Teachers' Perspective of Effective Use of Teaching and Learning Materials in Basic School Integrated Science Lessons

Valentina Osei-Himah[1], Kenneth Adu-Gyamfi[2*]

[1]Department of Science Education, Atebubu College of Education, Atebubu, Ghana.
oseihimah@yahoo.com
[2]Department of Science Education, University of Cape Coast, Cape Coast, Ghana.
kenneth.adu-gyamfi@ucc.edu.gh
*Corresponding author

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Abstract: Teaching and Learning of science in basic school is recommended to be interactive in enhancing students' conceptual understanding. For science lessons, the importance of teaching and learning materials (TLM) cannot be overemphasized. This research explored perceived effective use of TLM in science lessons among teachers categorised as; supervisors, mentors, and mentees in teacher education on three factors. Using a cross-sectional survey design, 252 teachers were selected through multi-face sampling techniques to respond to a 40-item questionnaire. The responses obtained were analysed using exploratory factor analysis and one-way ANOVA. It was revealed that there were no differences existed between supervisors, mentees, and mentors on the effective use of TLM in science lessons. Implications of the findings of the research for science teacher preparation and policy are discussed.

Keywords: Constructivist; effective; science; teachers; teaching; resources

1. Introduction

Pre-tertiary education has undergone several reforms in Ghana (Adu-Gyamfi & Otami, 2020); all in the name of having well-balanced individuals who possess the requisite knowledge, skills, values, aptitudes, and attitudes to function as productive citizens. The pre-tertiary education is structured as 2 years of Kindergarten, 6 years of Primary School, 3 years of Junior High School, and 3 years of Senior High School. The government of Ghana believed that if this structure will contribute to the achievement of the aim of pre-tertiary education, then teacher education is a key. The majority of teachers teaching in the basic schools (Primary and Junior High Schools) are prepared from Colleges of Education with Diplomas in education (Ministry of Education, Youth and Sports, 2004) and now, awarding Bachelor of Education (Basic Education). The first graduates of the Bachelor of Education programme will come out in the year 2022 (Adu-Gyamfi & Otami, 2020).

The planners of the curriculum for integrated science for basic schools in Ghana advocate for the provision of science equipment and materials to help students understand scientific concepts. These science equipment and materials are expected to be used by teachers in a way that provides students with the opportunity to explore, observe, and discuss scientific knowledge relating to their environment (Ministry of Education, 2012). One of the instructional strategies being advocated for teaching and learning of integrated science is the activity method

(Ministry of Education, 2019). In this method, the student is at the core of the teaching and learning process and is made to actively interact with materials leading to making meaning of scientific concepts (Adu-Gyamfi, 2014). This is anchored in the constructivist perspective of making meaning of information, where students are provided with opportunities to expand, change, enhance, and modify the ways in which they view the world (Ministry of Education, 2019).

Pre-service teachers from the Colleges of Education are prepared to appreciate the role of teaching and learning materials in teaching science at the basic school level. From the 'methods of teaching integrated science' course material for the diploma in basic education by distance (Asare-Ahene, Asiamah, Nartey, Appiah, & Azumah, 2015), the pre-service teachers are trained to select, prepare, and use the most appropriate teaching and learning materials (TLM) for effective and efficient presentation of scientific concepts (Bušljeta, 2013).

1.1 Teaching and Learning Resources

Science teaching and learning is expected to be effective and there are a lot of dimensions to effectiveness (Mupa & Chinooneka, 2015). Tweed (2009) explained that an effective science lesson is characterised by the use of resources available to accomplish the purpose of the lesson (Bukoye, 2019; Bušljeta, 2013), and other stakeholders are even advocating for the use of high quality teaching and learning resources for achieving the purpose of science education (Bybee & Chopyak, 2017). From Sieber and Hatcher (2012), in using (real) objects, teaching become effective when students interact in small groups. Such instruction makes students work cooperatively, share their learning, and pool their knowledge (Adu-Gyamfi, Ampiah, & Agyei, 2020). Hence, for teachers to be effective, they need to provide students with enough learning experiences (Tweed, 2009).

Rosenshine (2012) reported that teachers use instruction to help students efficiently acquire, rehearse, and connect background knowledge. In such instructions, teachers provide support by modelling, guiding student practice, helping students to overcome their errors, providing scaffolds for difficult tasks, and providing enough practice and review. According to Bakar (2017), teachers use technology in the form of a management system to reduce their workload and to support monitoring and tracking the progress of students. Hence, education leaders are looking for resources to support students to make meaning of the world as to how the scientists see it (Bybee & Chopyak, 2017). However, one of the barriers to teaching science is a lack of resources (Tweed, 2009). Low levels of the use of teaching and learning resources in lessons (Abubakar, 2020; Bukoye, 2019) leads to ineffective management of classrooms and delivery of content (Bizimana & Orodho, 2014).

