



## **Effectiveness of Scie-chain Method on Students' Academic Achievement and Attitude in Managing Large Classes in Science 10**

**Ma. Mheliza S. Valiente<sup>1</sup> and Rema Bascos-Ocampo<sup>1\*</sup>**

<sup>1</sup>Apayao State College, San Isidro Sur, Luna, Apayao, 3813, Philippines.

### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author MMSV conceptualized the study, performed the statistical analysis, wrote the first draft of the manuscript and managed the analyses of the study in collaboration with author RBO wrote the protocol, improved every section of the manuscript and did the editing and proof reading. All authors read and approved the final manuscript.*

### **Article Information**

DOI:10.9734/AJESS/2021/v15i330382

#### Editor(s):

(1) Dr. Vlasta Hus, University of Maribor, Slovenia.

#### Reviewers:

(1) Mohammad Hosein Ghorbani, Allameh Tabataba'i University, Iran.

(2) Claudia Tatiana Mora Yate, Corporación Universitaria Minuto de Dios, Colombia.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/64976>

**Received 15 November 2020**

**Accepted 20 January 2021**

**Published 13 March 2021**

**Original Research Article**

### **ABSTRACT**

The researchers aimed to find out the effectiveness of Scie-chain method on students' academic achievement and attitude in managing large classes in Science 10 of Flora National High School. Specifically, it identified the difference and effect to the academic achievement of students and students' attitude towards Science of the traditional method and Scie-chain method of teaching. The researchers employed the two-group pretest- posttest quasi-experimental design which made use of the Scie-chain method (Inquiry-based, ICT utilization, and flock system) in the experimental group. The data were analyzed with the use of weighted mean. Results of the study showed that originally the experimental group and the control group are equal in terms of academic achievement and attitude towards Science. After the intervention, the experimental group yielded better result in terms of academic achievement and attitude towards Science as Manifested in the difference in their post test. From the findings of the study, the following conclusions were drawn: 1. students exposed to the Scie-chain method attained better academic achievement compared to students exposed to traditional teaching method; the intervention (Scie-chain method) enhanced the level of attitude of students towards Science; and the Scie-chain method is an effective strategy to manage large classes.

\*Corresponding author: Email: [ascrnd@yahoo.com](mailto:ascrnd@yahoo.com);

*Keywords: Large classes; scie-chain method; quasi-experimental; inquiry based; flock system; ICT teaching.*

## 1. INTRODUCTION

Science education has been perceived as the vehicle for economic development and technological modernization [1]. Accordingly, the ultimate goal of education is the generation of scientifically and technologically literate citizens to cater the Philippine workforce demand of the 21<sup>st</sup> century. However, Filipino students showed dismal performance in the Trends in International Mathematics and Science Study (TIMSS), lagging at the bottom along with some African countries.

In 2011, teachers of large classes have difficulty controlling their students and guiding their learning. She further stated that the biggest problem of large classes is that students are not getting the education they deserved [2]. Students capture only 20-40 percent of a lecture's main ideas in their notes. Without reviewing the lecture material, students remember less than 10 percent after three weeks. The cited numbers present a clear challenge: how to teach such that students learn and retain the lessons taught. In order to make learning more meaningful to students in large classes, it is therefore important to find efficient and effective ways of teaching [3].

As Davis and McLeod quoted "to communicate effectively in large group is not impossible, but like the actor and the politician, the teacher who would communicate effectively with a mass audience must learn new skills."

Class size has an impact on student engagement. It also affects teachers' allocation of time, hence, the effectiveness [4,5]. In effect, students are more likely to experience sense of anonymity, passive learning, and distraction which can have negative impacts on student learning, attrition, and motivation for learning.

The Dep-Ed Curriculum Guide emphasized that the core Science standard for the entire K to 12 is for the learner to demonstrate understanding of basic Science concepts, apply science process skills, and exhibit scientific attitudes and values, to solve problems critically, innovate beneficial products, protect the environment and conserve resources, enhance the integrity and wellness of people, and make informed and unbiased decisions about social issues that involve Science and technology. However, due to

large class sizes, achieving this goal is difficult. Students in large classes do not develop the scientific skills nor master the concepts taught. These result to the students' low scores in the National Achievement Tests (NAT).

UNESCO reported that having large class impedes the quality of education [6]. Unfortunately, large class is one of the perennial problems that confront the Philippine educational setting, especially in the public school system.

