# A comparison between the problem-solving teaching method (PSTM) used in China and western countries in primary schools

Shiyin Fang

University of Glasgow G11 6PE, Glasgow, United Kingdom

**Abstract.** This study was conducted with the aim of comparing the differences in the use of the problem-solving teaching method (PSTM) between China and western countries in primary schools. In China, PSTM is based on Confucius' teaching method, while in western countries it has developed from the Socratic teaching method. According to the research literature, the main idea of PSTM can be divided into four parts: raising problems, discussing problems, solving problems and reflecting, in which the questions are raised by the teacher or students. There are similarities and differences in PSTM application between Chinese and Western classes. In addition to reviewing the main ideas behind PSTM, this paper will also compare the subjects using PSTM in schools, the school classroom setting for PSTM, the effectiveness of PTSM, PTSM and online teaching, and the challenges of PSTM application and teacher training for PSTM. It will suggest possible reasons for the differences in order to gain a more suitable effective teaching method for the current cultural background of China. Due to the integration of cultures, more and more international students go to foreign countries to study. A comparison between Chinese and Western teaching methods is not only conducive to the updating of education methods, but also promotes the exchange of Chinese and Western cultures, laying a good foundation for Chinese and Western students to learn knowledge. At the end of this study, some representative suggestions on how to solve the challenges of using PSTM and teacher training plans will be put forward.

**Keywords:** Law Teaching, Chinese and Western, Elementary School.

## 1. Introduction

### 1.1 The Socratic and Confucian teaching methods

The earliest education in China was not open to everyone. With many private schools founded by the Chinese great educator, Confucius, school education became popular in China, and the thinking behind China's modern education was gradually shaped at that time (Li Lian et al., 2021). Confucius advocated *'teaching without discrimination'*, and since then, education began to spread from officials to the masses. He believed '*reviewing the past to learning the new'*. He was not eager to instill knowledge to students, but to guide them how to learn and think by themselves. He was good at using various questions to inspire students to think and stimulate their minds (Pan, 2021). Confucius implemented teaching by asking volunteers and encouraging students to ask questions, helping them to think actively, and providing knowledge tips when students could not continue. Critical thinking was regarded as the most important thing for students by Confucius, therefore, to teach students well, teachers need to make them know how to possess materials and put the individual critical thinking into materials (Xiancheng, 1982). This is the problem-solving teaching method that firstly appeared in China.

At the same time, the Western educator Socrates also proposed answering-question in teaching, which has many similarities with Confucius' teaching methods. Meizhong (1991) pointed out in the summary of heuristic teaching methods that Socrates also opposed the way of telling conclusions to students directly, so he would like to ask questions and kept asking according to the answers of the students, make students contradict to themselves, so as to guide the students to think and draw the correct conclusions actively. Socrates asked students to use critical thinking to understand the essence of things and form concepts by summarizing specific details. This method is called Socratic method, which is also the beginning of modern western teaching methods (Kelam et al., 2019).

Ruocun (2019) and other sociologists compared the two teaching methods, they found that the teacher is at the center of the process of Socrates' dialogue, but Confucius' heuristic put students into the center of the process, however, the main idea of both of them is surrounding the contradictions of students' thinking and letting the student learn knowledge by asking. They bring the problem to the final resolution. This teaching method by enlightening students with questions has had a continuous influence on later education, and has been widely used up to now.

The teaching process involves two processes: teaching by teachers and learning by students. Huanyin (2006) pointed out that teaching method refers to the interactive activity mode adopted by teachers to guide students to learn so as to achieve the teaching purpose. It includes methods of teaching by teachers and methods of learning by students, which reflects the interaction and unity between teachers and students. Therefore, analyzing the effective use of PSTM based on Socratic and Confucian approaches, and then comparing the similarities and differences in the application environments and classroom settings enables us to do a better good job in teacher training and PSTM updating for this information age.

### 1.2 Questions to be addressed

With the globalization of education, it has become one of the important goals of primary education and higher education to cultivate students' diversified development (Zhang, 2019). Therefore, this research will take the PSTM in primary schools as the research object, summarize the main idea of PSTM in China and western country, and compare them from the following aspects based on previous literature: the application scope of PSTM, the classroom setting of PSTM, the effectiveness of PSTM, PSTM and online learning, the challenges of using PSTM, and the direction of teacher training for PSTM in the future. Through the comparison of six aspects, it will explain how to realize the diversification of teaching methods, which will guide the direction of the development of education globalization.

