International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 4 Issue 4, June 2020 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Instructional Lab Material Development using Real Science

Ghanshyam Kumar Singh

Himalayan University, Jollang, Itanagar, Papum Pare, Arunachal Pradesh, India

ABSTRACT

This study presents the current state of sciences instruction in NEI (North East Indian) state schools, to what extent the laboratories are used in the instruction of the courses, whether students take active roles in laboratories, and some examples in relation to the materials that can be used in science laboratories and the laboratory tools that can be made with students. The present study, which is qualitative in nature, is also a material development study for sciences instruction. Data in the first section of the study were collected through a "semi-structured interview form". The second section included review of literature for the tools and presented authentic samples that could be developed considering the environmental possibilities and conditions of schools. The study was conducted with 14 classroom teachers teaching fourth graders; it included three state schools and one primary school. Teachers' views showed that sciences instruction was not delivered in accordance with the content of the course, thus students are made to memorize the disjointed information given to them. Therefore, it is highly important to disseminate sciences instruction laboratory tools that can be made by teachers with their students and even to educate prospective teachers about this issue.

KEYWORDS: *Sciences instruction, Science laboratory, School education, development of laboratory tools*

How to cite this paper: Ghanshyam Kumar Singh "Instructional Lab Material Development using Real Science" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-4 | Issue-4, June 2020, pp.562-566, URL: www.ijtsrd.com/papers/ijtsrd31076.pdf

IJTSRD31076

I. INTRODUCTION

People are surrounded by technology in their daily life. Regardless the culture they live in, the nature of people's lives is deeply affected by the presence or absence of technology. Today, it is known that countries that give importance to fundamental sciences develop rapidly while those that do not do so make no progress. Hence, these areas should be given more importance and people should be producers of the modern technology rather than the consumers (Gao, Feng, Zhan and Zheng, 2017; Soylu, 2005), which could be possible through educational practices such as researching and learning by doing and living. If daily life and environment are shown students as a laboratory, it can be possible for them to know an existing information web by using simple ideas and materials and to construct structures on them, which could increase interest in science courses. Although its issues are about nature and daily life, science courses are difficult to comprehend as many of its concepts are abstract and complicated (King and Ritchie, 2012).).Laboratory method gains importance in sciences instruction because science gives importance to observation and experiments. Besides, constructivist learning theory, which puts students in the center, emphasizes the importance and necessity of the learning environments that will help learners to make connections with daily life and to make research with a view to obtaining in depth information (Cinici, Sözbilir and Demir, 2011; Hofstein, Eilks, and Bybee, 2010). Several studies have demonstrated that laboratory method is quite effective in sciences instruction (Lawson 1995). Laboratory activities provide several contributions to students' developing scientific process skills such as observation, classification, data collection, explanation and experiments (Aydoğdu and Kesercioğlu, 2005). With the help of the experiment activities conducted, students both explore new information and have the opportunity to test the accuracy of the current information (Adams, Gupta and DeFelice, 2012; Kaptan and Korkmaz, 2001).

Despite the changes in the programs, instead of education that makes students think and encourage them to practice what they learned in real life contexts, students seem to still be provided with teacher-centered and lecture based sciences instruction where students are passive. Students should be provided with such opportunities as making observations and producing something in line with observation results, rather than memorizing scientific laws and copying the figures in the book. Students should be encouraged to look at the natural events with suspicion and test the known rules, and to do experiments on their own. This way, their self-confidence should be gained. Starting from school, students should be given the opportunity to gain skills such as scientific thought, study, observation, data collection and drawing conclusions from these data and design their own scientific experiments. Through questions and problems with multiple answers or solutions, students should be encouraged to think in a multidimensional way and produce more than one solution and they should be asked open-ended questions that will help them tell their ideas freely (Gomes and McCauley, 2012; Gürdal, Çağlar and Şahin, 1997, 2001; King and Ritchie, 2012).

