

Curriculum Development of Future Kindergarten Science Education Integration Based on STEAM Concept

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Abstract: The STEAM education concept is a comprehensive education model that integrates the five elements of science, technology, engineering, art, and mathematics. Children are the hope of the future, and the education of children needs to keep up with the pace of the times. The traditional early childhood education separates subjects through curriculum, resulting in a serious simplification of the ability to cultivate talents and a lack of comprehensiveness. The STEAM education concept can integrate the content of the courses learned by children, so that children can receive systematic and comprehensive education in the future, which can stimulate children's interest in learning, expand children's learning knowledge, and improve children's learning efficiency. This experiment compares the future kindergarten science education integration curriculum based on the STEAM concept and the traditional kindergarten education curriculum. The results show that the kindergarten science education integration course based on the STEAM concept has 29.0% more active learning than the traditional education model, 43.7% more in the acquisition of interdisciplinary knowledge. The kindergarten children' average self-solving ability is 46.5% and 33.3% respectively. In terms of activity room learning efficiency, the results are 74.6% and 63.3%, respectively. Through the comparison of four aspects, the teaching quality of kindergarten education courses based on the STEAM concept is better than that of traditional kindergarten education.

1. Introduction

With the development of the Internet, it has had a profound impact on all walks of life. In the 1950s, the concept of STEM, a new education model based on the Internet, was proposed. STEM is an interdisciplinary concept that integrates science, technology, engineering, and mathematics. The school's teaching concept has gradually moved from a single-subject model to the STEM concept. After decades of development, in the educational practice of the STEM concept, students' learning efficiency and the knowledge involved have been significantly improved. With the increase of people's understanding of the art of life, art elements are added to STEM to make it develop into a more complete STEAM teaching concept. The early childhood stage is the first and most important stage of physical and mental development and knowledge reserve. If all aspects of knowledge training and education can be carried out in the early childhood, it will provide great help for the

development of young children. However, most of the preschool education today is still in the form of single subject education or subject education with low comprehensiveness. Therefore, it is urgent to carry out science education integration courses based on STEAM concepts in kindergartens to help children grow better.

Learning in early childhood is the main resource for its development; so many people have conducted in-depth research on the kindergarten science education integration curriculum. Among them, Tohyama S's research shows that when school education adds art mode, kindergarten children's ability to express art will be enhanced [1]. Upadhyay B said that combining technology, art and other fields can enhance children's creativity [2]. Koerber S conducted experiments on children aged 5-8 and found that children's learning in a multi-disciplinary integration method in early childhood education can greatly improve their own abilities [3]. Lee Y's research found that an educational model combining multiple fields can improve the learning ability of kindergarten children [4]. Jung E investigated the mathematics learning situation of children in a kindergarten and found that children who like to learn art have more advantages in mathematics [5]. The way of combining two or three subjects can improve children's learning ability, but the comprehensive ability can not be comprehensive enough.

The STEAM concept is an educational model that integrates five aspects of ability. Many educational researchers have combined the STEAM concept with kindergarten science education for research. Among them, Ying surveyed more than 400 kindergartens. He found that 80% of the kindergartens wanted to implement the STEAM concept in early childhood teaching [6]. Hong J C's experiment carried out STEAM concept teaching in kindergartens, and the teacher's teaching mode was all changed to STEAM lesson plans. The experiment showed that children's learning ability was improved [7]. Zhang M's research showed that the implementation of STEAM concept in children's education can better cultivate children's self-solving ability [8]. Jaelyn conducted STEAM education for children aged 5-7. During the 9-week experiment, the children's learning ability in multiple areas was significantly improved [9]. Kim R E sets up a comparison of STEAM education and traditional early childhood education, research shows that STEAM education can improve the overall ability of kindergarten [10]. The STEAM concept can help children expand their learning areas, but there is a lack of systematic STEAM concepts in the kindergarten science education integration curriculum.

This paper studies the development of the kindergarten science education integration curriculum based on the STEAM concept. The innovations are as followings: (1) combination of the STEAM concept with kindergarten education; (2) comparison of the kindergarten science education integration curriculum of STEAM concept and the kindergarten education curriculum of traditional concept.

2. Method for the Development of Kindergarten Science Education Integration Curriculum Based on STEAM Concept

The STEAM concept is a discipline integration concept. It is developed by adding artistic elements on the basis of the STEM concept. S represents science. T represents technology. E represents engineering. A stands for art, and M means mathematics. The STEAM concept is applied to the development of kindergarten science education integration curriculum development, focusing on cultivating children's systematic and logical thinking ability, interdisciplinary ability to deal with affairs, and ability to solve practical problems [11]. The STEAM concept model diagram is shown in Figure 1.