## 2. Methodology

### 2.1 Approach to the research questions

To establish research methodology, the underpinning paradigm should be first considered. As Brown et al. (2020) put it, *'Research paradigms help define research philosophy'*. Brown (2020) believes that the researcher should have a clear world view and provide theories and methods for philosophical research. In addition, as Kaushik (2019) said, every research follows a certain paradigm, which refers to the common basic world outlook of a particular field, consisting of unique observation perspectives, basic assumptions and research methods. It represents the basic way that scientists view and interpret the world. The research paradigm is described as thinking about the research process and implementation methods. There are two common paradigms of sociological research: constructivism and positivism. Positivism uses deductive reasoning to verify hypotheses, while expressing the relationship between independent and dependent variables through functions. (Schrag, 1992). However, positivism research does not completely rely on quantitative methods (Park, 2020). The main goal of positivism investigation is to generate explanatory correlations and predict and control causality of related phenomena through linear regression functions (Chua, 2019). However, most of the literature cited here adopts constructivism (that is interpretivism) to study the effect of teaching method through teaching diaries, teacher interview records and student achievements. Because some factors cannot be quantified by data and functional models , constructivism is mostly used in literature related to this research topic. HAY (2011) pointed that the ontology of constructivism holds that there are no natural idealists. Interpretists prefer to use experience to explain the behavior of actors, they obtain the belief and concept behind the behavior by reconstructing their behavior (HAY, 2011). The ontology of constructivism is that actions and practices are shaped by ideas such as belief, understanding, and meaning. Just as policies provide explanations for government actions, teachers' actions are also based on specific teaching ideas. Therefore,

interpretivism is not only the subject of ideological analysis, but also the medium of ideological analysis (Bevir et al., 2005). Due to the pandemic covid-19 virus, it was not possible to carry out a primary research investigation and gather local data. Moreover, comparing the similarities and differences of this teaching methods, the influencing factors cannot be expressed by specific numerical values, and the relationship between variables cannot be empirically analyzed by functional model. This study decided to adopt constructivism (interpretivism) and make use of previous research results for analysis and research. As BilauWitt and Lill (2018) say, *'The purpose of explanation is to find the cause'*.

## 2.2 Research Design

### 2.2.1 Research method

This study will use systematic review as a research method because a literature review paper synthesizes a series of findings from many empirical studies that address the research question more forcefully than a single study (Snyder, 2019). This research compares the similarities and differences of problem-solving pedagogy in different literature areas such as teaching process, policy and social environment. After analyzing a large number of publications related to the problem-solving teaching method, it was found that the eastern problem teaching method is mainly based on the educational thought of Confucius, the great educator, while the western problem-solving teaching method is derived from the Socratic teaching method of the same period (Guan, 2019). The research of PSTM based on Confucius and Socratic has always been an important topic for the integration of Chinese and Western teaching methods. So far, this paper has summarized the similarities and differences of PSTM prior to 2020, however, the covid-19 epidemic has accelerated the process of online education, and so an analysis is needed of how PSTM can be combined with the online environment. Most of the studies cited in this paper take an interpretivist paradigm as the philosophical stand. And this research will explain the relationship between the behavior of using PSTM and the results through the process of teaching by teachers.