New approaches in instruction are based on raising individuals who think, question, search, and produce rather

than the ones who know a lot and give answers a lot. Considering the new approaches in instruction, it can be seen that these approaches focus mainly on two fundamental principles. These are individual differences and instruction by doing-living principles. Experts in the field of science state that science topics could be instructed in a more qualified way through laboratory activities; they even point that science topics cannot fully be learned without involving experiments. (Brandt, Möller and Kohse-Höinghaus, 2008; Çepni and Ayvacı, 2006; Hofstein and Lunetta, 1982). Arslan, Mirici, Özel, Sevimli, and Samancı (2006) compared instruction methods supported with visual materials and the ones with laboratory method and found that laboratory method was more effective in promoting student success. Killermann (1998) compared success of students who did the experiment themselves and who were provided with demonstration and instruction method and found that students who were directly involved in the experiment activities were more successful. As a result, laboratory method, by helping students understand the nature of science, helps them to learn ways of producing information, it makes science topics more comprehensible, and, it improves comprehension and critical thinking by helping students to gain experience about using information (Ayas, Çepni and Akdeniz, 1994, 2005; Gao, Feng, Zhan and Zheng, 2017; Hofstein and Lunetta, 2003)

There are two sciences that students learn, one is the school science (science that is learned at school) and the other one is the real science (real science in natural environments). Students have substantial ideas and experiences about the natural world events because they experience real science in the natural environment where events are happening. They live together with the real events of natural environment in every phase and period of their lives.

We are trying to teach nature events to children in science courses rather than in their natural environment, with fake models in the fake environments we create in classrooms. Many features of the nature events that we try to teach with board and chalk, at least half of them, are lost. Nature events are four-dimensional. When we draw a picture on the board, we can make it only two-dimensional. Therefore, the event cannot be kept in mind with all of its features. In this case, the event that we design according to the information in mind does not fully overlap with the real event. When children have a problem about a nature event, they cannot make connections between what they learned and what they experience. Then, instruction and instructional approaches should be taken into consideration (Gao, Feng, Zhan and Zheng, 2017; Soylu, 2005).

It is the detailed demonstration of fundamental scientific laws that help students understand nature and the events happening around them, how wind and water courses are formed, causes of erosion, and how machines make jobs easier. Students should be able to understand and classify the things that have happened and are still happening around them; they should also be able to form them whenever or wherever they want. They should understand what life in one drop of water in pond is, how some insects change (transform), how insects spin different webs, and how plants spread their seeds around.

To summarize, materials used in sciences instruction laboratories should be familiar to students, they should be composed of things that we can find around and that students can collect and understand what they are. Students should be able to create this environment whenever they want. Laboratories should include materials made by teachers and students. The same material should not be used over and over again; if possible, experiments and observations should be done with the materials collected from students' own environment, and experiments should not be done in a haphazard and standard way. This study presents the current state of sciences instruction in NEI (North East Indian) state schools, to what extent the laboratories are used in the instruction of the courses, whether students take active roles in laboratories, and some examples in relation to the materials that can be used in science laboratories and the laboratory tools that can be made with students. The study involved both teacher and student interviews, but the present report includes teacher interviews only.

II. MATERIALS AND METHODS

This study is both qualitative and material development study for sciences instruction. Teachers instructing 4th grade primary school students were administered face to face interviews, one of the techniques used in qualitative studies. It then developed tools that could easily be designed with students to make the topics in science courses more concrete and enable active participation of students.

The data in the first part of the study were collected using "Semi-structured interview form" while the tools in the second part of the study developed original samples by reviewing the related literature considering the environmental conditions and facilities of the schools.

The participants were teachers instructing 4th grade students enrolled in four schools (three state schools and one private school) in Seyhan, Adana. The reason for including 4th grade teachers are that the way this course is instructed at the beginning level and how students are prepared for upper levels are important for this study. Abbreviations used in the study are presented as school type, grade level taught, and gender respectively. For instance, (S4M) means state school, 4th grade, and male teacher.

The participants were a total number of 14 teachers, 10 from state schools and 4 from private schools. Majority of the teachers graduated from classroom teaching departments, but three teachers had different branches. Years of working in profession ranged between three to 32 years. As for the classroom size, the groups consisted of 40 students on the average.

The data were collected using a semi-structured form that consisted of 15 questions. The form had questions that aimed to collect personal information, as well. The data were collected through face to face interviews conducted with the teachers. The interviews were recorded using a voice recorder. The data were analyzed using content analysis methods.

