



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## 1. Introduction

Many cross-cultural studies have shown that traditional Chinese parents, regardless of their socio-economic background, consider providing a good educational learning environment for their children to be an important parental responsibility [1,2]. They also believe that academic achievement is an important indicator of a child's success [3]. Therefore, the most important reference for parents when choosing a kindergarten is whether the educational environment and learning style provided by the kindergarten can help their children win at the starting point. This depends on whether the kindergarten can meet the parents' expectations for their children's education.

Computational thinking is the application of basic computer science concepts to problem solving, system design, and human behavior understanding. It is a fundamental skill that is used worldwide [4]. In 2016, President Barack Obama proposed the Computer Science for All (CSFA) program, which begins with the study of computer science in kindergarten. To help children in Taiwan have early access to and develop computer

technology literacy, Asia International Children and Teens Coding Education (ACTC) (https://www.csunplugged.net, accessed on 20 November 2022) launched a program in 2016 that does not require computer tools, but only simple activities and props. It helps children learn programming logic to adapt to programming education. It is also known as the unplugged programming program. According to the Computer Science Education Research Group of Canterbury University, New Zealand, the CS Unplugged curriculum is based on the constructivist concept of unplugged programming, in which students experience the principles of coding without using a computer or connecting to a network. Students will be able to experience the principles of coding using pencil and paper, their own bodies, and hands-on experience to understand the logic of how computer technology works, analyzes, and thinks to help equip children with new skills for the digital age. Through unplugged programming, children have the opportunity to perform activities related to programming concepts such as algorithms, loops, units, and commands without any digital technology tools [5]. The main goal is to help children internalize the logic of writing programs and build a good foundation of thinking logic.

Unplugged programming courses are gradually being implemented in other countries around the world and have been empirically studied by scholars. Research has shown that the computational approach developed by pre-programming thinking can help children transition more easily to computer programming [6] and improve basic programming for preschoolers [7]. The development of computational thinking skills in the preschool child helps to improve the young child's ability to understand, use, apply, develop, and perform everyday computing [8]. Küçükkara and Aksüt [9] found that an unplugged curriculum could enhance students' focused behavior and cooperative learning and stimulate students to generate ideas for communication. Unplugged programming courses have been implemented in education systems in many countries around the world. It also has a positive effect on the initiation of young children in computing skills.

However, Radich [10] found that teachers had doubts about the appropriateness of implementing computational thinking for young children. He argued that younger children are still developing their abstract thinking skills and need to learn through physical play or hands-on work. In addition, the visual development of kindergarten children is not yet mature, and too much and too early exposure to 3C screens has a significant negative impact on their visual acuity. This suggests that there may be a cognitive bias in the concept and practice of unplugged programming. Lack of knowledge about unplugged programming leads to poor decision-making. Sy, et al. [11] found that parents always have high educational expectations for their children. They are concerned about and actively involved in their children's academic education. Parents are important decision-makers in the way their children are educated. The choice of education style will influence the subsequent success of their children. Therefore, it is important to understand the parents' intention to accept the unplugged programming program and its related factors.

The theory of planned behavior (TPB) was modified by Ajzen [12] based on the theory of reasoned action (TRA). The framework was developed by adding perceived behavioral control to it. It predicts the intention and likelihood of a particular behavior together with both variables, the behavioral attitude and the subjective norm. The theory of planned behavior has been empirically tested in many studies to successfully predict the behavioral intentions of subjects. For example, leisure examples [13], medical and health [14], information management [15], educational psychology [16], and consumer behavior [17]. In Taiwan, there have been a few studies that applied the TPB theory to parents' behavioral intentions [18,19]. TPB is also a good application for exploring the influences on parents' intentions to send their children to learn a talent, including parents' attitude toward children's learning programming, the influence of important people around them, and their practical capability to send their children to learn. Moreover, Flannery, et al. [20] proposed ScratchJr as a graphical programming language learning method that uses interactive animations to enhance kindergarteners' programming and problem-solving

skills. However, there is a lack of experimental research on the use of the theory of planned behavior to explore the intention of unplugged programming for kindergarten parents.

To summarize the above, this study applied the theory of planned behavior to examine parents' behavioral intentions toward the unplugged program design in kindergartens. Parental intention can be interpreted as the degree of parental acceptance. Therefore, behavioral intention was expressed as a parental acceptance variable in this study. The relationship between parental expectations, compensation, attitudes, subjective norms, knowledge, perceived behavioral control, and parental acceptance was tested. Based on the results of the study, this study proposes specific recommendations. The main objectives of this study are proposed as follows.

(1) Exploring the influence of parents' expectations and compensation on kindergarten's attitude in unplugged programming curriculum design.
(2) Exploring the influence of parents' knowledge on perceived behavioral control in unplugged programming curriculum design.
(3) Exploring the influence of parents' attitude, subjective norm, and perceived behavioral control on the parents' acceptance in unplugged programming curriculum design.

## 2. Theoretical Background and Hypotheses Development

### *2.1. The Theory of Planned Behavior (TPB)*

Fishbein and Ajzen [21] proposed a theory of reasoned action (TRA). The theory asserts that individual behavior is based on the outcome of the individual's rational will. TRA can be used to explain and predict individual behavior. The theoretical framework contains variables such as attitude, subjective norm, and intention. However, in practical situations, many factors beyond the control of an individual can and will influence the behavior. TRA often fails to provide a reasonable explanation. Therefore, Ajzen [12] added the perceived behavioral control variable to the TRA and developed TPB, which is more suitable for understanding the intentional patterns of individual behavior, for predicting and explaining individual behavior [22]. TPB indicates that an individual's intention to engage in a particular behavior reflects behavior intention, which is composed of attitude toward the behavior, subjective norm, and perceived behavioral control. That the overall structure of TPB is so-called matters to people's subjective positive or negative views of a particular thing. Subjective norms are important to people's third-party views and evaluations of individuals engaged in specific behaviors. Perceived behavioral control refers to the degree of an individual's capability to engage in a specific behavior, including its knowledge, technology, economic, ability, and other realistic conditions. The more positive the individual's attitude toward the specific behavior, the more positive the opinion given by the social reference group, and the higher the control of the will to engage in the behavior, the stronger the intention to engage in the behavior and the higher the probability of actually engaging in the behavior.