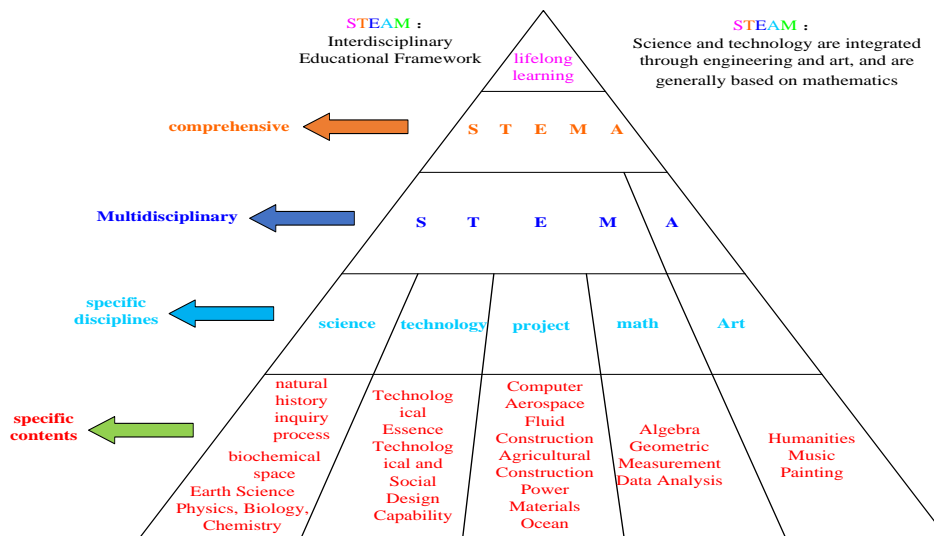


Figure 1: STEAM concept model diagram

It can be seen from Figure 1 that STEAM covers a lot of specific content, and there are many methods to support the STEAM concept. For the future kindergarten science education integration course based on the STEAM concept, it is necessary to use questionnaires and other methods to count relevant personnel's views on STEAM education, and use index evaluation to reflect the impact of STEAM education on kindergarten children [12].

2.1 Questionnaire survey method

Questionnaire survey method is a method to conduct a survey of related items on relevant personnel, and to concretize the content to be investigated into a series of measurable indicators with organic connections for quantitative measurement [13]. To evaluate and analyze STEAM kindergarten education, it is necessary to conduct a questionnaire survey of people who are exposed to STEAM education. The population of the survey is mainly children's parents and teachers.

(1) Questionnaire survey of children's parents

Conduct detailed research on children's parents, mainly to investigate their views on STEAM teaching. The research items include whether STEAM education can improve children's academic performance, whether they can improve children's liveliness, whether they can improve children's thinking ability, and whether they can improve children's learning ability [14]. Children's independence, etc. The parent object of the survey is from 200 randomly selected parents of young children who have received STEAM education. Through the survey, the number of parents who agree that STEAM education can improve children's ability is collected, and the number of parents who approve each survey and the proportion of parents are analyzed to analyze the parent's attitude towards STEAM. Perspectives on kindergarten education.

(2) Questionnaire survey on STEAM education teachers

Conduct a detailed survey of STEAM education teachers, mainly investigating teachers' views on STEAM education methods and teachers' perceptions of STEAM education's ability to educate young children. The research items include the difficulty of STEAM teaching, whether STEAM education can better manage children, whether it can improve children's academic performance, and whether STEAM teaching methods are more effective. The surveyed teachers are from 100 randomly selected STEAM kindergarten teachers. Through the survey of teachers' opinions and proportions of various surveys, the views of STEAM kindergarten teachers on STEAM kindergarten education are analyzed.

2.2 Observation

Due to the young children's age, the impact of STEAM education on children cannot be analyzed by means of a questionnaire survey, but an observation method can be used to analyze. Observation method is a process of planning and objective analysis of the target experimental group and collecting target data. It is the most basic and common method.

Observing the children who are STEAM education for one semester, during this semester, the children should not know the process of the investigation, so as to avoid affecting the observation results. The main items to be observed are: children's multidisciplinary knowledge mastery ability, children's liveliness, children's independent ability and so on.

The various abilities of kindergarten children can be determined by the performance of children in STEAM teaching activities. For example, the ability to master children's multidisciplinary knowledge can be set up by setting manual courses (building blocks) as an example. If children's building blocks are tall and regular[15]. And beautiful, it shows that the child's artistic and scientific ability in STEAM education has been improved. As well as placing children in a cluttered and disordered pile of building blocks, observe children's ability to independently build blocks, and the ability to actively learn when they can't.

The observers scored the various abilities of the kindergarten children, every other month, to observe the changes of the children's ability of various indicators in one semester.

2.3 Extension Theory Evaluation Analysis Method

Kindergarten education is the first education that children come into contact with, and early childhood education must be efficient. With the integration of the STEAM education concept, the STEAM education concept is applied to kindergarten education to give kindergarten children a more comprehensive education. In order to evaluate the teaching quality of STEAM education concept in kindergartens, an extension evaluation analysis was carried out on STEAM kindergarten teaching [16].