Some students seem naturally enthusiastic about learning, but many need or expect their instructors or teachers to inspire, challenge or stimulate them. "Effective learning in the classroom depends on the teacher's ability to maintain the interest that brought students to the course in the first place. Not all students are motivated by the same values, needs, desires and wants. Some students are motivated by the approval of others or by overcoming challenges.

There is a pressing need, therefore, to upgrade Science instruction to improve the performance of students, especially in schools with large classes. Providing tools to address the difficulty of teaching large classes is, thus an important step towards realizing quality Education for All (EFA) in school settings.

While there is no immediate solution to reducing class size into the ideal one, teachers ought to try different approaches and strategies to improve students' learning in these classes. One of the ways to improve students' learning is through the use of Scie-Chain Method, in managing large classes in terms of students' achievement and how it influenced the attitude of students towards Science. The Scie-Chain Method is a combination of three techniques, namely; 1. Inquiry-based learning, 2. ICT Utilization, and 3. flock system. By studying the effectiveness of Scie-Chain Method, managing large classes in Science 10 will guarantee quality education.

In any educational institution, teaching large class is a very difficult and challenging task. The consequences of having large classes are increase in diversity of the student population and corresponding increase in the complexity of teaching. Having a higher student-teacher ratio inevitably makes it more difficult for teachers to

personalize their lectures, maintain student's attention, facilitate collaboration between students, and assess how the students perform in the class.

At the heart of the study, Gagne (1965) believes that six classes of learning form an ascending hierarchy, and before a learner can "chain" they have to learn specific responses and so on [7]. The role of the learner is also to learn how to learn. In fact, the most important long-term outcome of instruction may be the students' increased capabilities to learn more easily and effectively in the future, both because of the knowledge and skill they acquire and because they have mastered the learning process. How teaching is conducted has a large impact on students' abilities to educate themselves.

Edgar Dale's Cone of Experience suggests that when choosing an instructional method it is important to remember that involving students in the process strengthens knowledge retention. It reveals the "action-learning" technique. Students learn best when they use perceptual learning styles, the more sensory channels possible in interacting with a resource, the better chance that many students can learn from it [8].

The theory of *facilitative learning* is based upon a belief that people have a natural human eagerness to learn and that learning involves changing your own concept of yourself. This theory suggests that learning will take place if the person delivering it acts as a *facilitator*. To facilitate learning, you should establish an atmosphere in which your learners feel comfortable and are able to discuss and explore new ideas.

Stated learning occurs when the five senses of sight, hearing, touch, smell and taste are stimulated. Laird's (1985) theory suggests that if multi-senses are stimulated, greater learning takes place [9].

Moreover, John Dewey (1938), proponent of learning by doing – rather than learning by passively receiving states that students learn more when he does it [10]. "First, his belief that education must engage with and enlarge experience has continued to be a significant strand in informal education practice. "Second, and linked to this, Dewey's exploration of thinking and reflection – and the associated role of educators – has continued to be an inspiration. We can see it at work, for example, in the models

developed by writers such as David Boud and Donald Schön. "Third, his concern with interaction and environments for learning provide a continuing framework for practice.

In this study, the effectiveness of the Scie-Chain method will be measured by applying the combination of three techniques, namely; 1. Inquiry-based learning 2. ICT utilization and 3. flock system.

This study generally determined the effectiveness of Scie-Chain Method in managing large classes, in terms of students' academic achievement and attitude in Science 10.

## 2. METHODS OF RESEARCH USED

The researcher employed the quasi-experimental two-group design. The achievement and attitude in Science 10 were measured using the pre-test and post-test scores from the Science Achievement Test and Science Attitude Questionnaire, respectively.

There were two groups of respondents namely the experimental group and the control group. The research design is presented below:

O1 x	O2
O3 no x	O4

Where:

- O1 - Pre-test score of the experimental group
- O2- Post Test score of the experimental group
- O3 - Pre-test score of the control group
- O4 - Posttest score of the control group
- X - Experimental treatment (use of Scie-Chain method)
- no x - Traditional method

This study was conducted at Flora National High School, Poblacion East, Flora, Apayao.

Flora National High School (FNHS) is one of the biggest schools in Apayao. It is composed of more than five hundred enrollees and almost 40 teaching and non-teaching staff as of S.Y 2016-2017.