In Taiwan's current social environment, academic achievement is still the most important value that people care about—parents' expectations, beliefs, and attitudes toward their children's development and education. It is very easy to influence their children's learning performance, educational achievement, and future social status through their external behaviors [23]. Therefore, when parents receive an unplugged language program design, they make a decision based on whether or not it will benefit their child's education in the future. This attitude of approval or disapproval determines the level of acceptance. This study applied the theory of planned behavior (TPB) to examine the acceptance of unplugged language programs by kindergarten parents. Based on the theory of planned behavior framework, parents' acceptance of the unplugged language program can be interpreted as parents' intention to accept the program. Therefore, this study replaces the intention of the TPB framework with parental acceptance. The TPB framework was influenced by attitudes, subjective norms, and perceived behavioral control. When parents are faced with an unplugged language program, they will base their decision on whether or not the content of the program will have a positive impact on their child's learning. Some

parents have expectations for their children to enhance their children's competitiveness in the workplace, and some parents have expectations for their children to compensate for what they did not receive as children. In this modern age of fewer children, many parents want to give their children the best. However, on the other hand, some parents believe that learning too many skills at a young age can cause stress. This can cause children to lose interest in learning and worry about over-education.

### *2.2. Unplugged Programming Language*

Wing [24] introduced the term computational thinking, which advocates the application of computer science concepts to a basic design system for understanding concepts related to human behavior and solving complex problems. Through the learning of computer-related scientific skills, computational thinking such as logical thinking and systematic thinking will be cultivated, and through the design and implementation of information technology, the ability to apply computational thinking, problem-solving, teamwork, and innovative thinking will be enhanced [9]. The earlier the training of computational thinking is taught, the better it will be for enhancing computational-thinking-related skills, especially in children's education [25]. Computational thinking is critical to children's learning of programming, and it is best to help children through the early education process and personality development through activities that they can understand [6]. Computational thinking and computer programming are highly correlated [26]. Therefore, a simple, visual, and real-time execution tool for children to learn a programming language is important [27]. In this regard, the "Un-plugged curriculum" helps students to develop basic logic concepts of programming through physical game activities or processes without the use of a computer or network (un-plugged or un-network).

The unplugged programming curriculum in Taiwan was first started by ACTC, which was established in 2016. Instead of using computers, children learn programming logic through simple and fun activities, games, teaching aids, drawings, cards, and verbal instructions to help them experience and adapt to programming education early. For preschoolers, unplugged programming uses physical materials for the curriculum. This is particularly suitable for kindergarteners who can already start thinking [28]. It also eliminates the negative consequences of 3C products for parents and is beneficial to the training of children's logical thinking.

The results of an empirical study on unplugged programming education for preschool children showed that unplugged programming programs based on group activities can improve basic programming skills [7]. An unplugged programming program based on group activities can improve the basic programming skills of preschool children [7]. In addition, students actively participated in activities and were able to propose multiple solutions to problems, understand computational concepts, and improve problem-solving skills [9]. Learning unplugged programming by young children not only affects success in math and science. It also plays an important role in language, creativity, and social–emotional interactions [29]. Unplugged programming not just enhances the interaction between young children's computational thinking and technology, it provides a symbolic language to help children read and write [30]. In addition, the study by [9] also found that students' behavioral focus was enhanced through unplugged courses. Students can stimulate and exchange ideas, which is more beneficial to stabilizing students' learning effectiveness. This shows that unplugged programming courses have been widely emphasized by educational promoters in Taiwan and worldwide. The program has been studied and researched to optimize the logical and computational thinking skills of young children.

### *2.3. Psychology of Expectation*

The concept of the psychology of expectation is a theory of motivation proposed by Vroom in 1964 for corporate employees. It is the product of an individual's expectation of an event and the value of the actual outcome, also known as the expectancy-value theory. There are several extended concepts of expectation, including self-efficacy expectation (whether

an individual can perform a behavior in a given situation), outcome expectations (whether a behavior produces a desired outcome), general expectations (whether certain outcomes or events occur and the probability of occurrence), and conceptualized expectations (whether the attitude toward the future is positive or negative) [31,32]. As parents always have great expectations or hopes for their children's learning and growth, including physical and mental development, cognitive, attitudinal, and emotional development, which is a kind of expectation that emphasizes learning and growth [33], the educational expectation or learning expectation for children's education and learning is also the psychology of parents' expectations for their children.

As a parent, they naturally have high expectations for their children's learning and growth, expecting their children to be healthy and happy, to succeed in learning, and to become famous. Yan and Lin [34] found that parents' educational expectations affect their children's motivation to participate in learning and their academic performance. Scholars [35,36] have also found that parents' educational expectations affect individuals' educational aspirations. It was found that parents' educational expectations influence individuals' educational aspirations and subsequent further educational achievement and future career status [23]. This shows that parents' expectations of their children's education can serve as a motivation for their children to improve and promote the possibility of success in educational learning. However, if parents' educational expectations exceed their children's actual capabilities, they may lose confidence because they are unable to achieve their parents' goals, which may have negative effects on academic achievement or physical and psychological development [37]. Moreover, Chen and Tu [38] confirmed that perceptions of the usefulness and work value of internet-related practices positively influenced their attitudes toward preschool expectations and acknowledged the pedagogical advantages of incorporating internet-related applications into instruction to develop young children's learning skills. In short, educational expectations motivate children to learn and grow, and appropriate expectations are an important factor in helping children to achieve academic success.