III. RESULTS

Findings obtained from the Analysis of the Interviews

Findings obtained from the interviews were presented in the framework of "Laboratory Use in Science Course", "Teachers'

Suggestions in relation to the Science Course and Laboratory Use" themes.

Laboratory Use in Science Course

Majority of the teachers participating in the study (35 teachers) reported to have a laboratory in their school; three teachers stated that their laboratory was used as a classroom due to the large numbers of students. One teacher stated that they had a laboratory, but he stated that it was used by both first and second stage students and thus it was inadequate.

"We have a laboratory, but since it is the only one, we have problems while using it. No program has been formed for this since the beginning of the year. Second stage students benefit from the laboratory more than the first stage students do." (S4M).

Another teacher says "There is a laboratory, but it is not used effectively. We have no sufficient equipment". (S4F).

Teachers in state schools were found to think that inadequate laboratory use resulted from lack of teachers in laboratories, incomplete laboratory materials, lack of guidance, and lack of knowledge about this issue.

"Increasing laboratory studies could be possible under expert supervision. Each school should have a laboratory teacher". (S4M).

"I have difficulty almost in all experiments; a laboratory teacher is a must" (S4M).

"Laboratory environment should be ready; and we need an in-service training about this issue".

"Even I myself cannot do some of the experiments, so how can I make students do it? These kinds of problems could be solved if we had a laboratory teacher". (S4M).

The teachers in private schools stated that they had a laboratory in their schools and they had the opportunity of performing the experiments in the content of the course together with the laboratory teacher. On the other hand, the teachers also stated that due to overloaded curriculum topics to be covered, they performed some of the experiments in the classroom.

Teachers generally stated that they enjoyed teaching science course, but two teachers stated that they did not enjoy teaching science. As it can be seen in the excerpt below, not enjoying science course resulted from lack of laboratory environment and negative experiences.

"I have never liked science course, and I do not like teaching it. While I was at teacher's training school, I used to fail in the physics, chemistry and biology courses. That's why I do not like it. (S4M).

There were teachers who reportedly enjoyed teaching science but also mentioned some inadequacies.

"Yes, I enjoy teaching science, but limited laboratory facilities and lack of laboratory teachers make teaching this course difficult. Besides, many topics to be instructed and worries about catching up with the curriculum also prevent me from instructing the course in the way I want" (S4M).

On the other hand, there were some teachers who stated that they enjoyed teaching science due to such factors as it is easier to connect with real life, there are so many ways to make it concrete, and it appeals to sensory organs.

"Yes, I enjoy it because I can show the results to children implicitly. Students better understand the topics that are made more concrete. The topics are interesting and they affect them." (S4M).

"I enjoy instructing science a lot. Because it audio- visual" (P4F).

Teachers defined the purpose of science course as introducing natural life, learning by doing and living, helping to meet fundamental needs, and teaching scientific methods. They also stated that the science course enables permanent and productive learning. The following excerpts provide examples about the teachers' views on this issue.

"Knowing the environment, the world… seeing the relationships between living and non-living things. It helps people to know themselves. It is appropriate to instruction from near to far. It helps to get information about the world and space. One of its aims is to enhance permanent information through learning by doing and living. It also gives experiment-observation opportunities. (S4M).

"Teaching scientific ways of thinking, making students realize that concrete results are obtained through scientific ways". (S4M).

The teachers stated that they first read the topic, gathered materials related to the topic, did the experiments first at home or asked the students to bring the materials providing that they were informed beforehand.

"I first read the topic I will teach. I identify the materials to be used in the experiment mentioned in the topic. Before doing it in class, I myself do the experiment, I mean, not all the experiments, particularly those that are dangerous. If the materials are things that students can find in their environment, I let them know one day before the course and ask them to bring those materials" (S4M).

After the teachers' ideas about laboratory use, the purpose of science and technology course, and their preparations to achieve these aims were identified, their suggestions about laboratory use were also explored.

Teachers' Suggestions in relation to the Science Course and Laboratory Use

The teachers reported that the inadequacies in the sciences instruction were related to themselves; they reportedly had insufficient knowledge about this issue and needed in-service training courses. The teachers emphasized such issues as decreasing program load, starting branching or assigning laboratory teachers, solving the substructure problem, and solving the shortage of materials problems.

