Working together
www.rcis.ro

Revista de Cercetare si Interventie Sociala

ISSN: 1583-3410 (print), ISSN: 1584-5397 (electronic)

EFFECTS OF THE APPLICATION OF STEAM EDUCATION ON STUDENTS' LEARNING ATTITUDE AND OUTCOME - FUJIAN CHUANZHENG COMMUNICATIONS COLLEGE

Fenxia HUANG

Revista de cercetare și intervenție socială, 2020, vol. 69, pp. 349-356

https://doi.org/10.33788/rcis.69.23

Published by:
Expert Projects Publishing House

expert projects
publishing

On behalf of:
„Alexandru Ioan Cuza" University,
Department of Sociology and Social Work
and
HoltIS Association

REVISTA DE CERCETARE SI INTERVENTIE SOCIALA
is indexed by Clarivate Analytics (Social Sciences Citation Index),
SCOPUS and CROSSREF

Effects of the Application of STEAM Education on Students' Learning Attitude and Outcome - Fujian Chuanzheng Communications College

Fenxia HUANG[1]

Abstract

Going through the major change of learning styles in the 21st century, traditional single-field education and productive labor oriented and targeted education could no longer satisfy the social needs. The education model of STEAM becomes the latest issue, with which people create brand-new professional fields through the integration of science, technology, engineering, arts, and mathematics to have the future students keep up with the advance. With experimental design, total 198 students of Fujian Chuanzheng Communications College are studied. A half of them are in the experimental class (99 students) for STEAM education and another half are the control class (99 students) for traditional education. The research results show significant effects of 1.STEAM education on learning attitude and 2.STEAM education on learning outcome, and 3.remarkably positive effects of learning attitude on learning outcome. According to the results, suggestions are proposed, expecting to help Fujian Chuanzheng Communications College exceed traditional apprenticeship education in the systematicness and effectiveness of teaching, the modernity of teaching content, and the strictness of assessment.

Keywords: shipbuilding institution, STEAM education, learning attitude, learning outcome, social needs, social environment.

Introduction

Machines replaced manpower in the first Industrial Revolution; the emergence of internal combustion engines and electrification deeply affected the society in the second Industrial Revolution; and, a mass production world in the third Industrial Revolution resulted in mass production of various products with promoted quality but lower prices that rich product diversity appeared in human society. The power of the fourth Industrial Revolution is slowly emerging in past years. Technologies of networking, artificial intelligence, and Internet of Things are implemented in

[1] Faculty of Education, Fujian Normal University, Fuzhou, CHINA. E-mail: fenxiahuang@hotmail.com

the manufacturing and products to induce changes in mode of production. The proportion of traditional labor and technology becomes smaller and mass production is not the major competition, while personalized and customized production presents better competitive advantage. Under the effect of the fourth Industrial Revolution, people also experience the major change in learning styles. Traditional single-field education and productive labor oriented and targeted education could no longer satisfy the social needs, while the education model of STEAM becomes the latest issue. The boundary among physics, mathematics, biology, and arts becomes ambiguous in the future generation. People would create brand-new professional fields through the integration of science, technology, engineering, arts, and mathematics to have future students keep up with the advance. Current education system with subject-specific teaching is inappropriate in the cultivation of students' knowledge integration and real world problem solving abilities. The talent cultivation in the 21st century therefore should not emphasize spoon-feeding knowledge recitation and memorization, but should stress on students' integration and application of subject knowledge and flexible problem-solving ability in STEAM. In other words, education in the new age should focus on the connection between subject knowledge and practical application, stress on interdisciplinary integration and application, and have students, through hands-on or project-based learning, experience the integration of knowledge and the application of tools and proper skills to solve real world problems. Fujian Chuanzheng Communications College, the start of modern vocational education in China, bravely challenged old education of "official schools" and "private schools", innovated the 1300-year imperial examination and the education model stressing on teaching but ignoring skills, insisted on "Chinese learning as substance, western learning for application", absorbed the essence of western civilization, taught science and technology, created the new model of technology talent cultivation in China through theoretical learning and practical operation, and cultivated innovative talents taking on the country and technology literacy for the country. The educational practice of shipbuilding institution contained the tinder of current apprenticeship, craftsmanship, and STEAM education in China. The review of the educational process presented important value and meanings on the construction of vocational education system with Chinese style. In this case, the effect of Fujian Chuanzheng Communications College applying STEAM education on students' learning attitude and outcome is discussed in this study, expecting to help Fujian Chuanzheng Communications College exceed traditional apprenticeship education on the systematicness and effectiveness of teaching, the modernity of teaching contents, and the strictness of assessment.