### *2.4. Compensatory Psychology*

Compensatory psychology is a psychological adaptation mechanism of an individual; when an individual has deviations and losses in the process of adapting to society, he or she will show the thought of seeking compensation from other aspects, which in psychology is also called displacement [39]. In other words, when an individual feels uncomfortable because of physical or psychological defects, he or she will try to use a certain method. This is a psychological adaptation method to alleviate one's discomfort, which is a compensatory psychological mechanism for the individual. If the target of compensation is inwardly directed toward oneself, it is internal compensation; if it is displaced to others, it is external compensation. The psychological behavior of compensation for children is mainly external compensation [40].

Parents' compensation mechanisms for their children can be broadly divided into two aspects: compensation psychology and guilt psychology. The compensatory psychology is that some parents themselves have lost the opportunity to realize their ideals because of the influence of time and space. As a result, they are left with a specific life regret and psychological deficit. Therefore, they allow their children to fulfill their parents' ideals and wishes, complete their parents' unfinished business, and compensate for their own biological deficiencies [41]. Therefore, parents take care of their children in their daily lives. In addition, they are dedicated to their children's development and learning, and they are eager to let their children move forward according to their own goals. In addition, the development of guilt [42] may also lead parents to engage in compensatory behaviors toward their children. Parents may feel guilty because of their own factors that affect the child's normal development, such as family finances, living environment, or other factors that cause physical and emotional trauma to the child's development. At this time, the parent may have a psychological compensatory effect on the child that is due to guilt. They

will try to compensate for the effects on the child, since parents always want their children to have a better future as a starting point for their child's development. Therefore, the behaviors derived from the compensatory psychological mechanism also aim to help the child's future.

However, not every parent is able to make the right adjustments to their child's ability to grow and develop for their child's actual ability to learn. On the contrary, it will have a negative impact on the early stages of socialization and will increase the negative effects of over-socialization [37]. Therefore, parents' compensatory psychologies have an influence on their children's educational learning.

### *2.5. Hypotheses Development*

According to Susperreguy, et al. [43], when parents have higher academic expectations, they are higher toward arithmetic, which increases the frequency of children's arithmetic activities. Therefore, the stronger the expectation and compensation, the more positive the use of positive attitudes to encourage children to participate in the program, and the higher the acceptance of parents. Subjective norms are mainly influenced by the perceptions of important third parties on their own behavior. When the children of close friends and relatives are learning the unplugged language, parents are likely to feel pressure not to participate because of the social atmosphere, news media reports, and recommendations from authority figures. Therefore, the higher the level of subjective normative pressure, the higher the parental acceptance. Therefore, the hypotheses of this study are as follow.

**Hypothesis 1 (H1).** *Parents' expectations of unplugged programming language courses will have a positive and significant effect on attitude.*

**Hypothesis 2 (H2).** *Parents' compensation for unplugged programming language courses will have a positive and significant effect on attitude.*

**Hypothesis 3 (H3).** *Parents' attitude toward the use of unplugged programming language courses will have a positive and significant impact on acceptance.*

**Hypothesis 4 (H4).** *Parents' subjective norms about unplugged language programs will have a positive and significant effect on acceptance.*

According to the theory of planned behavior [22], perceived behavioral control is the degree to which an individual perceives the ease or difficulty of performing a particular behavior, as influenced by past experiences and expected obstacles. The more resources and opportunities an individual perceives, the fewer the expected obstacles; the stronger the perceived control over the behavior is directly influences the behavioral intention or behavior. For example, when parents understand that unplugged language programs are not about memorizing instructions or learning complex knowledge, but rather about learning spatial direction and logical thinking through unplugged game modules, they are more likely to be willing to send their children to a programmed language program. On the other hand, in reality, parents' financial ability and time are the key factors that affect whether they will send their children to learn an unplugged programming language. Therefore, a hypothesis of this study is as follows.

**Hypothesis 5 (H5).** *Parental perceived behavioral control of unplugged programmed language courses will have a positive and significant effect on acceptance.*

To summarize the results of the above discussion, this study investigated the parents' acceptance of unplugged programming language courses and understood the influencing factors. The results of the literature review were used to develop the framework of this research as shown in Figure 1. In this study, expectation, compensation, attitude, subjective norm, and perceived behavioral control were used as independent variables, and parents'

acceptance was used as a dependent variable to investigate the acceptance pattern of unplugged programmed language curriculum by parents of kindergarten children.