### 2.2.2 Literature collection and analysis

The literature used in this research were obtained from CNKI (China National Knowledge Infrastructure), University of Glasgow Library and Google Scholar, inputting the key words of the problem and restricting the range year of the literature to last ten years (2012-22). Endnote was used to record literature information, every group includes: journal or publisher, title, author, publication date, part of the abstract, so as to facilitate quick retrieval. Literature on other teaching methods was not included in this research. In addition, most literature types were research literature and policy analysis, which can provide sufficient data and theoretical support for this research. The researchers analyzed and expanded the origins of problem pedagogy, Confucius and Socratic pedagogies, and collected other literature by the same author, as well as other research papers cited in this literature. As this research is about the meaning of ideas, the research factors cannot be quantified by numbers, so the literature cannot be quantitatively studied. Previous researchers have provided sufficient knowledge and conclusive data background by questionnaires and teaching diaries. According to the analysis of Thibaut et al. (2018), secondary data are also effective for most research, especially for research questions with wide scope and long span. However, due to the inability to control how data are generated, the secondary data should be screened for the suitable data. In this research, the similarities and differences of Chinese and Western PSTM were summarized through literature review in the aspects of history, subject and grade, classroom setting, effect and frequency of the method. After analyzing and comparing the literature, the further explorations based on the current situation are how to do a good job in teacher training in the future, how to better apply this method to online teaching and the challenges of updating of this method.

# 3. Results

## 3.1 PTSM and subjects taught in school

Xenofontos (2014) conducted a comparative analysis of the application of PSTM in primary schools in the UK and Cyprus. Twelve of the 24 participants came from well-known universities in each country and conducted a qualitative interview study at the end of their undergraduate education. It illustrated PSTM is often used in mathematics and other scientific subjects. This paper also reviews how PSTM has been highlighted as a key expectation of student learning. Earlier studies written by Avcu (2010) and Chapman (1997) showed that problem solving is regarded as a curriculum objective in PSTM. Identifying how to solve problems is the core goal of science teaching.

Similarly, in China, Lupu (2011) carried out a study over several weeks of a group of primary school teachers who were teaching in different grades (years). He found that PSTM activities were used by most physics and mathematics teachers, and they achieved good results, because students used available mathematical knowledge to develop their intelligence. Not only in primary school, but also in secondary schools, high schools and universities, PSTM has been widely applied in China (Cahyani, 2020). Especially in medical area, PSTM is more prominent and many medical cases are used as research subjects (Tian, 2014).

## 3.2 The school classroom setting for PSTM

Xia (2016) studied mathematics teaching of primary and secondary schools in Guizhou, China, and found that Chinese teachers often design some math problems in class for students, such as mathematical proof, algebra calculation, numerical examination. Most of them were characterized by clear statement and goals, in the form of words, and students often worked in groups. Obviously, answering the questions can help students master mathematical knowledge and skills. In the West is a long history of ‘fun and recreation’ in teaching, and Plato praised Egyptian teachers using equipment with young children to provide games in their teaching (Hamilton et al., 1961). Western teachers are accustomed to regard games as a regular part of human experience (Felmer, 2019). Hailmann (2005) believed that play was crucial for children. Personas can be passed through a set of rules, just as the game is in general in children's games. Felmer (2019) pointed out in his study that many teachers in western countries make children spontaneously participate in mathematical relations provided by specific devices through warm-up. At the same time, children’s problems can inspire the others. Brown (2005) pointed out the importance of problem-posing as part of problem-solving.

In contrast to traditional education in which spoon- feeding is often used for mathematics (Wei, 2019), the western form of math games can make students quickly get into the right state of mind and actively explore problems before solving them. A primary school in Shanghai use a game called Wuzzit Trouble, which is used to teach the four arithmetic operations (addition, subtraction, multiplication and division), the keys of a specific number are aligned with the pointer to free a trapped creature by rescuing it. The program has achieved good results in a few primary schools in Shanghai, but the game is still not applied in primary school mathematics teaching in most areas of China (Deng, 2020). Maths-math relationships are represented by analogies with physical objects. In fact, both scientific discipline and mathematical activity, mathematics consists of two aspects: ‘problem posing’ and ‘problem solving’. Therefore, when the ‘problem’ is presented in the form of a game objective, it seems not only to be the object of ‘problem solving’, but also to stimulate students' mathematical creativity.

## 3.3 Effectiveness of PTSM

Gu (2015) used 59 students in a two-month experiment in a collaborative survey of primary schools in Shanghai. In the study, an intervention framework was used to explore students' collaborative problem-solving skills in the classroom environment, and appropriate training was provided to students. It was found that improved problem-solving skills could help children to

effectively solve problems. The results showed that these students performed better than ordinary students in solving problems through planning and evidence-based reasoning in group activities.