(1) Constructing evaluation indicators

In the construction of the evaluation index system of STEAM kindergarten teaching, the construction of evaluation indicators is very critical. Evaluation indicators can be used to judge the quality of kindergarten teaching. The establishment of evaluation indicators should meet the following conditions: The construction of evaluation indicators needs to be able to summarize the kindergarten. The main aspects of teaching include the improvement of teaching efficiency and the improvement of children's quality. Evaluation indicators must also be measurable, and only quantitative indicators can be compared and analyzed [17].

According to the principles of evaluation index construction, the indicators that STEAM course teaching methods can affect kindergarten children are analyzed. The process of establishing STEAM teaching evaluation indicators is shown in Figure 2.

(2) STEAM education method

STEAM kindergarten teaching is a way of integrating one or more subjects on the basis of kindergarten teaching. The core idea of STEAM early childhood education is to let children learn multi-disciplinary knowledge in the learning of integrated courses, improve children's independent thinking and problem-solving, improve children's creativity, and improve children's imagination. The common methods of STEAM early childhood teaching are [18]:

1) Intelligent machine teaching

Using robots to teach kindergarten children machine teaching is more interesting than traditional book teaching. Children learn with curiosity, which can enhance children's learning memory. And in the process of intelligent machine teaching, children can fully contact robots, so that they can learn

a lot of robot knowledge, such as some science and technology such as face recognition and language recognition.

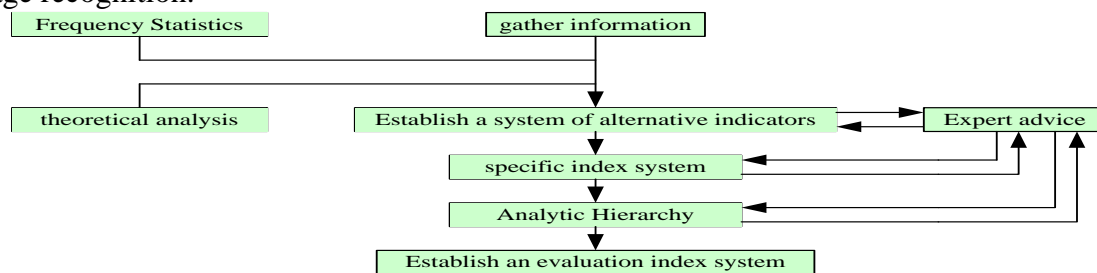


Figure 2: The process of establishing STEAM teaching evaluation indicators

2) Programming teaching

Children's intelligent programming is applied to children's teaching, and some interesting programming teaching is used to guide children to program, such as teaching children to make a simple animation applet, so that children can get access to advanced programming knowledge. At the same time, in the programming class, children's logical thinking ability can be exercised, so that children can solve problems independently in interesting programs [19].

3) Manual teaching

Adding manual elements to the STEAM curriculum for young children enables young children to enhance their hands-on ability and thinking and problem-solving skills through manual activities. For example, in the STEAM education classroom for young children, taking stacking wood as an example can make children interested in learning in the process of stacking wood. Through different ways of stacking wood, different shapes can be achieved, and children can find the best way to stack wood. In addition, children can also judge the aesthetics of the stacking blocks in the process of stacking them. Faced with different beautiful building blocks, children can make self-adjustment and creation. It trains children's independent thinking ability, problem-solving ability and cultivates children's aesthetic creation ability.

When carrying out STEAM kindergarten education, children can be divided into large classes, small classes, and middle classes. It is more convincing to conduct experimental statistics on children of three age groups. Taking the stacking wood activity as an example, let three types of children learn in the stacking wood activity, and observe the speed, beauty and way of stacking wood in the stacking wood activity. The faster the children build up the blocks, the stronger the problem-solving ability of the children, the higher the aesthetics of the children's stacking, the stronger the children's artistic and creativity, and the more effective the way of the children's stacking of the blocks, the stronger the independent thinking ability of the children.

3. Experiment of Kindergarten Science Education Integration Curriculum Development Based on STEAM Concept

3.1 Experimental Data

(1) Sample data

In order to better research the development of kindergarten science education integration curriculum development based on STEAM concept, this paper needs to investigate the kindergarten of STEAM concept. Questionnaires were conducted on teachers, kindergarten children and parents of kindergarten with STEAM concept to influence the teaching of kindergarten with STEAM concept. It mainly investigated the influence of STEAM concept contacts on STEAM, as well as their views on STEAM early childhood teaching [20].

Regarding the parents' views on STEAM education, the results of the questionnaire are shown in Table 1.

