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A Theoretical Review of the Effects of STEM Teacher Self-Efficacy and Teaching Style on College Students' Creativity

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Abstract

This article discusses the crucial need to enhance the self-efficacy and teaching styles of STEM teachers in order to improve the cultivation of college students' creativity and innovation in STEM education. With the increasing global demand for STEM talent, governments worldwide are promoting STEM education reform, recognizing the importance of teachers' quality and competence in achieving this goal. Studies have shown that teachers' self-efficacy and teaching styles have a significant impact on students' learning outcomes, particularly in developing their interest, thinking styles, and problem-solving abilities. However, current STEM teaching often focuses too much on knowledge transfer, neglecting the development of creativity and innovation. Therefore, improving teachers' self-efficacy and teaching styles is a vital research direction to enhance the effectiveness of STEM education.

Keywords: STEM Education, teacher self-efficacy, teaching style, creativity, innovation, college students

1. Introduction

The demand for STEM talent is continuing to increase globally as the demand for talent in science, technology, and innovation grows (Smith, 2021). Many studies have shown that the demand for innovative talents in STEM fields will continue to rise in the foreseeable future (Lee & Johnson, 2019; Zhang et al., 2020). In order to cultivate a new generation of STEM talents with innovative spirit and practical ability, governments around the world have been promoting the reform and development of STEM education to ensure the supply of STEM talents (Kramer et al., 2022). Specifically, the United States, the United Kingdom, Australia and other countries have introduced national strategies and funding programmes to support the development of STEM education (Taylor, 2020). China has also taken the enhancement of STEM education as an important initiative to build an innovative country (Chen, 2021).

In STEM education, the quality and competence of teachers are particularly critical (Zhang et al., 2020), which directly affects whether STEM education can achieve the goal of cultivating students' innovative abilities. In particular, the

self-efficacy of STEM teachers and the teaching styles they adopt have been shown in numerous studies to have a profound impact on students' interest in learning, thinking styles, and problem solving abilities (Liu, 2021; Chen, 2022). This is mainly because teachers' self-efficacy and teaching styles affect the content, teaching methods, and classroom atmosphere (Wang, 2021). However, STEM teaching in many parts of the world still focuses too much on knowledge transfer and fails to develop students' creativity and innovation (Wang, 2020), which has become one of the core problems in STEM education. How to improve the self-efficacy and teaching style of STEM teachers so as to enhance the cultivation of college students' creativity and innovation in STEM education is a hot research direction in the field of STEM education nowadays (Lee & Johnson, 2019).

The purpose of this paper is to clarify the relationship between STEM teachers' self-efficacy and teaching styles and college students' creativity and the underlying mechanisms through a literature review. Existing studies have gained some insights into this issue, but the conclusions vary slightly across disciplines and cultural contexts, and the causality and specific pathways of this influence mechanism have been less explored (Kim, 2020). Meanwhile, the existing studies are mainly at the level of qualitative analyses, and there are relatively few empirical studies and teaching-specific intervention studies (Taylor, 2021). Therefore, this review can systematically sort out the current status of research, main ideas and shortcomings in related fields, and provide a theoretical foundation and a direction for future research on STEM education. This is of great significance in guiding the reform and practice of STEM education and improving the quality of STEM talent cultivation (Zhang et al., 2020).

2. STEM Teacher Self-Efficacy and College Student Creativity

Let's dive right into the heart of the matter: the concept of a teacher's self-efficacy. At its core, it boils down to how much faith teachers have in their own capabilities. Think of it as their internal cheerleader, always chanting, "You got this!" whenever they face a classroom challenge. Chen (2018) hit the nail on the head, describing it as the backbone of an educator's belief that they can usher in meaningful educational outcomes. But here's the thing: it's so much more than just picking which textbook to use or what fun project to assign next week. It's the lifeblood of the connections they nurture with their students. When teachers back themselves, they aren't just walking through lessons; they're crafting educational experiences, paying keen attention to individual needs, and being fearless in their approach.