Kusumaningrum (2020) found the effect on the problem-solving ability of primary school mathematics students by designing experiments. The type of PSTM is used as his experiment, and normality test and homogeneity test are used as the preconditions. Using independent samples, it was found that there were significant differences in the effectiveness of problem solving in learning knowledge. After improving students' ability to solve mathematical problems, students can master knowledge more effectively.

### 3.4 PTSM and online teaching

In early 2020, the novel coronavirus (that is COVID-19) outbreak occurred in most countries on earth. In order to contain the spread of the COVID-19, many schools and universities around the world were locked down (Watermeyer, 2020). This made online teaching the only feasible mode of lesson delivery and it was frequently used (Liu, 2020). Many professors have been live-streaming their classes, playing recorded course videos and using instant messaging apps such as online conferencing systems to organize discussions.

Zhang (2020) takes the teaching of ‘data structure’ as an example to discuss the design of teaching process of PSTM, and found that online education provided a solution to the crisis, but teachers should pay more attention to the method for using apps with the help of parents. Take the teaching method of data structure in basic course of computer science as an example. The main idea of the new teaching programs revolves around problems. PSTM is introduced into the online teaching of data structure, and the teaching process is divided into three stages: independent learning on the Internet, live broadcasting and answering questions, and online practice. By introducing the learning concept of problem solving into each teaching stage, problem solving becomes a bridge between teachers and students.

However, this method needs computer skill to start online learning, and so it needs parental involvement to succeed. For some worker families, they do not have much time to spend with their children. Wenping (2018) takes railway traffic safety knowledge education as an example and points out that reasonable and targeted use of ‘stories based on multimedia technology’ often makes multimedia teaching more effective. By using modern multimedia education technology, teachers can integrate text, graphics, images, sound, animation, video and other media materials according to their needs and story situation, to achieve the interactive function of question- answering with students, in this process, the performance and interaction of teaching media can be improved, Moreover, it promotes the overall optimization of classroom teaching content and teaching efficiency.

### 3.5 Challenges of applying PSTM

Xia (2016) found it difficult to apply the PSTM in primary and secondary schools in Guizhou, because students were accustomed to learning by the ‘answer’ learning method. Wei (2019) studied the beliefs and practices of preschool, kindergarten and primary school teachers in China and found that Chinese teachers were accustomed to direct teaching and spoon-feeding teaching, which hinders students' innovation ability. Chinese students do not like to ask questions. Xia (2005) proposed that guiding and encouraging students to discover and raise problems with the help of problem awareness is the primary task of mathematics teaching in China. Today, people still lack a deep understanding of the nature of teaching and its fundamental issues, such as how to deal with problem formulation, situation creation, the relationship between problem solving and teaching objectives. Therefore, although the PSTM is widely accepted and used by Chinese primary and secondary school teachers, they normally set the questions and few can actually teach students how to ask the questions for themselves (Zhang, 2002). Chinese students usually do not have the learning experience to ask math questions, and their understanding of the problems is low. In order to change the situation of many disadvantages of traditional Chinese mathematics education, such as students' low ability to ask questions and the focus on results rather than process.

Similarly, in Europe, early studies (Bennett et al., 2002) have shown that the application of PSTM in European countries also faces difficulties. Walan (2016) investigated and studied the CPD program of 12 primary school teachers in a medium-sized town in central Sweden. In the teaching process, teachers used inquiry and situational science education (IC-Base) as teaching strategies to stimulate students' interest in learning science and solve problems. Over the course of five months, participants demonstrated how to organize IC-Base to interact with students, made recordings, and verbatim transcriptions of meetings. Analysis of data was done by inductive methods using content analysis (Miles et al., 1994). Categories of teacher reflection were found by reading transcribed group discussions and teachers' personal portfolios.