Table 1: Parents' views on STEAM education

| Serial number | Project | Approved ratio |
|---------------|---|----------------|
| 1 | Improve kindergarten children achievement | 60% |
| 2 | Increase kindergarten children's liveliness | 75% |
| 3 | Improve kindergarten children' thinking ability | 65% |
| 4 | Improve kindergarten children' autonomy | 65% |

Table 2 shows the results of the questionnaire survey on teachers' opinions on STEAM education.

Table 2: Teachers' views on STEAM education

| Serial number | Project | Approved ratio |
|---------------|-------------------------------------|----------------|
| 1 | Improve children' achievement | 81% |
| 2 | better manage kindergarten children | 72% |
| 3 | Teaching is easier | 68% |
| 4 | Teaching is more efficient | 70% |

The observation method was used for kindergarten children to observe the changes of kindergarten children during STEAM education. The observation results are shown in Table 3.

Table 3: Changes of kindergarten children during STEAM education

| Serial number | Project | Variety |
|---------------|---|---------------------|
| 1 | Children' multidisciplinary grade point average | improve |
| 2 | Children' liveliness | improve |
| 3 | Kindergarten children' independence | improve |
| 4 | Kindergarten children' basic course grades | basically unchanged |
| 5 | Kindergarten children' hands-on ability | improve |

(2) Sample correlation analysis

Through the investigation of 250 kindergarten children, 100 teachers and 200 parents, a total of 550 people were investigated. Correlation analysis was carried out on 6 aspects: kindergarten education resources based on the STEAM concept, kindergarten children' active learning, the degree of digital teaching, the acquisition of interdisciplinary knowledge, the ability to solve problems by themselves, and the efficiency of activity room learning. The correlation analysis on the teaching of young children that affects the concept of STEAM is shown in Table 4.

Table 4: Correlation analysis table of early childhood teaching based on STEAM concept

| Number of sample groups | Impact Indicator | Relevance |
|-------------------------|--|-----------|
| 1 | Educational resources | 0.085 |
| 2 | Kindergarten children' active learning ability | 0.197 |
| 3 | Digital teaching degree | 0.083 |
| 4 | Interdisciplinary knowledge acquisition degree | 0.213 |
| 5 | Self-solving skills | 0.189 |
| 6 | Efficiency of activity room learning | 0.234 |

From the correlation analysis results in Table 4, it can be seen that the efficiency of activity room learning is the best reflection of kindergarten children' learning in kindergarten, followed by the

acquisition of interdisciplinary knowledge. The two least relevant indicators are educational resources and the degree of digital teaching, which are only 0.085 and 0.083. Therefore, four indicators, including kindergarten children' active learning ability, interdisciplinary knowledge acquisition, self-solving ability, and activity room learning efficiency, are selected as the correlation indicators of kindergarten teaching.

(3) Sample validity analysis

In order to compare the pros and cons of the kindergarten science education integration curriculum based on the STEAM concept and the traditional kindergarten education curriculum, it is necessary to analyze the validity of the correlation indicators in Table 4. The experiment uses k-fold cross-validation to test the validity [21]. K-fold cross-validation is a test method when the amount of data is not very large. The experimental data is divided into k parts, and the experiment is performed k times. One part of each experiment is used as the test set, and the remaining k-1 times are used as the test set. The result of the experiment is the average value of the k experiments. Since the data dimension of this experiment is not very large, the experiment adopted a 4-fold cross-validation method. The results of the experimental cross-validation analysis are shown in Table 5.

Table 5: Cross-validation result table

| Impact Indicator | Relevance of kindergarten curriculum based on STEAM concept (%) | Relevance of traditional kindergarten education curriculum (%) |
|--|---|--|
| Kindergarten children' active learning ability | 92.0 | 88.0 |
| Interdisciplinary knowledge acquisition degree | 93.7 | 79.5 |
| Self-solving skills | 89.2 | 81.2 |
| Efficiency of activity room learning | 95.2 | 89.9 |

From the data analysis in Table 5, it can be seen that the most relevant indicator of the kindergarten curriculum based on the STEAM concept is the efficiency of activity room learning, with a correlation of 95.2%, while the most relevant indicator of traditional kindergarten education curriculum is 89.9%. The above four indicators have a high correlation for the kindergarten education curriculum of both models. Therefore, the above four indicators can be used as the basis for evaluating the quality of the kindergarten curriculum.

3.2 Comparative Experiment between Kindergarten Curriculum Based on STEAM Concept and Traditional Kindergarten Education Curriculum

The kindergarten science education integration course based on the STEAM concept is a kindergarten teaching that integrates multiple disciplines. The traditional kindergarten education curriculum adopts a one-to-many teacher guidance method and uses a subject-separated teaching model [22]. This experiment compared Kindergarten children' active learning ability, interdisciplinary knowledge acquisition, self-solving ability and activity room learning efficiency.

