International Journal of Pedagogics
(ISSN – 2771-2281)
VOLUME 04 ISSUE 02 PAGES: 68-76
SJIF IMPACT FACTOR (2021: 5. 705) (2022: 5. 705) (2023: 6. 676)
OCLC – 1121105677

Publisher: Oscar Publishing Services

Journal Website: https://theusajournals.com/index.php/ijp

Research Article

PEDAGOGICAL POSSIBILITIES OF IMPLEMENTING THE CPA (CONCRETE-PICTORIAL-ABSTRACT) APPROACH

Submission Date: February 11, 2024, Accepted Date: February 16, 2024,
Published Date: February 21, 2024
Crossref doi: https://doi.org/10.37547/ijp/Volume04Issue02-13

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ABSTRACT

The increase in the flow of information in the field of sciences requires the improvement of technologies that serve to master it, and the introduction of new technologies. Learning materials consist of variables, characters, etc. However, mastering educational materials is not just learning symbols, but most importantly, being able to apply knowledge in everyday life. And abstract educational materials are very important in mastering science. This article explores the pedagogical possibilities of introducing the CPA (Concrete-Pictorial-Abstract) approach to primary education. Based on the analysis, it became clear that the CPA (Concrete-Pictorial-Abstract) approach has not been thoroughly studied by local scientists and its possibilities have not been analyzed.

KEYWORDS

Cognitive, enactive, figurative, symbolic, concrete, visual, abstract.

INTRODUCTION

It is known that misconceptions can cause great problems for students in later topics. Conceptual understanding should be considered as knowledge that students should acquire from the beginning of learning science. This is especially true when working with complex materials, involving multiple actions at the same time, or with plot issues. As a result, students face difficulties in solving problems.

After the above, we should understand that making it easier for students to work with more complex, especially non-standard problems, will reduce the number of errors in working with concepts. Properly approached exercises help students to think logically, identify patterns, draw conclusions, make arguments, and solve new and unfamiliar issues.

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LITERATURE ANALYSIS AND METHODS

The concrete-visual-abstract approach (CPA) based on J. Bruner's concept of enactive, figurative and symbolic expression methods is a technology promoted by the Ministry of Education of Singapore since the early 1980s [14].

One of the educational concepts proposed by J.Bruner in the book "Toward a Theory of Instruction" [8] is "concrete (lat. concretus - real existing, clear, clear, marked [21]) (vital)- visual-abstract)" is a concept of expression methods. This concept lays the groundwork for a number of educational practices, all of which have significant tripartite similarities with J.Bruner's model.

The algorithm of J. Bruner's model consists of the "concrete-visual-abstract" (CPA) sequence. The CPA sequence has been shown to be particularly effective for struggling students in mathematics [9].

In particular, the "concrete" link in the sequence of CPA is the use of a real object ((r. subject - thing, object) any material thing that exists outside of our consciousness [21]) that can be felt through the sense organs. serves as a theoretical basis for [23].

Fuchs and Hollenback [5] also advocated the use of the CPA sequence to teach students about ordinal numbers, geometry, and fractions.

In the practice of teaching mathematics in Singapore, J. Bruner's enactive-image-symbolic concept is based on the "concrete-visual-abstract" (CPA) approach. The CPA approach, which emerged in the 1980s, is the main educational strategy promoted by the Singapore Ministry of Education. This is evidenced by its regular mention in official educational documents, including the curriculum introduced in 2013 [13]:

Again, the CPA approach involves learning by "doing." It is particularly effective for teaching mathematical concepts and skills at the elementary and intermediate levels, and in some cases at the advanced levels. Students use manipulatives (manipulation (lat. manipulus - hand movement)) to create meaning and concepts in the exercise of learning and mastering mathematical concepts and skills. can use communicative influence [22] or other resources that lead to the activation of states (emotions, attitudes, stereotypes). Based on specific manipulatives and experience, students reveal abstract mathematical concepts or results. During training, students clearly and communicate and share their perspectives using visual expressions.The teacher's role is to guide students through concrete, visual, and abstract levels of understanding while providing appropriate support and feedback. is the role of a mediator" (Ministry of Education, 2012, p. 23, emphases added) [13].