"There should be laboratory teachers. One should not expect all teachers to love the science course, precautions should be taken accordingly. Due to its nature, this course should be instructed in laboratories. Therefore, laboratory facilities should be increased. The curriculum should be made a little

bit easier and adjusted to students' levels. The teacher should not worry about catching up with the curriculum." (S4M).

"There should be more courses on sciences instruction and all teachers should be required to attend these courses. These courses could be divided into branches starting from the 3rd or 4th grades (S4M).

"Teachers should be trained about science. They should be provided with appropriate opportunities through timely courses. They should be given trainings on material education, material development, and the use of virtual laboratories. Moreover, each school should have a laboratory teacher." (S4F).

Some examples about the Materials that could be used Sciences instruction Laboratories and Laboratory tools that can be designed with students

A. Making Thermocouple:

Different from the main structure of the known thermometers, it does not contain mercury or alcohol; both it is easy to produce and it is easy for students to understand. Materials used: two different metal strips (with totally different expansion coefficients), screw or rivet.

How to do it: two different metal strips are drilled on some certain intervals and screwed down at a certain temperature (25 °C) in a way that they cannot get loose.

Function: When they are exposed to different temperatures from the ones they were set, the metals will have different amounts of expansion or shrinkage, so the metal couple will bend to the left or to the right and form a curve. Direction and amount of this curve will enable identification of the temperature.

B. Making a tool that measures resistance of Metals (OMH meter):

It aims to demonstrate that metals have various atom structures and understand that these fundamental structures respond differently (resistance) when they are exposed to electric current.

Materials: constant-voltage power supply (e.g. automobile battery- 12 volt), bulb, wires made from various metals with same length and lateral section (thickness)

How to do it and its Function: The wire is connected to the automobile battery in a way to make the bulb light. The bulb lights when current gets through the bulb. The light given by the bulb is observed by using (connecting) a different metal wire each time. It is observed in OHM law (V=IR) that resistance and light are inversely proportional.

C. Experiment for measuring short time and people's response time:

This experiment enables investigation of multiple topics in science with a few materials. This experiment measures people's seeing movement through their eyes (transformation of light energy to chemical energy) as well as the duration of responding after this sight. This experiment is convenient for investigating and understanding where a meter dropped is caught and after which drop signs of tiredness is indicated in people and the differences between right hand and left hand.
Materials used: Ruler or Meter

D. Soap Bubbles Experiment:

This experiment investigates behaviors of objects in the atmosphere. It aims to understand the changes caused by gravity, surface tension, temperature, and inner-outer pressure. Through the various materials foamed, it could be possible to investigate many behaviors such as the life of bubbles produced in hot and cold water, type of fading and color changes.

Materials Used: Foaming materials, various soaps, wire hoops or hollow bars (reed), hot and cold water

IV. Conclusion and Recommendations

Results of the present study indicate that science course is not instructed in accordance with its content; as a result students are made to memorize the disjointed information given to them. Findings in the study conducted by Didar and Yangın (2007) also support these findings. Didar and Yangın (2007) found that majority of the 4th and 5th grade classroom teachers adopted aims that are based on behaviorist approach, sciences instruction increased students' knowledge about science but could not make them science literate individuals. Therefore, it is highly important to disseminate sciences instruction laboratory tools which were designed in the scope of this study and which can be made by teachers with their students and even to educate prospective teachers about this issue.

REFERENCES

[1] Adams, J. D., Gupta, P., & DeFelice, A. (2012). Schools and informal science settings: Collaborate, co-exist, or assimilate? *Cultural Studies of Science Education*, 7: 409–416.

[2] Arslan, O., Mirici, S., Özel, Ç. A., Sevimli, A. & Samancı, N. K. (2006). Agrobacterium aracılığı ile gen aktarımı konusunun laboratuar destekli olarak işlenmesinin öğrenci başarısına etkisi. *VII. Ulusal Fen Bilimleri Eğitimi Kongresi Bildiriler Kitabı.* Ankara: Milli Eğitim Basımevi

[3] Ayas A., Çepni, S. & Akdeniz, A. R. (2005). Fen öğretmen adaylarının çözelti hazırlama ve laboratuar malzemelerini kullanma yeterliklerinin belirlenmesi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 28(1): 65-72.