(1) Comparison experiment of kindergarten children' active learning ability

The active ability of kindergarten children' learning is to judge a kindergarten children's learning attitude and to recognize the kindergarten's learning model. Traditional early childhood teaching is an extremely passive teaching method. Teachers only focus on lecturing, while children are responsible for listening to the lectures. There is little communication between teachers and children

or between children and children. In order to explore the difference between the kindergarten science education integration course based on the STEAM concept and the traditional kindergarten education course in children's active learning ability, the experiment selected 6 kindergartens for the experiment. Among them, 3 kindergartens were traditional kindergartens, and the other three were kindergartens with STEAM concept. Experiments were carried out on three types of kindergarten children in the kindergarten: senior grade of kindergarten, mid-class of kindergarten and junior grade of kindergarten. The experiment was set for 6 months to compare the improvement of children's active learning ability of two types of kindergarten courses. The improvement of children's active learning ability is shown in Figure 3.

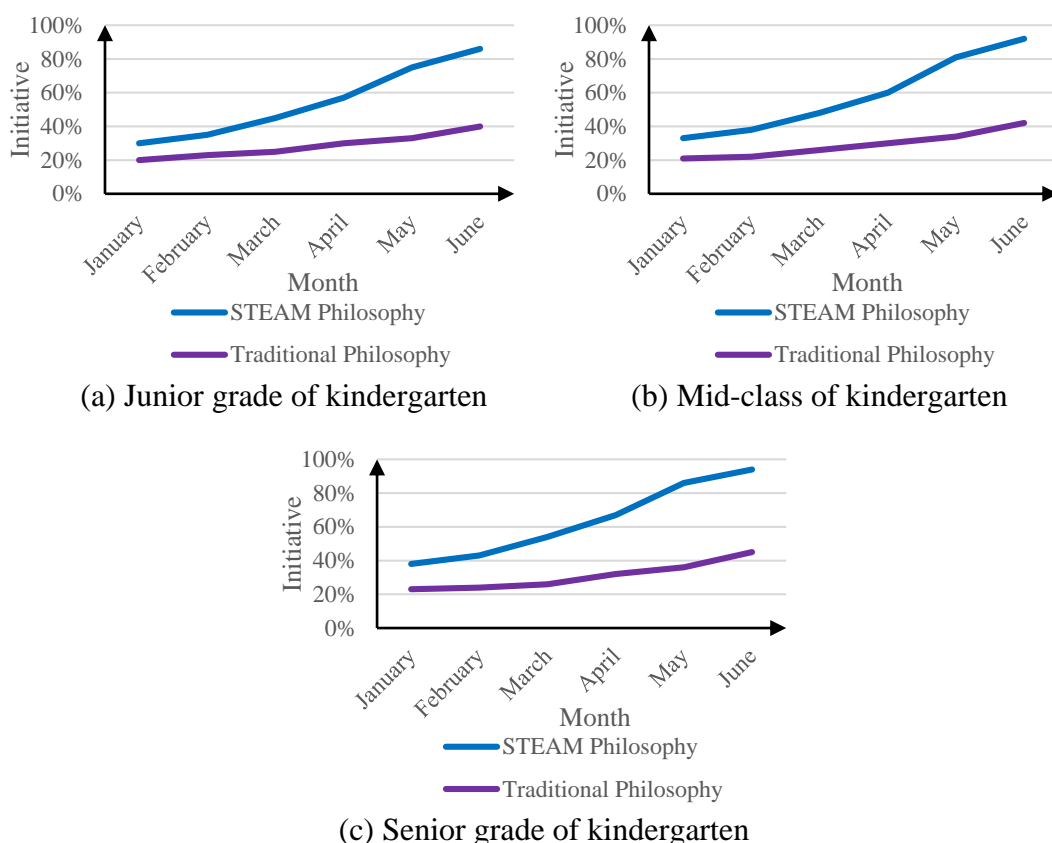


Figure 3: Improvement of children's active learning ability

From the analysis in Figure 3, it can be seen that no matter whether it is in senior grade of kindergarten, mid-class of kindergarten or junior grade of kindergarten, the degree of learning initiative after one month of STEAM concept course education is above 30%. In traditional kindergarten teaching, the degree of learning initiative after one month is between 20% and 30%. But with learning in both educational modes, children's active learning in STEAM concept courses increased over time, and by a large margin. After 6 months of STEAM concept study, the active learning ability of the three classes can be improved to about 90%. Compared with the STEAM concept, the improvement space of the traditional education model is a bit low, and it can only increase to more than 40% in 6 months.

(2) Comparison experiment of interdisciplinary knowledge acquisition degree

The acquisition of interdisciplinary knowledge is to test the breadth of the teaching content of a teaching model. The traditional kindergarten teaching curriculum is a single-course teaching form, and each class only teaches the content of one subject. The kindergarten science education integration course based on the STEAM concept will often add a variety of subject content to the

teaching together. For example, when teaching kindergarten children mathematical addition, they can draw animals by hand, and use computer technology to identify and add the drawn animals. In this process, children not only use hand-painted artistic behavior, but also have scientific calculation and taught mathematics knowledge.