However, through these research summaries, teachers also faced challenges when using these teaching strategies (Anderson 2002; Jones et al., 2007). Due to the lack of teachers' skill in teaching science in primary schools, pupil experience of these subjects was weak, and so pupils in secondary school tended to have low interest in these subjects (Hargreaves et al., 2002). Lindahl (2010) found in a longitudinal study that students' interest in science was mainly formed at the primary school stage, so it was crucial for primary school teachers to form their interest in science. Maltese (2010) concluded that additional efforts were needed to attract students' interest in science education at an early stage. Researchers such as Osborne and Collins(2003) found that most young children have a positive attitude and are interested in learning science. Unfortunately, research also shows that students' attitudes toward science begin to decline significantly between the ages of 8 and 11 (Murphy et al., 2003). Maltese et al. (2014) found in their research, most critical experience to stimulate the interest in science education was the classroom in school, so teachers were the most important people to stimulate the initial interest in science education. And elementary school teachers lack solutions to inspire students' interest.

### 3.6 Teachers training for PSTM

Chen et al. (2013) pointed out that primary school students lack of interest in science was because their teachers did not give more useful examples to stimulate their students' interest in these subjects. Over the past few years, the European Commission has also pointed out that teacher training must shift to IC-Base (that is inquiry- and context-based teaching) to develop the right skills for the future and for science education to improve. Through teaching, students are given the opportunity to ask questions based on their own experiences and current events. Furthermore, education should provide students with opportunities to seek answers to questions using both systematic surveys and various types of sources. In this way, the teaching should help students develop a critical thinking about their own results, the arguments of others and different sources of information. Through teaching, students should also develop an understanding of how claims can be tested and evaluated using scientific methods. (Swedish National Agency for Education, 2011). IC- Base is also a teaching-by-problems approach. Osborne (2008) also mention this in their review of science education. IC-Base has proved successful in stimulating students' interest in science learning (Bennett et al., 2002).

Jones et al. (2007) pointed out that primary school teachers lack experience in science, the same as Chinese teachers, and they often follow the list of book chapters, and when using inquiry, it is often done with the help of toolkits. As mentioned above, compared with western teaching, Chinese teachers can add more games into class to stimulate students' interest. Mellone (2021), by analyzing the data collected on future teacher career development programs, pointed out that future teacher professional development should be centered on the teaching method of problem-solving activities, namely the thinking classroom. From the perspective of different cultural contexts and teaching practices. Problem solving is strongly conditioned by their personal or professional experience and cultural background (Xie et al., 2020). Therefore, it is necessary to establish cross-cultural research experience, which provides valuable experience for the renewal of Chinese and Western problem teaching methods.

## 4. Conclusions and discussion

This research takes the Chinese and Western problem teaching methods as the main object of comparison. The Chinese PSTM is based on Confucius' question method, while the Western PSTM is based on Socrates' question method. Firstly, the similarities and differences of PSTM is explained by teachers' behavior in the literature through the constructivism paradigm. Through the summary and analysis of published literature, the research found that PSTM is mostly used in science in primary and secondary schools, also some case problem teaching is used in medical research in universities in China. Secondly, compared with the Chinese PSTM, which is presented in the classroom in the form of words, the western PSTM using games can motivate students to take the initiative to solve problems. Thirdly, through the literature analysis of the effect of PSTM in China and the West, it is better than the direct teaching method to improve classroom efficiency and students' thinking ability. Fourthly, COVID-19 has brought online teaching to a peak. Through some online teaching apps, this research found that the application of PSTM is better presented in the form of stories by means of audio, video, images and other tools in primary and secondary school. Fifthly, by summarizing the role of the teachers in this teaching process, we found that Chinese teachers lack of the experience of how to guide students to ask questions, while western teachers lack of experience for establishing primary students' critical thinking. Therefore, this research posed the future development direction of the teacher, it should focus on the teaching methods of PSTM activities, establishing cross-cultural research and thinking classroom experience, teachers should share successful cases of guiding students to ask questions and build critical thinking to each other. Due to the limitation of text, there is little research in this research on how to combine Chinese and Western ideas to promote the internationalization of primary and secondary education, leaving this target for a future research.

## Endnotes

Classwise – a VLE for schools https://www.classwise.com/
Mathletics – an online maths teaching and learning system https://www.mathletics.com/uk/
Schoolrun – a website full of learning apps https://www.theschoolrun.com/
Codespark – a coding/programming app for kids https://codespark.com/
ABC Micro-class http://www.cr173.com
U- class http://www.abc360.com/IntroClient
Bling abc https://www.blingabc.com/
Pothomath https://www.photomath.com/

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