International Journal of Early Childhood Special Education (INT-JECSE)
DOI: 10.48047/intjecse/V12I1.201072 ISSN: 1308-5581 Vol 12, Issue 01 2020

Transformative Learning That Affects Science Argumentation Skills of Mathayom 6 Students in Thailand

Ampon Dhamacharoen[1]*, Somjate Waiyakarn[2], Buncha Panacharoensawad[3]

St Theresa International College, Nakornnayok,Thailand

***Corresponding Author, Email: ampon.d@stic.ac.th
Received: 25 March 2020, Revised, Accepted: 17 April 2020, and Published: 26 April 2020

Abstract
The objectives of this research are 1) to develop transformative learning activities that affect science argumentation skills of Mathayom 6 students, with an efficiency according to the 80/80 criteria 2) to compare learning achievements, before and after, in Physics learning about magnets and electricity of Mathayom 6 students who received transformative learning 3) to study science argumentation skills of students who received transformative learning. The sample group consists of 40 Mathayom 6 students from schools in Ongkharak district, Nakhon Nayok province, in the first semester of academic year 2017. The research instruments for the study are 1) learning activity set 2) learning achievement test 3) assessment of students' science argumentation skills. The statistics used in data analysis are percentage, mean, standard deviation, and dependent t-Test. The results of the study found that 1) transformative learning activities had an efficiency of 87.65/83.25, which passed the required 80/80 criteria 2) students had higher learning achievement in Physics learning about magnets and electricity after than before the learning activities. The transformative learning model has a t-Test value of 27.513, statistically significant at the .01 level 3) students gained a high level of science argumentation skills from transformative learning, both overall and in every component.

Keywords: Transformative Learning, Transformative Learning Activities, Science Argumentation Skills, Learning Management Science

Introduction

An important Thai education plan is the National Education Plan 2017-2036. Its main goal is for students to develop their abilities the fullest potential, possess desirable characteristics for Thai society, knowledge, life skills, and sufficient competency to work happily in society (Office of The Education Council, 2016).

To achieve the goals of the National Education Plan, it is necessary to focus on both 21st century skills and the context of learners in society (Puncreobutr et. al., 2016), which nowadays is completely different from the context of learners in the past. This is especially true for information, news and knowledge that exists abundantly and increasing each day from social networks and the internet. Classrooms are not only in schools, but anywhere there is internet signal. Therefore, students no longer lack a source of knowledge, but they must find ways to lead themselves to search for knowledge using their intellect, learning content along with analytical thinking, until it leads to synthesis for effective use (Cussker, 2013). Consequently, it is important for teachers to use learning management science to organize learning activities suitable for the subjects they are responsible for (Titiworarat and Puncreobutr, 2016).

Transformative learning is one of the learning management sciences that aims to create a deep awareness of changing familiar expectations and an integrated perspective to embrace new things, which makes it possible to make choices or do various things on a new basis (Mezirow, 2000). It is a learning that changes the original frames of references which were still unclear, such as habits of mind, meaning perspective, mindset, to a larger, wider frame of reference that can distinguish differences, better reflect and present feelings and thoughts, and be more open to change, leading to behavioral changes in understanding oneself and others (Imel, 1998; Tylor, 1998; Mezirow, 2003).

Frames of references, according to the meaning of transformative learning, has 2 dimensions. The first dimension is habits of mind; it is a set of conclusions in the mind, a broad principle that each person sets according to their perception, social background, language, etc. The second dimension is point of view; it is a dimension of character and mind that consists of a meaning scheme, a set of

various meaning such as expectations, beliefs, feelings, thoughts, and specific decisions whether something is good or bad, wrong or right. In general, it can be said that transformative learning is learning that aims to change internal characteristics of learners based on a change in perspective and meanings to the world and life (Mezirow, 2003).

Transformative learning is therefore learning that leads to holistic change, from mindset change, affective attributes, cognitive attributes, and psychomotor attributes. There are 10 steps for change including 1) Disorienting dilemma 2) Self-examination with feeling of fear, anger, guilt or shame 3) Critical assessment of assumption 4) Recognition that one's discontent and process of transformation are shared 5) Exploration of options for new roles' relationships and actions 6) Planning a course of action 7) Acquiring knowledge and skills for implementing one's plan 8) Provisional trying of new roles 9) Building competence and self-confidence in new roles and relationships 10) Reintegration into one's life on the basis of conditions dictated by one's new perspectives (Mezirow, 1991).

Science argumentation skill is used to prove the truth in order to gain confidence, trust, and acceptance from others, reasonably and undergoing criticism from various perspectives to eliminate errors (Horsella and Sindermann, 1992; Kuhn, 1993; Osborne and Patterson, 2011). Educational argumentation refers to a way of thinking, teaching, and learning as a process of social interaction. It is used to create and critique knowledge, create consideration of scientific concepts with logic and reason, which are used as part of science learning management (Berland and Reiser, 2008; Lin and Mintzes, 2010).