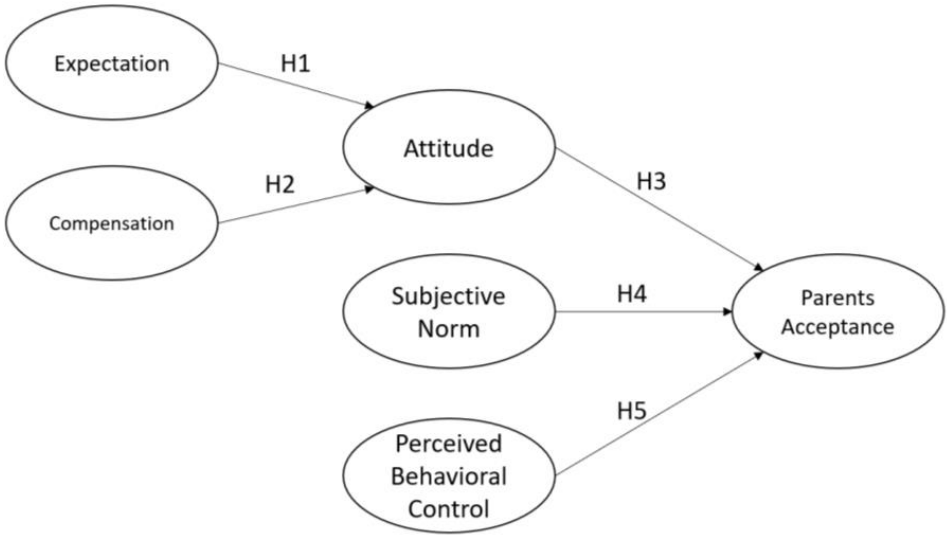


**Figure 1.** Research framework.

## 3. Methodology

### *3.1. Research Subjects and Data Collection*

This study was conducted to examine the acceptance of an unplugged programmed language curriculum among kindergarten parents. The study was conducted with parents of children aged 5–6 years in Taiwan. A questionnaire was used to survey a convenience sample of social media friends from parents, kindergartens, and related organizations. An online e-questionnaire was distributed for one month from 30 November to 30 December, 2021, to collect data. According to the recommendations of the Survey System website (https://www.surveysystem.com/sscalc.htm, accessed on 1 November 2022), the sample size of the study was calculated to be 384 valid questionnaires by using a confidence level of 95% and a confidence interval of 5%. Therefore, this study set all questions of the electronic questionnaire as compulsory questions to avoid invalid questionnaires.

### *3.2. Measurement Items*

The variables in this study include personal information, expectations, compensation, attitudes, subjective norms, perceived behavioral control, knowledge, and parental acceptance, and the operational definitions of each variable are described below. The primary purpose of the survey was to examine basic information about the sample, including the parents' gender, age, occupation, and education level. In addition to presenting the distribution of the sample characteristics, it also shows the representativeness of the sample to the overall data. In addition, a differential analysis will be used based on different demographic variables. This study compares the acceptance of unplugged programming language by parents with different characteristics and its constructs to see if they can reach the level of statistically significant differences.

The questionnaire questions for this study were based on Venkatesh et al.'s questionnaire [44] on employees' expectations of receiving information technology. The expectations of employees in using information systems to perform their jobs include improving work efficiency, work quality, and recognition by colleagues, and getting a raise or promotion at work. Six of these questions were adapted for this study [44]. If parents send their children to learn programs, children will increase their logical thinking skills, become more competitive, learn more efficiently, become more confident, gain a sense of accomplishment, and gain peer recognition.

A search of the literature on the psychology of compensation reveals that Western research on the psychology of compensation focuses on the labor–employment relationship.

The indicators of compensation are divided into economic compensation (wages, incentives, commissions, health insurance, sick leave/pregnancy, and pension payments) and non-economic compensation (assignment of responsibilities, recognition, and promotion opportunities) [45]. On the contrary, Chinese scholars Wang and Gao [41] argue that the problem of parental over-education has left some parents with specific life and psychological deficits because of their particular life experiences. They want their children to fulfill their parents' unfinished business and realize their parents' ideals, and they wish to compensate for their own hearts' deficiencies. This study believes that parents often compensate their children in financial or non-financial ways. Parents may be too busy to spend time with their children, or they may compensate their children financially by allowing them to learn various talents. Five questions were used to measure compensation.

The questions of the questionnaire for measuring attitudes in this study were revised by referring to the Bae and Chang [46] questionnaire on "no contact" travel behavior in March 2021 and also revised by referring to questions 34–36 of the questionnaire by Hung-Chou, et al. [47], and a total of six questions were designed.

This study on subjective normative pressure concerns a reference to [48]. In exploring some of the questions to revisit the understanding of green consumer behavior among young urban consumers in India through the perspective of the theory of planned behavior, these questions were modified into five questions.

The present study on the construct of perceived behavioral control draws on the [49] study. The questions were modified into five questions when exploring the extended theory of planned behavior to predict destination revisit intentions.

This study applied the theory of planned behavior to examine parents' behavioral intentions toward the unplugged program design in kindergartens. Parental intention can be interpreted as the degree of parental acceptance, so this study expressed the behavioral intention as a parental acceptance variable. Parental acceptance constructs refer to Bawack and Kamdjoug [50] applying an integrated technology acceptance model to the adequacy of physician adoption of health information systems: a case study question in Cameroon. As well, based on the Hamidi and Chavoshi [51] analysis of the underlying factors in the adoption of mobile learning in higher education, a research question with students from polytechnics, the questions were modified into five questions. The measurement items are shown as Table 1.

### *3.3. Statistical Analysis Methods*

The latent variables were measured using a seven-point Likert scale. Scores were given on a scale of strongly disagree (1), disagree (2), somewhat disagree (3), average (4), somewhat agree (5), agree (6), and strongly agree (7). The higher the score, the higher the level of agreement with the study variables. The design of the questions for each construct is described as follows. The statistical analysis of this study is based on structural equation modeling (SEM) and is divided into several major stages. First, descriptive statistics will be used to present the data distribution of this study sample. Second, this study will test the reliability and validity of the questionnaire. A confirmatory factor analysis will be conducted to exam the reliability of the items, the reliability of the constructs, and the consistency validity of each construct. After that, a discriminant validity test will be conducted to ensure the validity between the constructs. Furthermore, this study will examine the model fit between the proposed research model and the sample. Then, the hypothesis of the direct effects will be examined through a path analysis. Finally, bootstrapping mediation analysis will be used to test whether the indirect effects between the variables are significant.