This study involved the two intact large class sections of Grade 10 students in Flora National High School (FNHS) during the S.Y 2016-2017. The Grade 10-Sapphire with 54 students and Grade 10-Emerald with 54 students were designated as experimental and control groups,

respectively. The Scie-Chain Method was applied to the experimental group while the traditional method of teaching was used to the control group.

The Science Achievement Test and Science Attitude Questionnaire were the instruments used in gathering the needed information or data in this study.

### 2.1 Science Achievement Test (Pre-Test/Post-Test)

This is a researcher-made instrument designed to measure the achievement of students in Science 10. It was administered to the experimental and control groups on a pretest and posttest basis. It consisted of 50 items on the following topics: behavior of gas, gas laws, chemical reactions, balancing chemical equations, collision theory and factors affecting rate of reactions. In addition, open-ended questions were given to the students in the experimental group to determine if the intervention enhanced students inquiry skills.

The items were formulated using the Table of specifications, and content validated by the master teacher in the department and the Science teachers of the Apayao State College. Item analysis was also done to further improve it.

This instrument is a 5 point Likert Scale adopted from Tuan's SMTSL (*Science Education International* Vol.22, No.3, September 2011, 218-232, "Students' Motivation towards Science Learning" (SMTSL) scale developed by Tuan, Chin & Shieh (2005) questionnaire. It was administered to both groups to determine and compare the attitude of the students towards Science.

Permission to conduct the study was asked from the Principal of Flora National High School. Upon approval, the researcher utilized her time in her Science subject to conduct the study. Pre-test was administered to the experimental and control group. Then, the researcher applied the Scie-Chain Method to the experimental group and the traditional method of teaching to the control group. Posttest was administered to both groups after.

The procedures in conducting the study are:

1. The Scie-Chain method was used to deliver lessons in Science for five-ten periods.

2. The entire class was divided into groups where each group composed of different types of students (high, average, and low performing). (Flock System)
3. Experiments or tasks gathered from the book (Science 10) were given to students in such a way that they would be responsive to individual learning needs. (Inquiry-based).
4. Team study on the experiments or tasks were provided by the teacher. Students who had already mastered the experiments or tasks given tutored the slower teammates.
5. After which, presentation of output by any member of the group followed. Some presented their outputs individually, in pairs or in groups.
6. Class quizzes were also administered to see if the students had learned the materials while in the group.
7. Recognition was given to teams with the highest average scores to motivate slow performing groups do better.
8. After the presentation of output, the lesson was discussed using ICT. PowerPoint presentation, video-clip presentation and others were used in order for students to appreciate more the lesson.

Descriptive statistics such as frequency counts, mean and standard deviation were used.

The five point scale was used to describe the attitude of students towards Science.

The t- test for independent sample was used to compare performance and attitude scores of student-respondents in the experimental and control group.

### 3. RESULTS AND DISCUSSION

Table 1 shows that the control group obtained a higher pretest result compared to the experimental group with a mean of 26. Before the intervention, the control group had a standard deviation of 6.93 while the experimental group, 6.87. This shows that in their pretest the experimental group is more intact or homogenous than the control group.

In Table 2, when the pretest scores were subjected to t –test, the computed value of t was 0.87. This value is less than the tabular value of t, 1.98 at 5 percent level of significance. This

means that the null hypothesis is accepted, thus the difference in the achievement of the experimental and the control group in their pretest is not significant. This could be attributed to both groups having not received any form of instruction yet. This findings is supported by the study of Ocampo and Ocampo on the effectiveness of students team achievement division on students attitude towards Physics and Ocampo and Abayo-Rillo on the effectiveness of audio-visual teaching on the writing performance of Grade 8 [11,12].

**Table 1. Pretest Mean and standard deviation of achievement scores of the two groups**

Group	Mean	Standard deviation
Control	26	6.93
Experimental	25	6.87

The mean of the experimental group is 39 while the control group is 34 as manifested in Table 3. This implies that the use of the Scie-chain method enhances the academic achievement of students. The improvement of students' academic achievement can be attributed to the various method introduced in the Scie-chain method of teaching. Furthermore, the notable increase in the academic achievement of the experimental group can be attributed to the intervention implemented.