In order to explore the difference in the acquisition of interdisciplinary knowledge between the kindergarten science education integration curriculum based on the STEAM concept and the traditional kindergarten education curriculum, the above six kindergartens were still selected for the experiment. The experiment of acquiring knowledge of science, technology, engineering, art, and mathematics will be tested for three groups of children in senior grade of kindergarten, mid-class of kindergarten and junior grade of kindergarten. The experiment was set up for 6 months and compared children' interdisciplinary knowledge acquisition in two types of kindergarten programs. The interdisciplinary knowledge acquisition of children is shown in Figure 4.

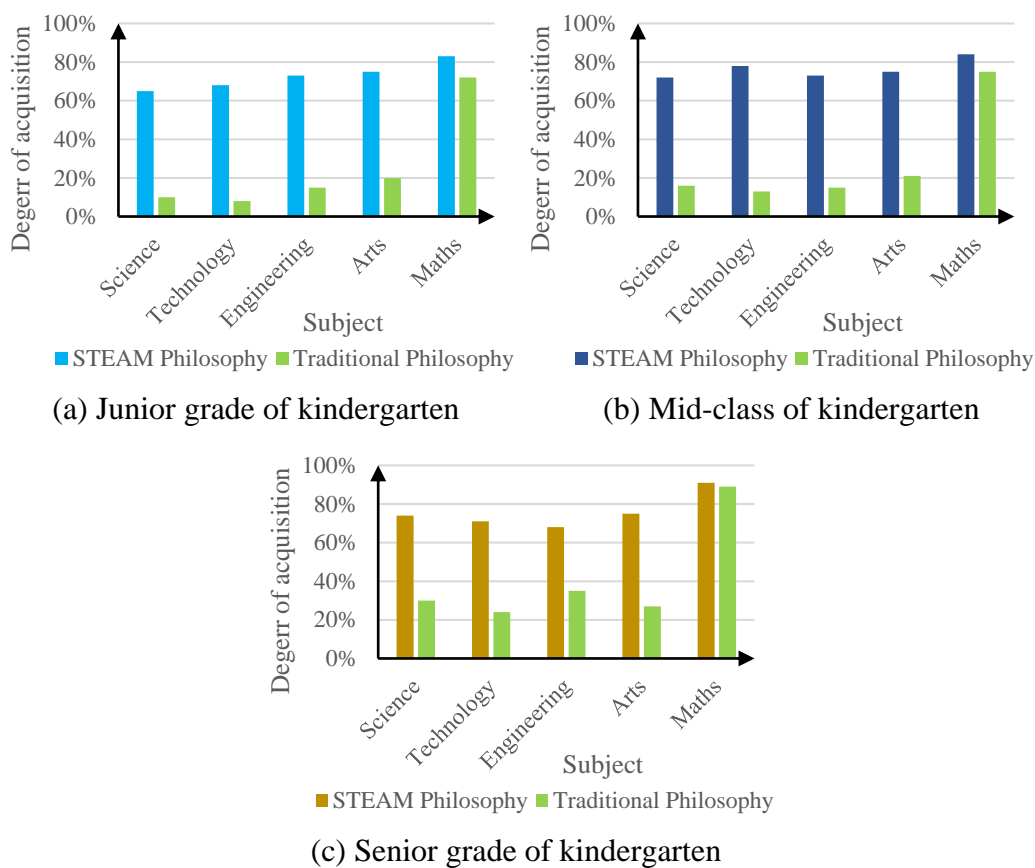


Figure 4: Interdisciplinary knowledge acquisition degree diagram of children

From the analysis in Figure 4, it can be seen that with the increase of the age of the kindergarten children, the children' knowledge acquisition ability has been improved, but the average knowledge acquisition degree of each class in general is not much different. In the three types of classes, after studying in the STEAM concept course, children can learn more than 60% of the knowledge in the five major subjects of science, technology, engineering, art, and mathematics. After the traditional curriculum, children can only get a good study in this area of mathematics, and acquire very little knowledge in other subjects.

(3) Comparison experiment of self-solving ability

A large portion of children' potential for later development is influenced by independent problem-solving. Therefore, it is very important to improve self-solving problems in childhood.

Traditional kindergarten teaching is a kind of caring and instilling teaching, which simply demonstrates how children should do it, but does not give children the exercise of self-solving problems. In order to explore the differences in the ability of self-solving problems between the kindergarten science education integration course and the traditional kindergarten education course based on the STEAM concept, the experiment carried out a 6-month teaching experiment for two types of early childhood teaching. Children's self-solving abilities were tested at monthly intervals. The comparison results of children's self-solving problem under the two teaching courses are shown in Figure 5.