Although CPA is now well-known within the Singaporean mathematics education community (and even beyond), it is extremely difficult to find scholarly work in the literature regarding its theoretical roots and practical application in the classroom. The study examines the origins of CPA technology and its impact on science curriculum development and teaching.

It is known that the recommended approach is to first start with more concrete teaching methods for elementary students, and then gradually replace images with formal mathematical symbols or shapes to acquire the necessary knowledge. important in mastering. For example, this is the teaching strategy recommended by Ketterlin-Geller, Chard and Fien [10].

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is important in the effectiveness of the education of students with disabilities.

In a new study using the CPA sequence for some elementary students with low math achievement, Flores [4] found that students improved fluency and increased confidence in performing arithmetic calculations. emphasizes what they have demonstrated. In addition, a number of other studies have reported that the use of CPA has had a positive effect on students who have difficulties in mastering fractions [2], word problems [18]. Therefore, using the CPA approach to teach mathematical concepts, especially at the elementary level, has been proven to be effective.

Despite similarities with other methods of determining the sequence of training, some features of the CPA approach are unique.

A number of authors [3] believed that the theoretical roots of the CPA approach belong to J. Bruner's "enactive", "image" and "symbolic" concepts.

It should be noted that views on enactivism have been reflected in a number of studies. The concept of active cognition (active cognition) or activity (enactivism) is considered as a new form of constructivism in epistemology, which includes the problems of mind and body, subject and object of cognition, cognition and life, living organism and environment, reality and virtuality. the traditional solution is obtained [26].

J. Bruner began by clearly defining the parameters to which such a theory must conform:

- determining methods of helping students to develop "tendency to learn";

- determining the ways of creating an approximate amount of knowledge for students;

- determining the most effective sequence of presentation of educational materials;

- defining rubrics.

The enactive-image-symbol concept played a role in the second and third parameters to a certain extent.

In the second paragraph about the structure of knowledge, J. Bruner introduced enactive-image-symbolic "methods of expression" [8].

Any knowledge ... can be expressed in three ways:

with a set of actions suitable for achieving a certain result (active expression);

with a set of brief images or graphics that represent the concept without fully describing it (figurative representation);

(symbolic) representation by a set of symbolic or logical sentences derived from a system of symbols regulated by formative and transformative rules or laws" [8].

J. Bruner did not mean internal mental operations; on the contrary, he paid attention to external expressions of knowledge. According to him, knowledge can be embodied in action, visual image or symbolic language. J. Bruner was a supporter of expressing the concept in every way [8].

The scope of his educational theory is, firstly, related to the amount of information needed to process expressions in understanding basic knowledge; the second is related to the potential of the student to

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acquire deeper or domain-specific concepts. J.Bruner proposed methods of expressing mathematical ideas that teachers can bring into the classroom and how they can make decisions about the realistic forms they can take to teach students using these methods.

According to J.Bruner, if it is true that the normal course of intellectual development moves from enactive to symbolic representation of the world, then the optimal sequence in education can develop in the same direction [8].

It is well known that step-by-step movement provides comprehensive learning, with particular emphasis on the gradual development of symbols in a symbolic system in alternating stages and overlapping ways.

Ultimately, the goal of the CPA (Concrete-Pictorial-Abstract) approach is to get students to freely use symbols and abstract concepts. In fact, if students work only in enactive and figurative ways, if they cannot work with symbols and abstract concepts, they will not be able to master the material sufficiently. Because, like other researchers [17], it should be noted that working freely in the field of symbols is the essence of mathematics. It is known that, in practice, in many cases when working with symbolic (symbolic) expressions, the previous stages are omitted, or in an accelerated case, the transition to this stage is observed. If the students have achieved the ability to work with the symbol system, the first two steps can be skipped. But if the learner fails to achieve the goal of solving the problem of symbolic transformations, there is a danger that he will not have figurative thinking on which to rely" (8; p. 49).