This study applied SPSS 20.0 software to conduct descriptive statistics to analyze the current situation of sample gender, education level, and average monthly income. Then, AMOS 20.0 software was used to validate the measurement model and structural equation model. Convergent validity, discriminant validity, model fit, and path analysis were used to further validate the hypotheses of this study. Since the structural equation model is better

than traditional first-generation statistical analysis techniques in estimating the relationship between variables, it is suitable to be applied for potential inter-variable relationship verification (Hsu, 2012). Therefore, this study applies the structural equation model for hypothesis model validation, which can increase the reliability of the research data.

**Table 1.** Questionnaire items.

| **Expectation** | **Source** |
| --- | --- |
| If I send my children to study programming:<br>1. Children will increase their logical thinking skills.<br>2. Children are more competitive in their studies.<br>3. Children are more effective in their studies.<br>4. Children will have more confidence.<br>5. The child will gain a sense of accomplishment.<br>6. The child will gain peer recognition. | Venkatesh, Morris, Davis and Davis [44] |
| Compensation | Source |
| 1. I envy people who can write programs.<br>2. I regret that I did not learn talent courses when I was a child.<br>3. Although I can't write programs, I hope my children can write programs.<br>4. I did not have the opportunity to learn to write the program before is quite a pity.<br>5. If I can write the program will make more money. | Wang and Gao [41] |
| Attitude | Source |
| 1. It is very useful for young children to learn programming language.<br>2. It is valuable for young children to la earn programming language.<br>3. It is very beneficial for young children to learn programming language.<br>4. Learning programming for young children is very attractive to me.<br>5. It's a good idea for young children to learn programming language.<br>6. I have a very positive view of young children learning programming language. | Bae and Chang [46];<br>Hung-Chou, Te-Yung and Su-Hui [47] |
| Subjective Norm | Source |
| 1. Most of my friends think I should send my kids to learn programming languages.<br>2. Most of my neighbors think I should send my kids to learn programming languages.<br>3. Most of my colleagues think I should send my kids to learn programming languages.<br>4. Most of my families think I should send my kids to learn programming languages.<br>5. Most of my relatives think I should send my kids to learn programming languages. | Taufique and Vaithianathan [48] |
| Perceived Behavioral Control | Source |
| 1. I have full authority to decide whether to send my children to study programming or not.<br>2. I am very confident about sending my children to study programming.<br>3. I have enough money to send my children to study programming.<br>To program<br>5. I have the opportunity to send my children to learn to program. | Soliman [49] |
| Parental Acceptance | Source |
| 1. I believe it is a good thing to send children to learn programming languages.<br>2. I am in favor of sending children to learn programming languages.<br>3. I will send my children to learn programming languages.<br>4. I look forward to sending my children to learn programming languages.<br>5. I should send my kids to learn a programming language. | Bawack and Kamdjoug [50];<br>Hamidi and Chavoshi [51] |

## 4. Data Analysis

### *4.1. Sample Background Statistics*

The basic information collected in this study includes gender, occupation, education level, and average monthly income (see Table 2). The majority of the respondents were female (297), accounting for 60.7%. Among the occupations, 256 (52.4%) of the respondents were office workers. The largest number of respondents with an education level was 366

(74.8%) from college and university. The monthly income of NT$ 30,001–50,000 was 243, accounting for 49.7%.

**Table 2.** Distribution of the number of times.

| Category Variables | Label | Frequency | Percent | Cum Percent |
|---|---|---|---|---|
| Gender | Male | 192 | 39.3 | 39.3 |
| | Female | 297 | 60.7 | 100.0 |
| Education level | Junior high school (or under) | 4 | 0.8 | 0.8 |
| | High School | 50 | 10.2 | 11.0 |
| | University | 366 | 74.8 | 85.9 |
| | Master's degree (or above) | 69 | 14.1 | 100.0 |
| Occupation | government employee | 42 | 8.6 | 8.6 |
| | Office worker | 256 | 52.4 | 60.9 |
| | Engineer | 54 | 11.0 | 72.0 |
| | Small business owner | 39 | 8.0 | 80.0 |
| | Freelancer | 85 | 17.4 | 97.3 |
| | others | 13 | 2.7 | 100.0 |
| Monthly income | Under NT 30,000 | 100 | 20.4 | 20.4 |
| | NT30,001–50,000 | 243 | 49.7 | 70.1 |
| | NT 50,001–100,000 | 121 | 24.7 | 94.9 |
| | Over NT 100,000 | 25 | 5.1 | 100.0 |

### *4.2. Reliability and Validity Analysis*

Table 3 shows the results of the confirmatory factor analysis performed in this study. Standardized factor loadings are used to test the reliability of the questions, and composite reliability (CR) is used to test the reliability of the constructs. According to Chin [52], the proposed criterion is that the reliability of the questions should be greater than 0.45 and the reliability of the constructs should be greater than 0.7 [53]. The standardized factor loadings for this study ranged from 0.620 to 0.915. The values of the construct reliability ranged from 0.874 to 0.952. In addition, average variance extracted (AVE) is used to test the convergent validity of the study constructs, and its standard is recommended to be greater than 0.5. The AVE values of the constructs in this study ranged from 0.584 to 0.800. All of these criteria were met.