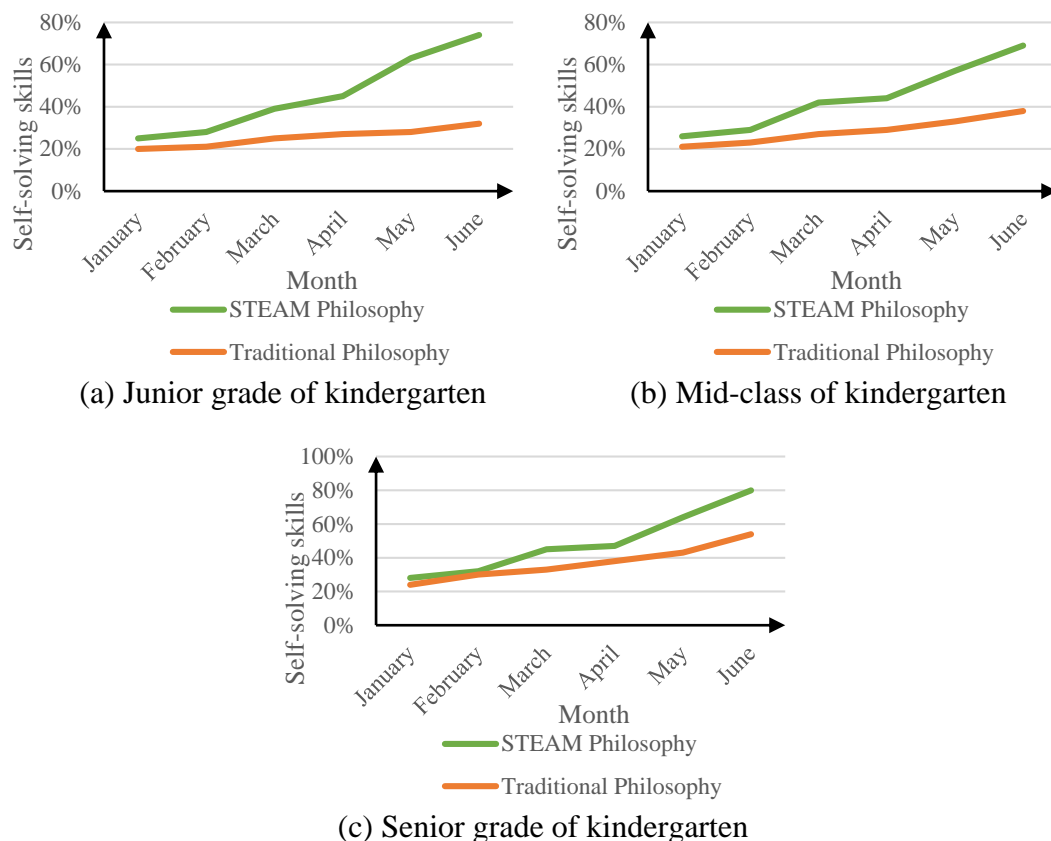


Figure 5: Comparison chart of children's ability to solve problems by themselves

From the data analysis in Figure 5, it can be seen that after one month of study in two different educational courses, there is little difference in the ability of children to solve problems by themselves, but the teaching model based on the STEAM concept is slightly better. With the increase of study time, in the three different types of classes of senior grade of kindergarten, mid-class of kindergarten and junior grade of kindergarten, children's self-solving ability under the teaching mode based on the STEAM concept has grown rapidly. It can grow to 80% when performing best in senior grade of kindergarten, while the self-solving ability of children under traditional kindergarten education grows slowly.

(4) Efficiency comparison experiment of activity room learning

The most important indicator for testing kindergarten education courses is the learning efficiency of children in activity room. The learning efficiency of children in traditional kindergarten teaching is not very high. The main reason is that the content of children's learning in the activity room is single, and no primary colors of other subjects are integrated into it. In order to explore the difference between the kindergarten science education integration course based on the STEAM concept and the traditional kindergarten education course in the efficiency of children's activity room

learning, the experiment was still divided into three categories: senior grade of kindergarten, mid-class of kindergarten and junior grade of kindergarten. This is to ensure the data of the whole period of the kindergarten. The experiment was still for 6 months, and the children's activity room learning efficiency was checked every month. The comparison results of children's activity room learning efficiency under the two teaching courses are shown in Figure 6.