Literature review

Hong (2017) mentioned that the promoted national basic education stressed on the central concepts of subjects and the integration of interdiscipline into social issues in life, emphasized the exploration and practice of science, and cultivated students presenting learning attitude and ability. STEAM courses developed from the USA was student centered, combined interdisciplinary knowledge, had students operate the experiments, and focused on learning to meet practical needs. Consequently, the spirit of STEAM was integrated into the interesting curriculum design of force and applied to the active exploration and problem solving in daily life. Awad & Barak (2018) studied pre-service teachers in the field of science and technology and stated that teachers for the promotion of STEAM courses should be the departments related to science, technology, engineering, and mathematics to more easily integrate relevant knowledge, guide students to combine with life issues, and effectively enhance students' learning attitude. Krajcika & Delenb (2017) mentioned that STEAM education was the problem-based teaching with the application of real world situations, where students needed to solve problems with the skills of cognition, interaction, coordination, and creation in various subjects; and, there was no standard answer for the problems. In the unknown world, STEAM education presents great advantage, compared to current education, to efficiently cultivate students' learning interests and attitude as well as promote the ability. In this case, the following hypothesis is proposed in this study.

H1: STEAM education presents significant effects on learning attitude with remarkable differences.

Paik, Kim, & Lee (2018) integrated 3D modeling and printing in STEAM-based quasi-engineering courses to promote students' learning achievement and enhance the technology learning attitude. Maslyk (2017) indicated that STEAM teaching allowed students starting the design from persons to design more practical works and integrating several engineering contents to promote the effectiveness and practical skills. Barbre (2017) integrated STEAM courses into VR teaching to enhance students' abstract concept learning outcome and strengthen students' practical ability. Jamil, Linder, & Stegelin (2017) stated that the practice of STEAM courses could enhance students' interests, attitude, and specific success experience of the course as well as help students think and integrate the connection between knowledge and actual engineering. Carol (2017) indicated that students promoted the problem solving ability and attitude and females increased the self-confidence in solving problems after the problem-based STEAM course in a term, and the practice could induce students' interests and help students integrate subject knowledge to further promote the technology exploration ability on energy-related issues. The following hypothesis is therefore proposed in this study.

H2: STEAM education shows notable effects on learning outcome with significant differences.

In the research on the relationship between students' learning attitude, learning satisfaction and learning performance, Yoon & Kim (2016) discovered that students with more learning experience in thinking and analysis showed higher learning satisfaction and learning performance. In other words, better learning attitude towards relevant courses revealed higher learning outcome. Budinski, Lavicza, & Fenyvesi (2018) stated that learning outcome played a critical role in learning attitude, as better learning attitude could guide better learning outcome. Quigley, Herro, & Jamil (2017) pointed out notably positive correlations between learning attitude and learning outcome of hospitality and tourism students in vocational high schools. Karolyn (2017) discussed learning attitude and learning outcome of hospitality and tourism students in vocational high schools with work study program and proved the significantly positive correlations. Donegan-Ritter (2017) proposed that enhancing students' learning motivation could promote students' learning outcome. Students with interests would understand and participate in learning with positive and affirmative learning attitude to promote the learning motivation and learning outcome. For this reason, the following hypothesis is proposed in this study.

H3: Learning attitude reveals remarkably positive effects on learning outcome.

Methodology

Measurement of research variable

1. *Learning attitude*. Referring to Fan & Yu (2017), learning attitude contains two dimensions of 1.intrinsic motivation and 2.extrinsic motivation in this study. The overall reliability coefficients appear intrinsic motivation 0.85 and extrinsic motivation 0.87.
2. *Learning outcome*. Referring to So *et al*. (2019), learning outcome is measured with term assessment.