Inquiry-based is defined as any teaching and learning activity which involves students in observing or manipulating real objects and materials. Moreover, it refers to learning situations where students learn concepts and principles of a discipline in using its process through concrete examples. It also provides advantages in the teaching-learning process. It develops students' scientific knowledge and since it is of a more open-ended, investigative kind, it can develop students' tacit knowledge of scientific inquiry; revealed that through ICT, images can easily be used in teaching and improving the retentive memory of students; teachers can easily explain complex instructions and ensure students' comprehension and teachers are able to create interactive classes and make the lessons more enjoyable, which could improve students' attendance and concentration and a variety of educational approaches focusing on individuals working together to achieve a specific learning outcome [13].

Table 4 revealed that the mean scores of the experimental and the control group were subjected to t-test for independent samples, the computed t value was 3.24.

This value is greater than the tabular value of t at 5 percent level of significance which means that there is a significant difference in the academic achievement of the respondents after they are exposed to traditional and Scie-chain method. This further implies that the experimental group has better academic achievement than the control group. The use of Inquiry-based may have engaged the students in the learning of Science. As Ian Schwartz, a Science teacher at Casey Middle School, says: Having kids engage in inquiry-based science lessons really providesthem with a way to explore on their own. It removes the teacher as somebody who is providing them with information that they need to memorize. And instead, *what the kids are really doing is they're experiencing, they're discovering as they go. And that's what real scientists do.* Teaching Science through Science inquiry is the cornerstone of good teaching.

Students exposed to innovative teaching methods such as cooperative learning educational audio-visual music, educational games, Jazz chants significantly improved from pretests to posttests [14-18].

Moreover, the use of ICT provides advantages over traditional method of teaching. Students immersed in ICT have excellent communication, creativity, collaboration, leadership skills and technology proficiency. The students exposed to ICT get more motivated, thus, obtained greater academic gain. Besides, flock system also contributed to the high academic achievement of students. The utilization of flock system in educational settings has been effective in the development of teamwork, leadership, and communication skills in addition to improving students' understanding of course content.

Table 5 shows that the control group obtained a higher pretest result compared to the experimental group in terms of students attitude towards Science. The control group and the experimental group obtained a mean of 3.6 and 3.5 respectively. Before the intervention, the control group had a standard deviation of 0.328 while the experimental group had 0.283. Both groups exhibit positive attitude towards Science before the intervention.

This shows that in their pretest the experimental group is more intact than the control group. Hence, the group is said to be homogenous.

In Table 6, the computed value of t is 0.697 which is less than the tabular value of t at 5 percent level of significance. This means that the null hypothesis is accepted, thus the difference in the attitude of students towards Science of the experimental and the control group in their pretest is not significant. This could be attributed to both groups having not received any form of intervention yet before the pre-test.

Most research indicates that students develop more negative attitudes toward studying Science, toward their Science classes, and toward their Science teachers the longer they study typical school Science. It is important to develop student positive attitude toward Science by integrating approaches which may motivate students to learn.

The students' level of attitude is presented in Table 7. The control group exhibits positive attitude towards Science after the intervention. On the other hand, the level of attitude of students in the experimental group improved from positive to strong positive. Hence, the strong positive attitude of students in the experimental group is attributed to the use of Scie-chain method in teaching the lesson where different approaches or strategies such as inquiry-based approach, ICT utilization and flock system were utilized.

In all of the related studies, it has been mentioned that laboratory activities which made use of ICT increase students' motivation levels. Laboratory activities were very motivating for students and laboratories give opportunity for students to solve and analyze practical problems and to form higher hierarchies of learning. It has been determined that laboratory activities increase students' motivation [19]. The

environment in a school laboratory is less formal than the classroom environment [20,21]. Students are freer being away from teachers' authority [22]. Therefore, laboratories offer opportunities for students to generate and collaborate interactively and increase students' motivation.

Laboratories are environments in which students' pleasure towards Science learning is increased and students also gain some competences such as behaviour changing, effective performance, searching and discovering ability [23]. The reason for significant difference on students' motivation levels according to the "active learning strategies" sub-factor may be students' desire for self-study and formations of their own learning paths with self-study.. When they have positive attitudes, the learning of scientific information and Science process skills are enhanced [24,25,26].

Table 8 shows that when the mean scores of the experimental and the control group were subjected to t-test for independent samples, the computed t value was 6.7. This value is greater than the tabular value of t at 5 percent level of significance which means that the mean difference is significant. It signifies that the Scie-chain method enhanced the attitude of the students in the experimental group towards Science learning.