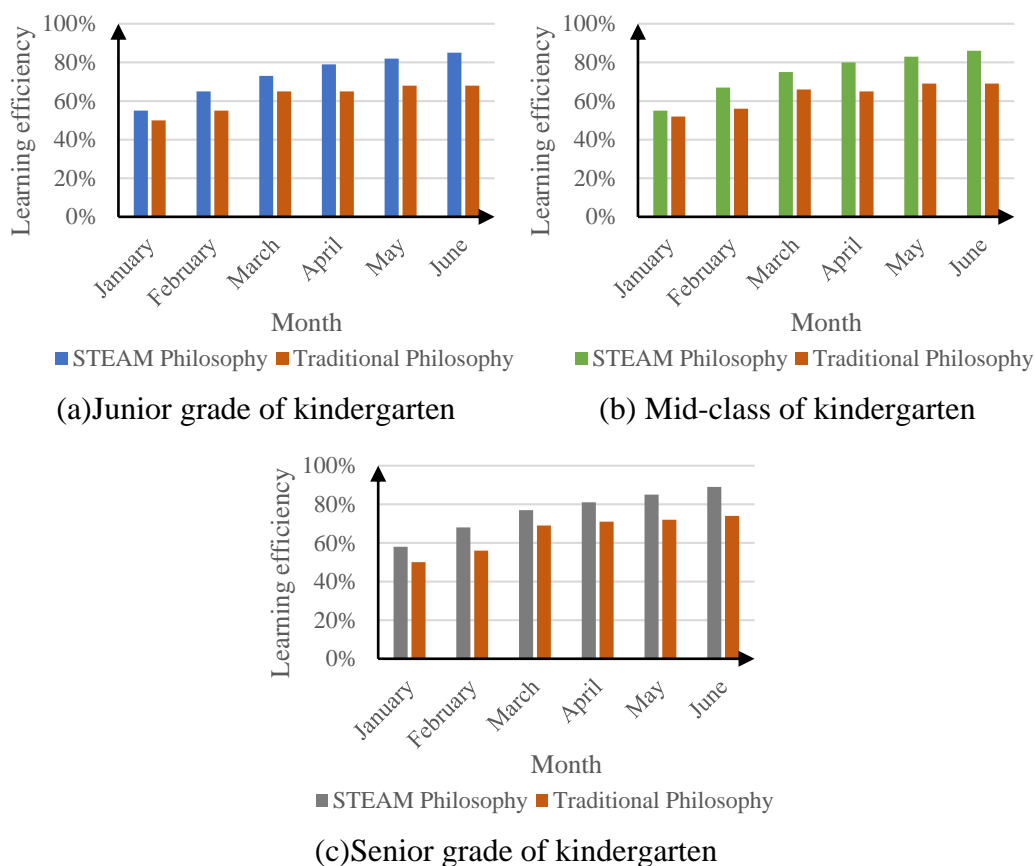


Figure 6: Comparison of the efficiency of children's activity room learning

From the data analysis in Figure 6, it can be seen that the two kinds of kindergarten education courses have similar effects on children's activity room learning efficiency in the early stage, but the learning efficiency of older children is slightly better. During the 6-month experiment, children's activity room efficiency improved much better than traditional kindergarten education under the teaching model based on the STEAM concept. The best efficiency of children's activity room learning in these two models was 89% and 74%, respectively.

3.3 Experiment Results

Table 6: Average comparison data table of two kindergarten education programs

| Compare items | STEAM Philosophy | Traditional Philosophy |
|--|------------------|------------------------|
| Active learning ability | 59.0% | 30.0% |
| Interdisciplinary Knowledge Acquisition Degree | 75.0% | 31.3% |
| self-solving skills | 46.5% | 30.3% |
| Efficiency of activity room learning | 74.6% | 63.3% |

Through the comparison and analysis of the four dimensions of children's active learning ability,

interdisciplinary knowledge acquisition, self-solving ability and activity room learning efficiency based on the STEAM concept of kindergarten science education integration curriculum and traditional kindergarten curriculum, the average comparative data of the two kindergarten education programs are shown in Table 6.

4. Discussion

With the deepening of STEAM concept research, great results have been achieved in the field of education in the way of subject integration. As people pay more and more attention to education, high-quality education for children is bound to be a problem to be solved in the future. Combining the STEAM concept with kindergarten science education, the construction of kindergartens in the future will bring higher quality teaching courses to children.

5. Conclusions

Through comparing the kindergarten science education integration curriculum based on the STEAM concept and the traditional kindergarten education curriculum in four aspects, the test results show that: (1) The average active learning ability of children in all stages of kindergarten based on the STEAM concept teaching course is 59.0%, while the traditional kindergarten education curriculum is only 30.0%. In terms of the acquisition of interdisciplinary knowledge, the average knowledge acquisition of the two education models are 75.0% and 31.3% respectively. (2) In terms of self-solving ability, the kindergarten science education integration course based on the STEAM concept is 16.2% more than the traditional kindergarten education course. In terms of learning efficiency in the activity room, it is also 11.3% more than traditional education courses. STEAM education integrates knowledge of many disciplines, which breaks the boundaries of curriculum, providing great help in the high-quality construction of kindergartens in the future. Therefore, improving children's learning efficiency in the activity room will be the research direction of the kindergarten science education integration course of the STEAM concept.

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