Research object and research design

To effectively achieve the research objective and test the research hypotheses, quasi-experimental design is applied in this study. Total 198 students of Fujian Chuanzheng Communications College are divided into the experimental class (99 students) for STEAM education and the control class (99 students) for traditional education.

Analysis method

Analysis of Variance is applied to discuss the difference of STEAM education and traditional education in learning attitude and learning outcome, and Regression Analysis is further utilized for understanding the relationship between learning attitude and learning outcome in this study.

Results and discussion

Effects of STEAM education on learning attitude and learning outcome

Difference analysis of STEAM education in learning attitude. According to the discussion of STEAM education and traditional education in learning attitude with Analysis of Variance, *Table 1* shows remarkable difference in intrinsic motivation between STEAM education and traditional education; STEAM education (4.16) is higher than traditional education (3.67). STEAM education appears notable difference from traditional education in extrinsic motivation; STEAM education (4.07) appears higher than traditional education (3.53). Accordingly, H1 is supported.

Table 1. Difference analysis of STEAM education in learning attitude

variable		F	P	Scheffe posteriori test
STEAM education	intrinsic motivation	17.523	0.000***	STEAM>traditional education
	extrinsic motivation	23.187	0.000***	STEAM>traditional education

** stands for $p<0.05$*

Difference analysis of STEAM education in learning outcome. According to Analysis of Variance, the difference of STEAM education and traditional education in learning outcome is discussed in this study. From *Table 2*, STEAM education reveals notable difference from traditional education in intrinsic motivation in learning outcome; STEAM education (4.21) is higher than traditional education (3.42). H2 is therefore supported.

Table 2. Difference analysis of STEAM education in learning outcome

variable		F	P	Scheffe posteriori test
STEAM education	learning outcome	43.215	0.000***	STEAM>traditional education

** stands for $p<0.05$*

Correlation analysis of learning attitude and learning outcome

The research analysis results, *Table 3*, reveal significantly positive effects of intrinsic motivation (β=0.275***) and extrinsic motivation (β=0.316***) in learning attitude on intrinsic motivation in learning outcome that H3 is supported.

Table 3. Analysis of learning attitude to learning outcome

dependent variable→	learning outcome	
independent variable↓	intrinsic motivation	
learning attitude	β	P
intrinsic motivation	0.275	0.000***
extrinsic motivation	0.316	0.000***
F	37.481	
significance	0.000***	
R2	0.358	
adjusted R2	0.327	

*Note: * stands for $p<0.05$ and ** for $p<0.01$.*

Data source: Self-organized in this study

Conclusion

It is discovered in the research results that STEAM education is the national development strategy proposed by the USA to cope with future social challenges as well as the comprehensive education principle and education integrating science, technology, engineering, arts, and mathematics. It represents the mutual link of subjects in various fields under different topics and the connection with the real world. The central principle is to create an authentic problem-based situation for students comprehensively applying the learned knowledge to creatively solve complicated problems in the real life, aiming to cultivate innovative high-technology talents with interdisciplinary integration to maintain the international leadership and competitiveness of the USA. Fujian Chuanzheng Communications College could not cultivate talents to cope with “the change in millennium” with traditional education. Under the situation of urgent needs for technology talents, “engineering combined” new-style teaching model is adopted to break through old model of traditional education, open the new page of education in China, and cultivate technology talents for shipbuilding in order to save the country. The talent cultivation goal and practice of Fujian Chuanzheng Communications College highly match the content of STEAM education to promote technology education in the cultivation of new-style talents. STEAM education appears in the practice process, where technology is grasped and the requirement for talent cultivation focuses on the new development of world technology.

Suggestions

Aiming at above research results, the following suggestions are proposed in this study.

1. Both Fujian Chuanzheng Communications College and STEAM education show the apprenticeship education model, present stronger practical characteristics, and reflect the essential feature of vocational education, i.e. "learning by doing". They focus on solving real problems or project tasks for organizational teaching, apply various demonstrations in the practice to explicit hidden processes, encourage students' observation and comment to gradually develop skills, and have novices participate in the construction process to gradually complete the problem cognition and enhance skills. Knowledge generated in the practice situation is the most powerful wisdom in the real world.