According to J.Bruner, although it is important for students to be able to work in the system of symbols, the method of symbolic representation is not necessarily "superior" to the figurative method in all mathematical situations. For example, in a problem-solving context, visual representation of a concept can be a good alternative to problem-solving. This implies that the inability to switch to another method limits the student's ability to solve problems; exposure to other methods allows students to "return". This can be interpreted as follows: if the learner learns only in a symbolic way, he will not be able to use this method effectively, causing him to "return" to restore the meaning of symbols in the symbolic way. If there are no stages of conscious learning (enactive-figurative) in other ways of expression, it will not be possible to "return"; Movement through the three modes of learning reflects "the course of normal intellectual development" [8].

It is not necessary to use all three steps unless there are potentially powerful resources for solving the problems explored in other methods. In this case, it is possible to consider an alternative teaching direction for students, bypassing the initial methods.

The CPA approach takes into account the differences between students and serves as an important empirical approach to the introduction of science ideas and methods. Due to its theoretical foundations and ease of use in education, this approach is considered effective enough.

There is a similar correspondence between Singapore's "concrete-visual-abstract" model and J. Bruner's "enactive-image-symbolic" concept. In the CPA (Concrete-Pictorial-Abstract) approach, the formal interpretation of "concrete" is not limited to "specific manipulatives" but also to "concrete experience". J.Bruner's "enactive-image-symbolic" concept is

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explained as enactive consists of activities with appropriate manipulatives. Thus, the views on "concrete" largely correspond to J. Bruner's views on "enactive". Also, the concept of "abstract" is conceptually close to the linguistic-symbolic meaning of J.Bruner's concept of "symbolic" [13].

Another source of information on understanding these terms can be found in the Singapore Mathematics Textbooks commissioned by the Singapore Ministry of Education. The CPA approach is included in these textbooks.

The Elementary Mathematics Textbook Project, led by Dr. Ho Teck Hong, aims to use effective approaches in teacher training and professional development, and to develop teaching materials for teaching and learning mathematics in elementary education. The "concrete-visual-abstract" approach to educational materials in primary education projects is promoted [11].

We reviewed primary education textbooks. A typical chapter introduction in these textbooks comes in the following order: a "real-life" situation that provides context for the featured situation or problem (e.g., the problem of dividing a pie), a visual representation of the situation or other related problem (e.g., representing pies in circles) and abstraction from visual forms to symbolic form (for example, working with numerical fractions). Thus, there is a sequence that exactly repeats the steps of CPA. However, the "concrete" things presented in the textbooks seem to deviate from J.Bruner's original concept of activity and take the form of a simple description of activity. In other words, the authors of the textbooks tried to extend the "concrete" to him not only the activity, but also this activity.

A distinction has been made between the concept of "concrete" used in projects on teaching mathematics in primary education in the early 1980s and in the curricula introduced in 2013. In this case, the concept of "concrete" corresponds to the concept of J.Bruner. According to the analysis, an important change in the 1990s was the shift from teaching to learning. In addition to educational manuals, a wide range of educational manipulatives was introduced. The teacher's role is to shape the learning experience of the respective student, including concrete experiences to support learning. Concrete experience can include educational activities, real-life contexts, or the ability to use manipulatives. Analysis of the Singapore Ministry of Education's CPA curriculum in recent years shows that CPA as an educational strategy was first introduced only in 1980 due to the results of projects on teaching mathematics in primary education. introduced. The original source was identified in the 1990 curriculum. In it, the CPA approach was officially approved as a recommended approach for teaching in junior high school classes [13].

However, there is one feature that differs from J.Bruner: "concrete", "visual" and "abstract" are described as "levels of understanding" in Singapore Ministry of Education documents. J. Bruner lists them as stages, not as "levels". The word "stages" used by J.Bruner refers to a sequence of teaching over time rather than "levels of understanding". It is known that the external forms of information expression depend on the internal psychological activity of students. Associating this with student competence is a very important step. Psychological process (as an activity) includes not only one level of mental activity in the conditions of problem solving, but also complex adaptive activity with various forms of expression.

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According to researchers, students who are able to work freely in the abstraction method have mental capabilities that allow them to solve more complex tasks.

Hence, cognitive psychologist Jerome Bruner believes that the goal of education should be intellectual development or development, not learning, teaching, or memorizing facts and information. In his research, he distinguished three stages of his cognitive concept.