Argumentation can be divided into 3 categories: 1) rhetorical argument which has 2 types: rational argumentation that uses reason and evidence of scientific knowledge and traditional argumentation that uses scientific concepts from other reliable sources 2) analytical argument which is the use of theoretical basis and logic to reach conclusions, primarily through textbooks and teachers 3) dialogical argument is an argument between two groups of people, creating interaction in arguments, with teachers as guides to promote knowledge (Zuhal Oguz Cakir, 2011).

Components of science argumentation skills that students use to express themselves include 1) specifying claims and warrants which involves presenting results of data study using reliable sources, related to a given situation and providing reasons to support the claim 2) using evidence which involves presenting evidence or supporting materials for argumentation from a reliable source, but for experiment results, it must be replicable meaning the same results should be obtained if repeated 3) giving counter arguments is arguing back in order to see a new perspective and making the original claims that was proposed in the beginning less reliable, as well as finding reliable reasons to support the counterclaim 4) using supportive argument is bringing up a situation or evidence in an argument in order to make the opponents' reasons less reliable (Toulmin, 2003; Chang and Chen, 2009; Lin and Mintzes, 2010; Thanapud et al, 2015).

In consequence, transformative learning is suitable for teaching Physics to high school students, so that teachers' learning management can accomplish the goals of the National Education Plan. In addition, the use of transformative learning in teaching Physics can also create important skills, namely science argumentation skills, which is an important basic skill for creating and critiquing knowledge in science learning management.

Therefore, the researcher is interested in using transformative learning activities to study the development of science argumentation skills of Mathayom 6 students, because it is important for students' learning and understanding, a basic concept for understanding physical phenomena that occur in everyday life, and a foundation for students' further higher education. It is also beneficial for developing abilities of Physics teachers in secondary schools, to make teaching more effective as well as using learning management science to develop teaching in the country's secondary schools.

Research Objectives

1. To develop transformative learning activities that affect science argumentation skills of Mathayom 6 students, with an efficiency according to the 80/80 criteria

2. To compare learning achievements, before and after, in Physics learning about magnets and electricity of Mathayom 6 students who received transformative learning

3. To study science argumentation skills of Mathayom 6 students who received transformative learning

Research Methodology

This research is pre- experimental with details as follows.

1. Population and Sample

The research population includes Mathayom 6 students in the first semester of academic year 2017 from Ongkharak School, a total of 3 classrooms with specialization in science and mathematics, under the Nakhon Nayok – Prachin Buri Secondary Education Service Area Office, Nakhon Nayok Province. All 3 classrooms have similar Physics level considering the GPA in Physics subject and are normal classrooms providing education according to the curriculum of the Ministry of Education.

The research sample included Mathayom 6 students with specialization in science and mathematics, who are learning about magnets and electricity for their Physics subject. In Ongkharak School, in the first semester of academic year 2017, classrooms were sampled using cluster random sampling method. The sample group consists of 40 people from room 6/2.

2. Variables in the Study

2.1 Independent variable is the organization of transformative learning activities.

2.2 Dependent variables are learning achievements in Physics and students' science argumentation skills.

3. Research Instruments

3.1Transformative learning activities set for Physics, magnets and electricity, totaling to 6 sets. Each set consists of learning management plans, activity sets, and student learning checklists.

3.2 Learning achievement test in Physics on magnets and electricity for Mathayom 6 is a multiple-choice test with 5 choices, a total of 20 questions, with a difficulty between 0.34-0.78, discrimination power between .27-.69, and reliability (KR-20) of 0.82.

3.3 Assessment of students' science argumentation skills in Physics, magnets and electricity, with 20 questions that have been tried out with students who were not in the sample. It has a discrimination power of .31 - .82, a reliability of .84.

4. Data Collection

4.1 The researcher conducted a pre-test using the Physics achievement test on magnets and electricity for Mathayom 6, with 20 questions in the duration of 30 minutes (conducted 2 weeks before the learning activity test).

4.2 Conducting a learning activity experiment for Physics on magnets and electricity for Mathayom 6, using a teaching period of 12 lessons, 50 minutes each, and conducting sub-tests at the end of each learning management plan, when teaching is completed for each learning plan.

4.3 When teaching for all learning management plans have been completed, a post-test was conducted for assessing learning achievement using the same test as before, and students have to complete an assessment for their science argumentation skills.

4.4 The researcher used the test results obtained to conduct an analysis using statistical methods and summarize the research results.

5. Statistics used in data analysis include percentage, mean, standard deviation, and dependent t-Test.

6. The researcher collected data during July-September 2019.

Research Results

Organization of transformative learning activities that affect science argumentation skills of Mathayom 6 students are as follows.