**Table 3.** Results for the measurement model.

| Construct | Item | Item Reliability | Construct Reliability | Convergent Validity |
|---|---|---|---|---|
| | | Std. | CR | AVE |
| Expectation | EX1 | 0.752 | 0.896 | 0.590 |
| | EX2 | 0.779 | | |
| | EX3 | 0.810 | | |
| | EX4 | 0.793 | | |
| | EX5 | 0.776 | | |
| | EX6 | 0.692 | | |
| Compensation | COM1 | 0.768 | 0.888 | 0.614 |
| | COM2 | 0.705 | | |
| | COM3 | 0.859 | | |
| | COM4 | 0.804 | | |
| | COM5 | 0.773 | | |
| Attitude | AT1 | 0.889 | 0.945 | 0.743 |
| | AT2 | 0.869 | | |
| | AT3 | 0.859 | | |
| | AT4 | 0.898 | | |
| | AT5 | 0.868 | | |
| | AT6 | 0.785 | | |

**Table 3.** *Cont.*

| Construct | Item | Item Reliability | Construct Reliability | Convergent Validity |
|---|---|---|---|---|
| | | **Std.** | **CR** | **AVE** |
| Subjective norm | SN1 | 0.880 | 0.952 | 0.800 |
| | SN2 | 0.892 | | |
| | SN3 | 0.915 | | |
| | SN4 | 0.895 | | |
| | SN5 | 0.891 | | |
| Perceived behavioral control | PBC1 | 0.620 | 0.874 | 0.584 |
| | PBC2 | 0.771 | | |
| | PBC3 | 0.764 | | |
| | PBC4 | 0.842 | | |
| | PBC5 | 0.805 | | |
| Parents' acceptance | PA1 | 0.817 | 0.940 | 0.760 |
| | PA2 | 0.872 | | |
| | PA3 | 0.889 | | |
| | PA4 | 0.883 | | |
| | PA5 | 0.895 | | |

Std: standardized factor loadings; SMC: square multiple correlations; CR: composite reliability; AVE: average variance extracted.

There should be some differences among the constructs in the model. The AVE square root value should be greater than the Pearson correlation coefficient for the other constructs to determine the discriminant validity. Table 4 shows the test results. All of the AVE square root values are larger than the correlation coefficients with other constructs. This result indicates that there is an acceptable discriminant validity in this study.

**Table 4.** Discriminant validity for the measurement model.

| Construct | Expectation | Compensation | Subjective Norm | Attitude | Perceived Behavioral Control | Parents Acceptance |
|---|---|---|---|---|---|---|
| Expectation | **0.768** | | | | | |
| Compensation | 0.583 | **0.784** | | | | |
| Subjective norm | 0.530 | 0.490 | **0.862** | | | |
| Attitude | 0.696 | 0.579 | 0.571 | **0.894** | | |
| Perceived behavioral control | 0.568 | 0.492 | 0.605 | 0.676 | **0.764** | |
| Parents' acceptance | 0.733 | 0.629 | 0.656 | 0.763 | 0.714 | **0.872** |

Note: The items on the diagonal in bold represent the square roots of the AVE; off-diagonal elements are the Pearson correlation estimates.

### *4.3. Model Fit*

Jackson et al. (2009) suggested that there are nine commonly used indicators of model fit in empirical studies in social sciences. Then, Bollen and Stine (1992) suggested that when the sample size is larger than 200, the statistical analysis by SEM will lead to chi-square inflation, making the model fit worse. The Bollen–Stine bootstrap is used in this study to correct the chi-square bias of the SEM. The results are shown in Table 5.

### *4.4. Hypothetical Testing*

In the test of the study hypothesis, expectation had a positive and significant effect on attitude (b = 0.777, $p < 0.001$). Second, compensation also had a significant effect on attitude (b = 0.272, $p < 0.001$). Furthermore, attitude, subjective norm, and perceptual behavioral control had a significant effect on parental acceptance (b = 0.382, $p < 0.001$) (b = 0.168, $p < 0.001$) (b = 0.319, $p < 0.001$). In terms of variance explanatory power, expectation and compensation explained 57.1% of attitudes. Attitudes, subjective norms, and perceived behavioral control could explain 68.7% of parental acceptance. Table 6 shows the results of the regression coefficient calculation for this study. Figure 2 shows the statistical model diagram of the study.

**Table 5.** Model fit criteria and test results.

| Model Fit | Criteria | Model Fit of the Research Model |
|---|---|---|
| $\chi 2$ | The smaller the better | 688.565 |
| DF | The larger the better | 453 |
| Normed Chi-square ($\chi 2$/DF) | $1 < \chi 2/DF < 3$ | 1.079 |
| RMSEA | <0.08 | 0.013 |
| TLI (NNFI) | >0.9 | 0.997 |
| CFI | >0.9 | 0.997 |
| GFI | >0.9 | 0.965 |
| AGFI | >0.9 | 0.958 |

Note: DF = degree of freedom; RMSEA = root mean square error of approximation; TLI = Tucker–Lewis index; NFI = normed fit index; CFI = comparative fit index; GFI = goodness of fit index; AGFI = adjusted goodness of fit index.

**Table 6.** Structural model results.

| DV | IV | Unstd. (b) | S.E. | Unstd./S.E. | *p*-Value | Std. |
|---|---|---|---|---|---|---|
| Attitude | Expectation | 0.777 | 0.071 | 10.964 | 0.000 | 0.569 |
| | Compensation | 0.272 | 0.048 | 5.727 | 0.000 | 0.266 |
| Parents' acceptance | Attitude | 0.382 | 0.032 | 11.919 | 0.000 | 0.474 |
| | Subjective norm | 0.168 | 0.028 | 5.940 | 0.000 | 0.241 |
| | Perceived behavioral control | 0.319 | 0.051 | 6.284 | 0.000 | 0.291 |

Note: DV = dependent variable; IV = independent variable; Unstd. = unstandardized regression coefficients; S.E. = standard error; Std. = standardized regression coefficients.