But let's zoom out a bit. A teacher's confidence, while pivotal, is just one color on the vast canvas of student creativity. Tao Zhang's 2020 research opened up a Pandora's box of insights. It's not just about the teacher; it's a jigsaw of elements. The burning fire of a student's motivation, the echoes of their family dynamics, the invisible threads of trust weaving between a student and their teacher — each plays its role in shaping a student's creative flair. So, by all means, let's cheer our teachers on and boost their confidence! But let's also remember there are myriad other pieces to this puzzle. The relationship between a teacher's confidence and their student's creativity isn't just a simple cause-and-effect scenario. Different subjects bring different dynamics, and the cultural and educational context, especially in STEM, throws its own curveballs. Li Jing, in 2022, threw us a curveball, spotlighting how every academic discipline has its own rhythm, its unique dance with creativity. So, whenever we're mapping out this intricate terrain of teacher confidence and student creativity, it's a must to keep in mind the vast landscape of variables.

So, what's the takeaway here? Boosting a teacher's self-belief? Absolutely a game-changer for lighting up creativity in STEM students. But remember, it's like trying to understand a symphony by just listening to the violins. Important, yes, but part of a grander ensemble. To truly grasp it, we need to hear every instrument, appreciate every nuance, and only then can we get a sense of the beautiful, complex masterpiece that is education.

3. STEM Teachers' Teaching Styles and College Student Creativity

Loads of research out there suggests that when it comes to firing up college students' creative juices, old-school teaching methods just aren't cutting it. Instead, STEM teachers are hitting a home run with inspirational and inquiry-based teaching, and we've got folks like Zhang Li (2020) and Yang Cui (2021) to back that claim. So,

what's the magic behind this approach? Well, it's all about getting students to roll up their sleeves, dive in, think critically, and get their hands dirty. It's like giving them an open playground for their minds, where they can flex their brain muscles and let their creative sparks fly. To drive this point home, Chen and team (2021) threw in a neat experiment with case studies. And guess what? They saw the students' creative ideas skyrocketing during the discussions.

But wait, there's more to the story. Group work? Oh, it's a game-changer. Just picture a bunch of college students huddled up, bouncing ideas off each other, and feeding off each other's energy. These collabs, like forming student squads to go Sherlock Holmes on investigations, can work wonders for sparking creativity. And to prove it, Ismail's 2019 research dropped the mic by showing how forming student project teams was like adding rocket fuel to the creative process in STEM classrooms.

Now, here's the curveball. It's not all about the teaching method. There are some backstage players in the game. Factors like how much mojo a teacher feels they've got (yeah, that's self-efficacy for the uninitiated, courtesy of Lee, 2019) and even the cultural backdrop where all this teaching magic is happening (big shoutout to Kai Wang, 2019) can twist and turn the effects of a teaching style on creativity.

So, what's the bottom line? Bringing inspiration and teamwork into STEM classrooms can totally give college students the creative boost they need. But let's not get tunnel vision here. There are other gears turning in the background that we've got to dig deeper into.

4. Research on the Creativity of University Students

There's a buzz in the air right now about sparking creativity in our university students, and for good reason. Dive into the research, and you'll see plenty of fascinating insights into what makes these young minds tick and burst with innovation. Delving into the personal and surrounding vibes that influence their creative prowess, Hu Lin (2020) unearthed a gem: the ambiance of one's household and their drive to learn can light up or dim their creative spark. But, let's not forget about the educators, especially those rocking the STEM world.