1. Efficiency in Organizing Learning Activities

Results of developing transformative learning activities that affect science argumentation skills in Physics, magnets and electricity, of Mathayom 6 students are shown in Table 1.

Table 1 Mean, standard deviation, percentage of efficiency in organizing transformative learning activities on magnets and electricity.

Score	No. of People	Full Score	Average Score	S.D.	Percentage	E_1/E_2
During Learning (E_1)	40	20	17.53	.846	87.65	87.65/83.25
After Learning (E_2)	40	20	16.65	1.098	83.25	

From Table 1, it shows that efficiency in organizing transformative learning activities in Physics, magnets and electricity, for Mathayom 6 students was 87.65/83.25, which passed the required 80/80 criteria.

2. Learning Achievement in Physics

Comparison of learning achievements, before and after, in Physics learning about magnets and electricity of Mathayom 6 students who received transformative learning is shown in Table 2.

Table 2 Mean, standard deviation and comparison of learning achievement in Physics, before and after organizing transformative learning activities.

Test	Sample Group	Full Score	Average Score	S.D.	t	df	p
Before Learning	40	20	10.30	2.244	27.513**	39	.000
After Learning	40	20	16.65	1.098			

* p < .05 ** p < .01

From Table 2, it was found that, before receiving transformative learning, Mathayom 6 students in the sample group had an average score of 10.30 and a standard deviation of 2.244. After receiving transformative learning, the average score was 16.65 and the standard deviation was 1.098. The t-Test between before and after learning was 27.513, statistically significant at the .01 level. This shows that students learning achievement in Physics learning about magnets and electricity is higher after than before students receive transformative learning.

3. Science Argumentation Skills

The results of science argumentation skills in Physics, magnets and electricity, of Mathayom 6 students who received transformative learning are as shown in Table 3.

Table 3 Mean, standard deviation, and level of science argumentation skills of students who received transformative learning (N=40)

Skills	mean	SD.	Skill level
Claim and Warrant	4.03	.312	High
Evidence	4.16	.289	High
Counter Argument	3.93	.513	High
Supportive Argument	3.82	.475	High
Overall Argumentation Skills of Students	3.98	.301	High

From Table 3 it was found, overall, students have a high level of science argumentation skills gained from transformative learning (mean 3.98, S.D. .301). When considering each component, it was found that in all 4 components, students have a high level of science argumentation skills, with an average between 3.82-4.16. The component in which students have the most science argumentation skills is evidence, followed by claim and warrant, and the components where students have the least science argumentation skills are supportive argument and counter argument.

Simulation supported teaching methods in biology is much more effective than the traditional teaching methods (sasikala, p and Yanyong, S, 2016). Academic achievements of female students have been significantly increased in DNA replication. The results of the different sections revealed and evidenced that statistically significant variation between the means of control and experimental group students of education. Hence, that animated based simulation-supported strategic teaching methods in genetics and DNA replication is much more effective than the traditional teaching methods science education domain (Reddy, M., & Mint, P. P. 2017).

Association between students' perceptions and their attitudes on problem solving difficulties and individualized physics classes, trainee teacher interpersonal behaviours on problem solving and physics laboratory experiments to encourage the students to learn how to solve the problems in science show significance as an indicator of students' attitudes toward physics. Having a standardized set of items for the assessment of achievement was shown to give more comparable sample results. Physics

laboratory classes' attitudes had a positive effect on both the five scales of ICEQ and PLEI. In terms of the QTI scales, the influence and proximity students in highly motivated classes had a more favourable perception of their teachers (Reddy, M., & Panacharoensawad, B. 2017).

Summary of Results

The research results are summarized as follows.

1. Transformative learning activities that affect science argumentation skills of Mathayom 6 students in Physics, magnets and electricity, has an efficiency of 87.65/83.25, which passes the required 80/80 criteria.

2. Mathayom 6 students who received transformative learning has higher scores for learning achievement in Physics, learning about magnetism and electricity, after than before learning, with a t-Test of 27.513 statistically significant at the .01 level.

3. Science argumentation skills of Mathayom 6 students who received transformative learning in Physics, magnets and electricity, is at a high level both overall and in each of the 4 components.

Recommendations

Recommendations for applying the research results:

1. Transformative learning activities involve steps that students are not familiar with, therefore, teachers must clearly explain the sequence of steps to students, and in the beginning, should not use questions that are too difficult to enable students to effectively apply the content to science argumentation.

2. Transformative learning emphasizes students creating knowledge on their own, therefore, teachers must not directly reveal answers but should stimulate learning by using questions. This allows students to adjust their thinking which leads to understanding of the content.