Constructivist learning theory considers teaching and learning resources (materials) as important in helping the students construct knowledge on their own (Bada, 2015; Boakye & Ampiah, 2017; Calik, Ayas, & Coll, 2006; Harris, 2005). Teaching and learning resources play important role in forming a constructivist learning environment (Birisci & Metin, 2010). To the constructivist, teaching and learning resources should be available for teaching and learning, but research revealed that the resources are not available in some schools (Abubakar, 2020; Boakye & Ampiah, 2017; Bukoye, 2019; Ibrahim, Adzra'ai, Sueb, & Dalim, 2019). In the midst of the unavailability of resources the difficulty teachers face is how to select the suitable ones (Kodriyah, Islamiah, & Aprizani, 2020), in particular when it is internet-based (Harris, 2005). From the review of Bada (2015), it was found that in a constructivist learning environment, there are multiple modes of representation such as the use of videos, images, films, audios (Bukoye, 2019; Bušljeta, 2013), cassettes, CD-Rooms, dictionaries, and workbooks (Kodriyah et al., 2020).

The suitability of constructivist-based teaching strategy as developed by Calik et al. (2006) is that it uses simple, low-cost teaching and learning resources. These teaching and learning resources in their model helped students to learn the dissolution of a gas into liquid. In a constructivist learning environment, students collaborate and exchange ideas (Adu-Gyamfi et al., 2020) through group projects (Bada, 2015) and internet resources (Wiesenmayer & Koul, 1998); use concept cartoons to elicit students' alternative conceptions in scientific concepts (Birisci & Metin, 2010); communicate among students (Wiesenmayer & Koul, 1998); inspire students to be careful in their learning (Drew & Rankin, 2004).

US Department of Education, Office of Communication and Outreach [USDOE] (2005) reported that the use of teaching and learning resources offer students opportunities to be confident of their abilities in solving problems. Birisci and Metin (2010) observed from the literature that in the perspective of constructivism, teaching and learning resources help teachers to gain the attention of students and to create a conducive learning environment where students can make meaning of scientific concepts and principles.

Students become more active in lessons where teaching and learning resources are provided for students' interactions (Bukoye, 2019; Drew & Rankin, 2004). Active exploration of materials (resources) occurs when students are presented with a carefully chosen assortment of materials. This should challenge students to discover something about the materials (Hughes-McDonnell & Burgess, 2011) leading to the promotion of knowledge construction among students as they are suitably challenged to learn (Andresen, 2015; Bušljeta, 2013). Science teachers are, therefore, prevented from assuming their usual role as disseminators of information to a facilitator's role (Wiesenmayer & Koul, 1998) as teaching and learning resources can be constructed by teachers to meet local demands and specifics (Diezmann & Watters, 2002).

Students at the basic school level construct knowledge by interacting with resources (Boakye & Ampiah, 2017; Bušljeta, 2013) and hence, they need to be introduced to teaching and learning resources that are safe and interesting (Binsaleh & Binsaleh, 2020; USDOE, 2005). Andresen (2015) asserted that students' introduction to the use of teaching and learning of resources (such as digital devices) in their early stages of learning brings about greater flexibility in knowledge construction. Teachers appreciate that, flexibility brings about differentiated teaching where different objectives are written for different students. Individualised learning (which is described as 1:1 initiative with respect to one student to a set of learning resources) brings about improved self-directed knowledge construction (Andresen, 2015).

However, it is reported that not all teaching and learning resources may meet the learning needs and expectations of all age groups of students learning science (USDOE, 2005). Hence, teaching and learning resources offer a lot to teacher education programmes in terms of flexibility in delivery (Diezmann & Watters, 2002). Technology, for instance, offers students more flexibility, more accessibility, and more reliability to make meaning of concepts anywhere and anytime (Bakar, 2017). One of the 21st century skills needed by students is learning with tools such as ICT (Rahmar, Leng, & Mashudi, 2020), and enhanced technology has changed the ways students interact with others to make meaning of concepts (Shuhidan, Majid, Shuhidan, Anwar, & Hakim, 2020). However, a good number of students struggle to adapt to online learning (Shuhidan et al., 2020). Online learning is an unlikely approach for Ghanaian basic schools as the schools are not endowed with computers and internet facilities though pre-service teachers in colleges of education are prepared to use the internet in learning.

Har (2013) considered scaffolding, which is a teacher support to student learning (Rahmar et al., 2020), as a popular strategy of teaching and learning in the domain of constructivism. Drew and Rankin (2004) explained one of the principles of using open-ended materials in instructions that students learn with support from their peers by working and playing in groups. Role-playing and demonstration are examples of scaffolds, where students are shown the processes of skills and concepts (Boakye & Ampiah, 2017; Har, 2013). According to Rahmar et al. (2020), the scaffolding method helps students to learn through constructivism as students learn by actively interacting with materials.