The Science activities in the school with the use of Inquiry-based fostered collaboration, socialization, and initiative among students. Moreover, this method developed creativity and communication skills which may have enhanced their attitude towards Science learning. The use of ICT, which is another feature of the Scie-chain method, can also be a contributing factor as well as with the flock system.

Who have positive attitudes show increased attention to classroom instruction and participate more in Science activities.

**Table 2. T-test of the pretest achievement scores**

Group	Mean	Computed t	Tabular t	Decision
Control	26	0.87	1.98	Accept null hypothesis
Experimental	25			

**Table 3. Posttest mean and standard deviation of the two groups**

Group	Mean	Standard deviation
Control	34	5.19
Experimental	39	8.89

**Table 4. T-test of the posttest achievement scores**

Group	Mean	Computed t	Tabular t	Decision
Control	34mm	3.24	1.98	Reject null hypothesis
Experimental	39			

**Table 5. Pretest mean and standard deviation of attitude of students towards Science in the two groups**

Group	Mean	Standard deviation	Verbal interpretation
Control	3.6	0.328	Positive
Experimental	3.5	0.283	Positive

**Table 6. T-test of the pretest attitude scores of the experimental and control group**

Group	Mean	Computed t	Tabular t	Decision
Control	3.6	0.697	1.98	Accept null hypothesis
Experimental	3.5			

**Table 7. Posttest mean and standard deviation of attitude of students towards science in the two groups**

Group	Mean	Standard deviation	Verbal interpretation
Control	3.66	0.28	Positive
Experimental	4.23	0.19	Strong Positive

**Table 8. T-test on the posttest attitude scores**

Group	Mean	Computed t	Tabular t	Decision
Control	3.66	6.7	1.98	Reject null hypothesis
Experimental	4.23			

Hence, the Scie-chain method enhanced the attitude of the students in the experimental group.

#### 4. CONCLUSION

From the findings of the study, it can be concluded that Scie chain can improve academic achievement and attitude of students towards Science. It is also an effective strategy to manage large science classes.

#### CONSENT AND ETHICAL APPROVAL

As per international standard or university standard guideline participant consent and ethical approval has been collected and preserved by the authors.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

1. Brown-Acquaye. New literacies in action. Connecting with the world-creating web-based treasure hunts. Reading Online; 2000. Available:[http://www.readingonline.org/newliteracies/lit\\_index.asp?HREF=/newliteracies/action/rozich/index.html](http://www.readingonline.org/newliteracies/lit_index.asp?HREF=/newliteracies/action/rozich/index.html)
2. O' Brein. Public schools display best practices in managing large classrooms; 2011. Available:<http://ph.news.yahoo.com/public-schools-display-best-practices-managing-large-classrooms-041412782.html>
3. Reis r. tomorrow's teaching and learning; 2005. [Web blog post] Available:[cgi.stanford.edu/~dept-ctl/cgi-bin/tomprof/posting.php?ID=790](http://cgi.stanford.edu/~dept-ctl/cgi-bin/tomprof/posting.php?ID=790)
4. Kerr a. teaching and learning in large classes at ontario universities: an exploratory study. Toronto: Higher