Another point about CPA is that there are various ambiguities regarding the terms "concrete" and "abstract". Part of this uncertainty is due to the different definitions of these terms in different theories. In some studies, for example J.Bruner, the "abstract" stage can be defined not as the concept of working in the system of symbols, but as the final result of the process of abstraction by comparison of similarities [24]. An additional complication lies in the subjective nature of what is considered concrete or abstract. Therefore, one of the results of these ambiguities and subjectivities in science teaching, particularly mathematics teaching, is that what is considered "concrete", "visual" and "abstract" for a given body of knowledge is not universal. ; teachers must tailor methods to the needs of their students. For this purpose, the characteristics of expressions provided by J.Bruner remain a useful guide.

You can also find scientific studies on the use of the CPA approach in classes [13]. In particular, the details of the application of the CPA approach in teaching mathematics are described in the works of Long, Tap, Tap, Thilagam, Karen, Quik, Tan [14]. At first, they discussed the difficulties that their students, who are behind the indicated results, face when they encounter mathematical manipulations. According to teachers, students make a lot of mistakes when performing symbolic manipulations. Thus, their goal was to develop lessons that would help students understand the meaning of the algebra they were learning. Research based on the CPA approach aims to help students start with concrete mathematical concepts and then gradually connect them with symbolic form during lessons.

In the CPA approach, by providing the child with multiple representations of the same general idea expressed in a common symbol, the learner is helped to move from concrete sensory properties of the concept to abstract properties. In some cases, there is a "fading" period (or phase) during the "transition". Many researchers have also discussed this fading process [6, 7, 12].

We can refer to the scientific research of a number of researchers about this process [19]. For example, studies have investigated the positive effect of fading on the transfer efficiency of group theory students [20].

The duration of the fading process varies from student to student. It is important to give motivational tasks in this process.

In the CPA approach, it is desirable to use the general features of the teaching model to guide the entire process based on the steps proposed by Lewis [16], Stepanek, Appel, Leong, Mangan, and Mitchell [25]: identify the difficulties students face and so on. setting goals, developing an activity plan; conduct additional discussions; conduct the lesson.

It is known that teachers feel a lack of time when they try to pass the curriculum within the time allotted in the lesson schedule [1, 15]. When working regularly

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with limited time to cover topics, there is a natural tendency to shift to basic skills to teach each topic in the most effective way. This leads to rapid convergence with the rules and formulas that students need to master, and also means abandoning other ways of expressing information and moving directly to the "abstract" stage. However, this often leads to students not paying attention to understanding the learning material. Therefore, it provides a basis for using the CPA approach.

RESULT

Despite understanding that direct teaching of arbitrary rules jeopardizes the thoroughness of students' mastery of basic mathematical concepts, the problem of lack of time is so strong that teachers often They do not use time-consuming approaches and technologies. Therefore, any realistic attempt to implement a CPA approach must take these issues into account.

It should be emphasized that when introducing the CPA approach, it is important to start with the development of training programs that create conditions for its use. At the same time, it is impossible to implement the CPA approach for the entire curriculum. Depending on the capabilities of the CPA approach sequence, it can be used in a specific sequence of lessons. The CPA approach may not be suitable for teaching some subjects. The main focus should then be on sections where the sequence of the CPA approach is appropriate.

CONCLUSION

Developing a CPA strategy over several lessons allows for a smooth transition from one stage to the next. The duration of several lessons allows students the freedom of time to move on to the next method of expression when they feel ready. "Intensification" of the CPA approach in a certain period, for example, within one lesson, does not allow to achieve the expected results; on the other hand, extending the duration of the CPA to a longer period makes it unrealistic in terms of meeting the time frames of the training schedule.

Thus, beginning with the development of continuity boundaries is also useful in terms of teacher development. Practicing teachers can be involved in the process. Thus, teachers do not see themselves as mere "end users" of CPA-based development; on the contrary, by actively participating in the development of duration limits and sequences of teaching materials, they will not only have the opportunity to develop a critical interpretation of the CPA approach, but also contribute to clarifying its use in practical teaching in the classroom.

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