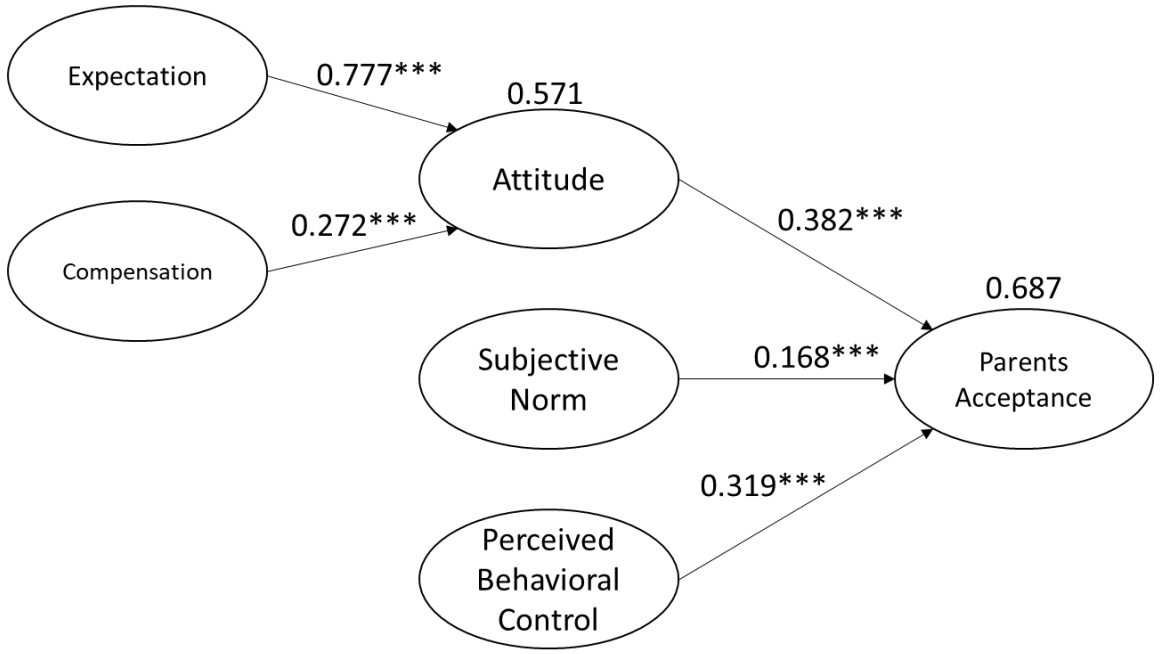


**Figure 2.** Statistical model diagram. Note. *** $p < 0.001$.

## 5. Conclusions and Discussion

This study was conducted to examine parents' acceptance of the unplugged language program in kindergartens. Using TPB as the theoretical basis, the research framework and hypotheses were developed by combining the expectation and compensation factors. A questionnaire survey was used to collect sample data. A structural equation model was used to test the model fit and validate the hypotheses.

### *5.1. Conclusions*

As technology continues to advance, training students to think in computer science is essential for developing creativity and logical thinking skills in future life. It is important to help solve various life problems that will be faced in the future. Parents have an important influence on the educational development of their children. Choosing an appropriate educational model that takes into account a child's learning ability can lead to subsequent academic success. Past research has found that parents consider it an important responsibility to provide a quality educational model for their children, such as Chen, Wang and Farn [15] and Hitz [54]. In the face of the emergence of a new educational model, parents' awareness of the learning model allows their children to accept the educational model and the opportunity to receive early training in computational thinking. Therefore, it is important to understand the influence of parental "expectations" and "compensatory" factors on their acceptance of unplugged language programs. Previous studies have focused on the implementation and effectiveness of unplugged language design programs, such as Lin, Chien, Hsiao, Hsia and Chao [25], Futschek and Moschitz [6], and DURAK and ŞAHİN [26], but have not yet addressed parental acceptance of the programs offered in kindergartens and the related influences. Therefore, this study attempted to investigate the factors influencing the acceptance of the unplugged language design program from the psychological perspective of parents. Using the theory of planned behavior as the basis, the factors of "expectation" and "compensation" were integrated to investigate the factors influencing kindergarten parents' acceptance of the unplugged language program. The results of the study are as follows.

#### 5.1.1. The Effect of Expectation and Compensation on Attitudes toward Unplugged Programming Language Use

Overall, the non-standardized regression coefficient for the path analysis of expectation influencing attitude was 0.777. The non-standardized regression coefficient of the path analysis of the attitude of compensation psychology was 0.272. The total variance of attitudes reached an explanatory power of 57.1%. This indicates that expectation and compensation factors have a high influence on parents' attitudes toward unplugged programming language courses. It also validates the research hypothesis that "expectancy" and "compensation" have positive and significant effects on attitudes toward use. The results of this study are similar to those of Huang [40], Yan and Lin [34], and Wang and Gao [41].

Compensatory psychology had a significant positive effect on attitudes toward unplugged language programs. The stronger the compensatory psychology of parents, the more positive the attitudes toward using the program, and the more positive the attitudes toward using the program, the more children are encouraged to participate in the program. When other people's children are exposed to the unplugged language program, the parents' perceptions of their children's attitudes toward the program are influenced by their desire not to let their children lose at the starting point.