- Education Quality Council of Toronto; 2011.
5. Brewer D, et al. Class size and student achievement; 2001.  
Available:[http://www.psychologicalscience.org/journals/pspi/pdf/pspi2\\_.pdf?origin=publication\\_detail](http://www.psychologicalscience.org/journals/pspi/pdf/pspi2_.pdf?origin=publication_detail)
  6. Lipinge SM. Challenges of large class teaching at the university: implications for continuous staff development activities; 2013.
  7. Integration of the disciplines. The role of the students; 2021.  
Available:<https://oregonstate.edu/instruction/ed555/zone2/studrole.htm>
  8. Gravells. Learning Theories; 2021.  
Available:[https://www.anngravells.com/information/learning-theories#:~:text=Laird's%20Sensory%20theory,-Laird%20\(1985\)%20stated&text=Laird's%20theory%20suggests%20that%20if,of%20their%20senses%20as%20possible](https://www.anngravells.com/information/learning-theories#:~:text=Laird's%20Sensory%20theory,-Laird%20(1985)%20stated&text=Laird's%20theory%20suggests%20that%20if,of%20their%20senses%20as%20possible)
  9. Pegg. D is for John Dewey: His Approach to Education; 2021.  
Available:<https://www.thepositiveencourager.global/john-deweys-approach-to-doing-positive-work/>
  10. Ocampo R, Abayo –Rillo A. Effectiveness of audio-visual teaching on the writing performance of grade 8. International Journal of Novel Research in Education and Learning. 2016;3(5):12-19.  
Available: [www.noveltyjournals.com](http://www.noveltyjournals.com)
  11. Ocampo, R, Ocampo R. Effectiveness of students' team achievement division on students attitude towards physics. Asia Pacific Journal of Multidisciplinary Research. 2015;3(4):112-117.  
Part III P-ISSN 2350-7756 E-ISSN 2350-8442 .  
Available:[www.apjmr.com](http://www.apjmr.com)
  12. Trautman Thomas, Klemm Robert. Computer aided instruction and academic achievement. A study of the A+nywhere learning system in a district wide implementation. Unpublished Dissertation, Chicago, Illinois; 2002.
  13. Maborang-Caban R. The effect of songs on students' attitude and achievement. International Journal of Novel Research in Education and Learning. 2016;3(6):74-80,  
Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)
  14. Ocampo R, Ancheta G Baddo, J Dugay W. Development, validation and summative evaluation of card pairing games for selected math 8 topics. Asia Pacific Journal of Multidisciplinary Research. 2015;3(5):179-186.  
Part I P-ISSN 2350-7756 E-ISSN 2350-8442.  
Available:[www.apjmr.com](http://www.apjmr.com)
  15. Ocampo R, Ballesteros M. Best practices of multigrade teaching in luna, apayao. International Journal of Novel Research in Education and Learning. 2016;3(6):61-73.  
Available: [www.noveltyjournals.com](http://www.noveltyjournals.com)
  16. Ocampo R, Amanunze M, Basilio R, Cabulagan R. Developing nutrition science card game in science iii. International Journal of Social Science and Humanities Research. 2016; 4,(3):102-106.  
ISSN: 2348-3164 (online)  
Available:[www.researchpublish.com](http://www.researchpublish.com)
  17. Ocampo R, Malapit S. Comparison of drama and jazz chants in developing phonemic skills of grade 1. International Journal of Novel Research in Education and Learning. 2016;3(6):51-60.  
Available: [www.noveltyjournals.com](http://www.noveltyjournals.com)
  18. Nevzat Yiğit. Investigation of primary students' motivation levels towards science learning.  
Available:[https://www.academia.edu/1963841/Investigation\\_of\\_primary\\_students\\_motivation\\_levels\\_towards\\_science\\_learning](https://www.academia.edu/1963841/Investigation_of_primary_students_motivation_levels_towards_science_learning)
  19. Hofstein, Lunetta. The Laboratory in Science Education: Foundations for the Twenty-First Century; 2003.  
Available:<http://kisi.deu.edu.tr/ercan.akpinar/dosyalar/lab1.pdf>
  20. Hofstein A, Nahum T L, Shore R. Assessment of the learning environment of inquiry-type laboratories in high school chemistry. Learning environments Research. 2001;4(2):193-207.
  21. Aladejana F, Aderibigbe O. Science laboratory environment and academic performance. Journal of science Education and Technology. 2007; 16(6):500-506.
  22. Lee S S, Fraser B J, Fisher D L. Teacher-student interactions in Korean high school science classrooms. International Journal of Science and Mathematics Education. 2003;1(1):67-85.
  23. Sevinc B, Ozmen H, Yigit N. Investigation of primary students' motivation levels towards science learning. Science Education International. 2011;22(3):218-232.
  24. Ergül R, Şimşekli Y, Çaliş S, Özdilek Z, Göçmençelebi Ş, Şanlı M. The effects of



- inquiry-based science teaching on elementary school students' science process skills and science attitudes. Bulgarian Journal of Science & Education Policy. 2011; 5(1).
25. Koksal EA, Berberoglu G. The effect of guided-inquiry instruction on 6th grade Turkish students' achievement, science process skills and attitudes toward science. International Journal of Science Education. 2014; 36(1): 66-78.
26. Abungu HE, Okere MI, Wachanga SW. The effect of science process skills teaching approach on secondary school students' achievement in chemistry in Nyando district, Kenya. Journal of Educational and Social Research. 2014; 4(6):359.

---

© 2021 Valiente and Bascos-Ocampo; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Peer-review history:*

*The peer review history for this paper can be accessed here:*  
<http://www.sdiarticle4.com/review-history/64976>