3. On any occasion learning activities are organized, it must be appropriate for the time spent learning, appropriate for the difficulty of the question, and should not have too much content or questions which may create boredom in learning.

4. Teachers must control the situation and noise level during activities, especially in the process of discussion and comparison as a whole class. When students present their own and group ideas, students in their group or other groups may express their emotions or interact with each other.

Recommendations for further research:

1. From the research, it was found that students have higher learning achievement in Physics, magnets and electricity, after than before learning, statistically significant at the .01 level. Therefore, transformative learning should be used for learning Physics in other contents of Mathayom 6 education further.

2. From the research, it was found that some groups of students scored lower in supportive argument than other components. Therefore, there should be further studies on the factors that affect students' use of supportive arguments in science argumentation.

References

Berland, L. K., and Reiser, B. J. (2008). Making Sense of Argumentation and Explanation. Science Education. 93(1): 26-55.

Chang, H., and Chen, S. (2009). Consumer Perception of Interface Quality, Security, and Loyalty in Electronic Commerce. Information & Management. 47(7): 411-417.

Cussker, M. P. (2013). Harnessing The Potential of Constructive Developmental Pedagogy to Achieve: Tranformative Learning in Social Work Education. Journal of Transformative Education. 11(1): 3-25.

Development Economics: Regional & Country Studies eJournal. 6(10): January 13, 2017.

Horsella, M., and Sindermann, G. (1992). Aspects of Scientific Discourse: Conditional Argumentation. English for Specific Purpose. 11(2): 129-139.

Imel, S. C. (1998). Tranformative Learning in Adulthood. ERIC Digest No.200.EDO-ce-98 200. Columbus, Ohio: ERIC Clearinghouse on Adult, Career, and Vocational Education.

Kuhn, D. (1993). Science as Argument: Implications for Teaching and Learning Scientific Thinking. Science Education. 77. 319-337.

Lin, S., and Mintzes, J. J. (2010). Learning Argumentation Skills through Instruction in

Socioscientific Issue: The Effect of Ability Level. International Journal of Science and Mathematics Education. 8. 993-1017.
Mezirow, L. (1991). Transformation Theory and Cultural Context: A Reply to Clark and Wilson. Adult Education Quarterly. 41. 188-192.
Learning as Transformation: Critical Perspectives on a Theory in Progress. (2000). Learning as Transformation: Critical Perspectives on a Theory in Progress. San Francisco, CA: Jossey-Bass.
Tranformative Learning asdiscourse. (2003). Tranformative Learning asdiscourse. Journal of Transformative Education. 1(1): 58-63.
Office of The Education Council. (2016). National Education Plan 2017-2036. Bangkok: Prigwarn Company Limited.
Osborne, J., and Patterson, A. (2011). Sciencetific Argument and Explanation: A Necessary Distinction? Science Education. 95(4): 627-638.
Puncreobutr, V., Srithongphimj, W., Sankham, S., Thipcharoen, T. (2017). Correlation Between the Quality Assurance of Education Program Level and Development of Skills of the Students in the 21st Century, in the International Educational Institution of Thailand.
Reddy, M., & Panacharoensawad, B. (2017). Students Problem-Solving Difficulties and Implications in Physics: An Empirical Study on Influencing Factors. *Journal of Education and Practice, 8*(14), 59-62.
Reddy, M., & Mint, P. P. (2017). Impact of Simulation Based Education on Biology Student's Academic Achievement in DNA Replication. *Journal of Education and Practice*, *8*(15), 72-75.
Sasikala, P., & Tanyong, S. (2016). A Study on Simulation Methods in Academic Success with Reference to Teaching Biology for Education Students. *Journal of Education and Practice*, *7*(11), 164-168.
Thanapud, A., Pitiporntapin, S., Jantrarotai, P. (2015). Development of Grade 10th Students' Argumentation Skills in Natural Resources Unit Using Socioscientific Issues-Based
Teaching. KKU Res J HS (GR). 3(2): 14-24
Titiworarat, T., and Puncreobutr, V. (2016). A Case Study on readiness of Bueng Kan Province's educational Management in educating people along Thai-Lao Borders. Rupkatha Journal of Interdisciplinary Studies in Humanities. 8(2): 104-110.
Toulmin, S. (2003). The Uses of Argument. Cambridge, England: Cambridge University Press.
Tylor, E. (1998). Transformative Learning: A Critical Review. Columbus, Ohio: ERIC Clearing house on Adult, Career, and Vocational Education.
Zuhal Oguz Cakir, B. (2011). The Influence of Argumentation Based Instruction on Sixth
Grade Students' Attitude toward Science, Conceptual Understanding of Physical and Chemical Chance Topics and Argumentativeness. The Degree of Master of Science, The Department of Elementary Science and Mathematics Education. Middle East Technical University.