#### 5.1.2. A Discussion of Parental Acceptance of Unplugged Programming Language Courses

In terms of the overall model, the unstandardized regression analysis coefficient for the path analysis of attitudes affecting acceptability was 0.382. The unstandardized regression analysis coefficient for the path analysis of subjective norm influencing acceptance was 0.168. The unstandardized regression analysis coefficient for the path analysis of perceptual–behavioral control on acceptability was 0.319. The total variance of acceptance was 68.7% of the explanatory power. This shows the hypothesis that attitude, subjective norm, and perceived behavioral control have a positive and significant effect on parental acceptance. This results are similar to those of Futschek and Moschitz [6] and Wang, Chen and Ciou [27].

Furthermore, among the perceived behavioral constructs, "I have enough time to send my child to program design" best reflected parents' "perceived behavioral control" over the unplugged program language course. This indicates that parents have control over their

children's participation in unplugged language programs. This study shows that parents have control over their children's participation in the program in terms of their own wishes, time, funding, and access to resources. In particular, given the socio-economic development and the structure of double-income families, the ability of parents to have sufficient time to transport their children to and from educational programs, even though they are busy, is the most important factor that affects the likelihood of their children receiving unplugged language education.

### *5.2. Academic Contributions*

The results of this study showed that parents' expectations had a significant positive effect on their attitudes toward unplugged language programs. According to [55] expectancy-value theory, which follows the theory of reasoned action model, expectations can replace beliefs as the antecedent variable of attitudes. Therefore, expectations influence attitudes and affect individuals' choices and the performance of related behaviors. In other words, parents' expectations directly affect their attitudes toward unplugged language programs. The question "Children are more effective in learning" best reflects parents' expectations. This indicates that parents expect their children to be more efficient in learning tools to help them accomplish their learning goals.

In terms of the effect of parents' attitudes toward unplugged language programs on acceptance, the results of this study showed that attitudes had a significant positive effect on parental acceptance. This result is the same as the results of previous studies [19,56]. In addition, it was found that subjective norms had a significant positive effect on parental acceptance, which was also the same as the results of previous studies. This result is also consistent with the results of previous studies [18,19]. The results are consistent with the theoretical framework of planned behavior, which suggests the influence of various factors.

### *5.3. Practical Suggestions*

Changes in the overall social environment in Taiwan have led to an increasing number of double-income families. The economic pressure of life also affects the current situation of fewer children. Parents are paying more and more attention to the care and education of their children. It is an important responsibility of parents to train their children to adapt to future lifestyles and to develop the ability to face competitive pressures. In the face of the advent of computer technology, the development of children's ability to think computationally, think logically, be creative, and solve problems in computer science is essential to adapting to future lifestyles.

The kindergarten introduces an unplugged language program to train children's logical thinking skills from an early age. The introduction of an unplugged language curriculum in kindergartens has been a major focus of many educational organizations and parents. Therefore, based on the findings, this study proposes the following recommendations for kindergartens and preschools to promote related policies. The study suggests the following recommendations for kindergarten and pre-school educational institutions to promote relevant policies to enhance kindergarten parents' acceptance of unplugged language programs and to lay the foundation for children's learning achievement early.

The results of this study found that subjective norms had a significant effect on parental acceptance. This indicates that parental acceptance of unplugged language programs is influenced by social pressure from significant others. The Ministry of Education's "Computational Thinking Promotion Program" promotes computational thinking in elementary and middle-school students to develop problem-solving, teamwork, and creative thinking skills. Previous studies have pointed out that computer science is the foundation for a successful career in the 21st century and should be taught early, preferably from early childhood education. Therefore, it is recommended that the Department of National and Preschool Education of the Ministry of Education should develop teaching examples and teaching kits that meet the learning standards of the unplugged language curriculum for early childhood learning by the objectives of the Computational Thinking Promotion Project. The

department should also organize teacher enrichment training for early childhood education teachers, develop implementation plans, and strengthen policy advocacy. Through the implementation of government policies to strengthen parents' recognition of the unplugged language curriculum and the intensity of social pressure to subjectively regulate it, this study will influence parents' acceptance of the curriculum and increase the probability that parents will allow their children to participate in the unplugged language curriculum.

The results of this study revealed that parental expectations and compensation significantly influenced acceptance by affecting attitudes. The results of this study showed that by motivating the pre-attitudinal variables, parents' acceptance of the unplugged language program could be increased, and parents' willingness to accept their children's participation in the program could be increased. Therefore, it is recommended that the program sponsors not only develop unplugged language curriculum materials but also develop a set of learning objectives. Parents should have a clear understanding of the benefits of the program for their children's future education and learning, as well as the goals for their children's future learning outcomes in programming language design. This will help parents to revise their expectations and compensate for their children's positive attitudes toward the program, and to increase their acceptance of the program and their children's chances of participating in the unplugged language program.

### *5.4. Research Limitations and Developments in the Future*

The study was conducted mainly with kindergarten parents as the target population. The results of the study showed that the education level of the sample was relatively high, with 74.8% of the sample having college or university education. Parents with higher education were more familiar with and accepting of computer information courses and had higher awareness of their children's unplugged language courses. Therefore, the results of the study may not fully represent the views of those with other education levels. The majority of the parents, 60.7%, were female, and 52.4% were office workers. This indicates that the majority of the parents were female office workers and had higher exposure to the use of IT in the workplace. In addition, the theoretical foundation of this study is the planned behavior theoretical framework. The study may be continued by combining other additional variables or theories. For example, the perceptual usefulness and perceptual ease of use variables of the technology acceptance model were studied to gain a better understanding of parents' acceptance of their children's participation in unplugged language programs.

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