Drilling down into the teaching realm, it's becoming crystal clear that STEM maestros have a power move up their sleeves: heuristic and inquiry-based teaching. And believe me, the stats back it up. Zhang Li (2020) brought to light that these modern teaching tricks can fire up students' creativity way beyond the old-school chalk and talk (Li Juan, 2020). But, the plot thickens! It's not just about how the material's delivered. The way students team up and tackle problems together, that whole 'collaborative teaching' gig? Well, that's a potent elixir for creativity too, as Ismail (2019) will tell you (Jing Zhang, 2021). Oh, and let's not sideline those educators who strut into the classroom, chests puffed out with confidence. Yang Cui (2021) showcased that teachers who truly back themselves are the ones really championing creative thought.

Wrapping it all up with a bow, it's a dance between the personal vibes and the environment that shape creativity in our college crowd. And if you're looking for MVPs in this game, cast your eyes on the teaching styles and the can-do attitude of STEM educators. There's still a treasure trove to unearth on this front, and future research has its work cut out. Here's to hoping they keep peeling back the layers and guiding educators everywhere!

5. Significance of the Study

The implications of the research on the impact of STEM teachers' self-efficacy and teaching styles on college students' creativity are as follows.

5.1 Theoretical Implications

1) The applicability of teacher self-efficacy theory and teaching style theory in the field of STEM education can be verified and extended.

2) It can enrich the relevant theories of STEM education and college students' creativity cultivation.

3) The influence of different disciplines and cultural backgrounds on research findings can be explored, expanding theoretical perspectives.

5.2 Practical Implications

1) The results of the study can inform the development of self-efficacy in STEM teachers.

2) the findings of the study may provide a basis for improving STEM teaching styles and methods.

3) The study can provide theoretical guidance to enhance the cultivation of college students' creativity by STEM education.

4) The study can promote the international exchange of ideas and experiences in STEM

education.

In conclusion, this study has the dual significance of enriching theory and guiding practice, and will promote the progress of STEM education and teaching reform.

6. Current Problems

With the implementation of innovation-driven development strategy, China is in urgent need of a large number of excellent STEM talents with innovative spirit and creativity. However, existing studies show that a considerable portion of STEM teachers have low self-efficacy and a single teaching method (Wang Kai, 2019; Li Juan, 2020). This is not conducive to the cultivation of college students' creativity.

The specific problems are mainly.

1) STEM teachers' self-efficacy is poorly evaluated, and their self-confidence in stimulating students' creativity is insufficient (Jing Zhang, 2021).

2) The dominant teaching mode is still based on knowledge transfer, and the cultivation of students' creative thinking is neglected (Ismail, 2019).

3) The intrinsic mechanisms of self-efficacy and teaching style on students' creativity in different disciplines and cultural contexts need to be studied in depth (Li Lin, 2020).

In order to improve the quality of STEM education for the cultivation of college students' creativity, it is necessary to analyse the relationship between STEM teachers' self-efficacy, teaching style and students' creativity through investigation and research, and to clarify the mechanism of their role, with a view to improving the teaching methods and cultivating more innovative talents.

7. Outlook for Future Research

With regard to future perspectives on research on the impact of STEM teachers' self-efficacy and teaching styles on college students' creativity, I summarise the following.

7.1 Expanding the Research Sample

Future research can expand the sample size and conduct large-scale questionnaire surveys or tests to make the research findings more representative. The samples can be selected from different types of universities and different regions to make the samples more diversified. Meta-analysis can also be used to integrate sample data from different studies to increase the robustness of the findings.

In addition, multi-country comparative studies can also be designed by selecting samples from China, Malaysia, and the United States and the United Kingdom to compare the differences in the effects of the independent variables on the dependent variables in different cultural contexts. Alternatively, multi-country comparisons can be made by investigating samples from several countries at the same time in a single study, so that the moderating effect of cultural factors can be observed more intuitively.

By expanding the sample size and making cross-country comparisons, future research can make the conclusions more generalisable and examine the role of cultural factors as moderating variables, so as to provide lessons for STEM education policies and practices in different countries. This will be of great significance in promoting the theoretical development and experience sharing in the field of international STEM education.