2. The curriculum setting of Fujian Chuanzheng Communications College, from the perspectives of comprehensive cultivation of knowledge, ability, and literacy, precedes multi-disciplinary integration and establishes science professional systems to present certain practice and connection among subjects. 1. Practice: The curriculum setting of Fujian Chuanzheng Communications College focuses on science and technology knowledge and aims to produce and drive ships. 2. Connection: Foreign languages and mathematics are learned in each profession. The curriculum setting reflects the learning concepts of western technology, "mastering western language" and "starting from mathematics". Each profession presents distinct cultivation goal that unique courses are set to form special systems. However, such courses would complement each other in the practice. It does not simply match the standard of vocational education curriculum structure, but comprehensively reflects the goal of schools cultivating practical talents.

3. STEAM education, by integrating various subjects, emphasizes the integrative cultivation of students' science, technology, engineering, and mathematics literacy, with interpenetration and mutual complementation to fully develop the function of innovative practical talent cultivation. When the social environment becomes complex in the digital age, the design of thinking ability, problem-solving ability, and cooperation ability becomes the primary education goal in STEAM education.

References

Awad, N. & Barak, M. (2018). Pre-service Science Teachers Learn a Science, Technology, Engineering and Mathematics (STEM)-Oriented Program: The Case of Sound, Waves and Communication Systems. *EURASIA Journal of Mathematics, Science and Technology Education*, *14*(4), 1431-1451.

Barbre, J.G. (2017). *Baby steps to STEM: Infant and toddler science, technology, engineering, and math activities*. US, St. Paul: Redleaf Press.

Budinski, N., Lavicza, Z., & Fenyvesi, K. (2018). Ideas for using GeoGebra and origami in teaching regular polyhedrons lessons. *K-12 STEM Education*, *4*(1), 297-303.

Carol, F. (2017). Full STEAM ahead. *Parenting for High Potential*, *7*(2), 6-8.

Donegan-Ritter, M. (2017). STEM for ALL Children: Preschool Teachers Supporting Engagement of Children with Special Needs in Physical Science Learning Centers. *Young Exceptional Children*, *20*(1), 3-15. DOI: 10.1177/1096250614566541

Fan, S.C., & Yu, K.C. (2017). How an integrative STEM curriculum can benefit students in engineering design practices. *International Journal of Technology and Design Education*, *27*(1), 107-129. DOI: 10.1007/s10798-015-9328-x

Hong, O. (2017). STEAM education in Korea: Current policies and future directions. *Science and Technology Trends Policy Trajectories and Initiatives in STEM Education*, *8*(2), 92-102.

Jamil, F. M., Linder, S. M., & Stegelin, D. A. (2017). Early Childhood Teacher Beliefs about STEAM Education after a Professional Development Conference. *Early Childhood Education Journal*, 46(4), 409-417. DOI: 10.1007/s10643-017-0875-5

Karolyn, L.T. (2017). *Lesson plans integrating art with STEAM: Providing students with universal education experience* (unpublished doctoral dissertation). Columbus State Community College, State of Ohio.

Krajcika, J., & Delenb, I. (2017). Engaging learners in STEM education. *Eesti Haridusteaduste Ajakiri*, *5*(1), 35-58.

Maslyk, J. (2017). Where STEAM is gaining steam. *School Administrator*, *74*(5), 18-22.

Paik, S.H., Kim, S.W., & Lee, Y (2018). A study on teachers practices of STEAM education in Korea. *International Journal of Pure and Applied Mathematics*, *118*(19), 2339-2365.

Quigley, C.F., Herro, D., & Jamil, F.M. (2017). Developing a conceptual model of STEAM teaching practices. *School Science and Mathematics*, *117*, 1-12. DOI: 10.1111/ssm.12201

So, H.J., Ryoo, D., Park, H., & Choi, H. (2019). What Constitutes Korean Pre-service Teachers' Competency in STEAM Education: Examining the Multi-functional Structure. *The Asia-Pacific Education Researcher*, *28*(1), 47-61.

Yoon, M., & Kim, H. (2016). Action research of the STEAM educational program on climate change using leaf fossils. *International Journal of Multimedia and Ubiquitous Engineering*, *11*(2), 381-388.