[4] Ayas, A., Çepni, S. & Akdeniz, A.R. (1994). Fen bilimleri eğitiminde laboratuarın yeri ve önemi-II. *Çağdaş Eğitim Dergisi,* 205(1): 7-12.

[5] Aydoğdu, M., & Kesercioğlu, T. (2005). *İlköğretimde fen ve teknoloji öğretimi*. Ankara: Anı Yayıncılık.

[6] Brandt, A., Möller, J., & Kohse-Höinghaus, K. (2008). Was bewirken außerschulische Experimentierlabors? [What's the effect of science laboratories?]. *Zeitschrift für Pädagogische Psychologie*, 22: 5–12.

[7] Çepni, S. & Ayvacı, H.G. (2006). Laboratuvar destekli fen ve teknoloji öğretimi. (5th ed.) S. Çepni (Ed.). *Kuramdan Uygulamaya Fen ve Teknoloji Öğretimi* (pp.158-188). Ankara: PegemA Yayıncılık,

[8] Çinici, A., Sözbilir, M., & Demir, Y. (2011). Effect of cooperative and individual learning activities on students: understanding of diffusion and osmosis. *Eurasian Journal of Educational Research,* 43(1):19-36.

[9] Dindar, H. & Yangın, S. (2007). İlköğretim fen ve teknoloji dersi öğretim programına geçiş sürecinde öğretmenlerin bakış açılarının değerlendirilmesi. *Kastamonu Eğitim Dergisi,*15(1): 185-198.

[10] Gao L., Feng C., Zhan M. & Zheng X. (2017) Elementary Science Education Reform in Guangzhou: Expectations and Changes. In: Liang L., Liu X., Fulmer G. (Eds) *Chinese Science Education in the 21st Century: Policy, Practice, and Research.* Contemporary Trends and Issues in Science Education, vol 45. Springer, Dordrecht

[11] Gomes, D., & McCauley, V. (2012). Science outreach and science education at primary level in Ireland: A mixed methods study. *New Perspectives in Science Education Conferences*. May 2018.

[12] Gürdal, A., Çağlar, A. & Şahin, F. (1997). *Birleştirilmiş sınıflar için fen bilgisi öğretmen kitabı I.* Ankara: I. MEB ve UNICEF Yayınları.

[13] Gürdal, A., Şahin, F. & Çağlar, A. (2001). *Fen eğitimi: İlkeler, stratejiler ve yöntemler*. İstanbul: Marmara Üniversitesi Yayını No: 668.

[14] Hofstein, A. & Lunetta, V. N. (2003).The laboratory in science education: Foundations for the twenty-first century. *Science Education*, 88(1), 28-54.

[15] Hofstein, A.& Lunetta, N.V. (1982). The role of the laboratory in Science teaching: Neglected aspect of research. *Review of Educational Research*, 52(2): 201-217.

[16] Hofstein, A., Eilks, I., & Bybee, R. W. (2010). Societal issues and their importance for contemporary science education. In I. Eilks & B. Ralle (Eds.), *Contemporary Science Education* (pp. 5–22). Aachen: Shaker

[17] Killermann, W. (1998). Researching to biology teaching methods. *Journal of Biological Education*, 33(1): 4-9.

[18] King, D., & Ritchie, S. M. (2012). Learning science through real-world contexts. In B. J. Fraser, K. G. Tobin, & C. J. McRobbie (Eds.), Second international handbook of science education: Pt. 1. Second international handbook of science education (pp. 69–79). Dordrecht: Springer

[19] Korkmaz, H., & Kaptan, F. (2001). Fen eğitiminde proje tabanlı öğrenme yaklaşımı. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 20(1)*: 193-198.

[20] Lawson, A. E. (1995). *Science teaching and the development of thinking*. Belmont, CA: Wadsworth.

[21] Soylu, H. (2005). *Fen öğretiminde yeni yaklaşımlar*. Ankara: Nobel Yayın Dağıtım.