7.2 In-Depth Exploration of Impact Mechanisms

Afterwards, the study can use more rigorous empirical research methods, through questionnaires or experiments to explore the path and internal mechanism of the influence between the independent variables and the dependent variable. For example, possible mediating variables, such as teaching attitudes and students' commitment to learning, can be introduced to explore their mediating role in the influence of the independent variables on the dependent variable.

In addition, intervening factors can be set as moderating variables to test their moderating effects. For example, teachers' years of experience, subject areas, and types of programmes may modulate the extent and direction of the effect of the independent variable on the dependent variable. This could present a richer and more dynamic research model.

The analysis of mediating and moderating effects can make the research results closer to the complexity of the actual situation of teaching, and can also provide a basis for the decision-making of teaching in different contexts. This is of great significance in understanding the influence mechanism and enriching the theoretical model.

7.3 Conducting Research on Pedagogical

Interventions

Based on the theoretical analyses, future research could design different types of pedagogical interventions to test the findings. For example, one group of STEM teachers could be trained in self-efficacy and another group could be trained in innovative pedagogical methods, and the effects of these two types of training could be observed on both teachers and students. A control group could also be set up for comparison.

Through teaching intervention experiments, it can be verified which strategies are more effective in improving STEM teachers' self-efficacy, optimising their teaching styles, and thus enhancing students' creativity. This kind of empirical research can provide a basis for STEM teacher training and teacher competence improvement.

It is also possible to experiment with teaching interventions for students, such as specific creativity development programmes for some students, to see if their creativity improves even more. This could verify the actual effectiveness of the pedagogical response.

7.4 Application of Research Results

The theoretical findings and empirical results of the future study should be further translated into policy formulation and teaching practice improvement measures for education policy makers and frontline teachers to improve the quality of STEM talent training. For example, research on the factors affecting teachers' self-efficacy and teaching styles can be translated into teacher training policies and targeted teacher training programmes. Research on the effects of innovative pedagogical methods can also be translated into actionable instructional design programmes and model curricula.

The implementation of these translational applications will help to improve the professionalism of STEM teachers, optimise the STEM teaching process, and thus enhance students' innovative thinking and creativity. This is an important step towards realising the practical value of the research findings.

7.5 Strengthening International Co-Operation

Future research can strengthen exchanges and cooperation in the field of STEM education research among different countries and promote the sharing of research theories and practical results. For example, an international STEM education seminar can be organised, inviting experts and scholars from different countries to participate in the exchange of theoretical views and discussions. It is also possible to establish an international alliance of STEM education research institutions to carry out multi-centre joint research projects and share research results. In addition, different countries can jointly set up STEM teacher training bases to exchange teacher training and project results. Or they can establish an international STEM quality curriculum library to share curriculum and teaching resources. These international co-operations can promote the mutual learning of theories and practical experiences of different countries, and help to promote the progress of international STEM education research and improve the quality of STEM talents training.

This paper explores the relationship between STEM teachers' self-efficacy and teaching styles and college students' creativity through literature review. Firstly, the higher the self-efficacy of STEM teachers, the more enthusiastic they are in teaching and the more open-ended pedagogies they adopt, which can effectively stimulate college students' creativity. However, this relationship may vary in different disciplinary contexts. Secondly, compared with traditional teaching methods, STEM teachers can better cultivate students' innovative thinking and creativity by adopting inspirational teaching and cooperative learning. However, teaching effectiveness is also affected by cultural differences and teachers' self-efficacy. Existing studies do not have a deep enough understanding of these issues, the theoretical foundation is weak, and empirical studies are insufficient. In the future, we can expand the scope of the sample, explore the mechanism in depth, and carry out pedagogical intervention studies to optimise the cultivation of college students' creativity through STEM education.

In summary, this paper has sorted out the relationship between STEM teachers' self-efficacy, teaching style and college students' creativity through the literature review, and put forward the outlook of future research, with a view to providing reference to improve the quality of STEM education.

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