Constructivist learning principle on learning resources (materials) is found to increase the success of students in academics as well as retention (Karaduman & Gultekin, 2007). A constructivist learning environment encourages the use of manipulatives to motivate students' (Kodriyah et al., 2020) construction of knowledge unlike the traditional learning environment, where resources are mainly textbooks and workbooks (Bada, 2015; Mupa & Chinooneka, 2015). The use of teaching and learning resources, such as videos and virtual, provides teachers with alternative experiences aside from textbooks (Bybee & Chopyak, 2017). From the constructivist perspective of teaching and learning resources reviewed so far, three characteristics of a conducive environment for learning science are: teacher and students should share information to help in knowledge construction; teachers and students should share authority in a science lesson, and teachers should play the role of a facilitator in a science lesson. These three characteristics are considered as factors that should underpin the effective use of TLM to help students learn science in this research.

1.2 Purpose of the Study

According to Banilower, Cohen, Pasley, and Weiss (2008), various surveys of teacher instruction including NAEP survey in 2005, teachers revealed that a substantial proportion of their instructions are built on hands-on activities where students interact with teaching and learning resources. Drew and Rankin (2004) explained one of the principles of using open-ended materials in instructions is students at lower levels of education may construct knowledge through hands-on experiences with diverse teaching and learning resources. The purpose of this research, therefore, was to explore the perceived effective use of teaching and learning materials (TLM) in teaching basic school science among pre-service teachers (as mentees), in-service teachers (as mentors), and college tutors (as supervisors). The research question that guided the survey was: "What does effective use of TLM in teaching science in the basic schools meant to mentees, mentors, and supervisors?"

2. Research Methods

2.1 Research Design

The research adopted a quantitative approach to explore the perceived effective use of TLM in teaching science in basic schools. To achieve this, a cross-sectional survey was conducted using the colleges of education within the Ashanti, Bono, and Ahafo zone in Ghana. The cross-sectional survey became necessary as there was the need to have large scale research and representative sampling, and to compare groups (mentees, mentors, and supervisors) within the sample.

2.2 Sample and Sampling Procedure

A multi-face sampling procedure was used to select 252 participants. The colleges of education in Ghana were stratified into five zones. The five zones were Central and Western; Greater and Eastern; Volta; Ashanti, Bono, and Ahafo; and Northern. For the purposes of this research, Ashanti, Bono, and Ahafo (AshBA) zone were randomly selected. This is because the zones were large study areas and hence, the selection of one, which met the characteristics of the others. There were 13 colleges in the AshBA zone. The 13 colleges were stratified into one single-sex male institution, three single-sex female institutions, and nine co-educational institutions. The only single-sex male institution was purposively selected for this research. One of the three single-sex female institutions and five of the nine co-educational institutions were simple randomly selected to form part of the study colleges.

There were three groups of pre-service teachers from each college of education (year 1, year 2, and year 3) available for the research. The year 3 pre-service teachers (herein referred to as mentees) and their college science teachers (herein referred to as supervisors) were purposively selected for the research. The mentees were selected as they were the group on the field having one-year long practicum and might have experienced the practical selection and usage of TLM. From each of the seven colleges, 20 mentees were simple randomly selected constituting 140. However, 129 mentees representing 92.1% were available for the research as seen in Table 1.

Table 1. Percentages of sampled teachers

Teacher	**N**	**n**	**%**
Mentee	140	129	92.1
Mentor	71	71	100.0
Supervisor	52	52	100.0
Total	**263**	**252**	**95.8**

Where N is the estimated number of teachers
n is sampled teachers from each group of teachers
% is the percentage of sample teachers from each group of teachers

The sampled mentees were located in 91 basic schools in the Ashanti, Bono, and Ahafo regions. As it was estimated that there were a minimum of four mentees having practicum in each basic school of which two were randomly selected. The 91 basic schools gave an estimated 71 in-service teachers (herein referred to as mentors). This is because in each basic school there was at least one mentor assigned to four mentees, purposively selected for the research. With respect to the supervisors, all science tutors, from the seven colleges, purposively participated in the research. In all there 52 college tutors (herein referred to as supervisors) were available for the research.

2.3 Research Instrument

The instrument for the research was a questionnaire on the effective use of teaching and learning materials (QEUTLM). The QEUTLM was structured in the form of a closed-ended question where teachers were supposed to rank each item on a scale of 1 to 5. The lowest rank was 1 and the highest rank was 5. The QEUTLM has two sections: Section A (assessing the biodata of the teachers) and Section B (assessing the constructs on effective use of TLM). The QEUTLM was constructed by the researchers. The items were constructed based on the literature and the researchers' experiences in relation to instruction and supervision of practicum. Initially, there were 52 items measuring the various constructs in Section B. The QEUTLM was pilot-tested with 20 teachers with similar characteristics to the teachers from the research zone. Thereafter, it was subjected to item analysis and 12 of the items that seemed to measure different constructs were deleted leaving 40 items. The Cronbach Alpha coefficient of reliability was calculated to establish the reliability of QEUTLM. The calculated Cronbach Alpha coefficient of reliability was 0.82 indicating that QEUTLM was reliable.

2.4 Data Collection Procedures and Analysis

The QEUTLM was administered in the month of May, where the basic school calendar was in its Term 3. During the month of May, the practicum of mentees from colleges of education has entered its final stage and the mentees have had enough experiences to respond to the QEUTLM. The two authors administered the questionnaire to the supervisors, mentors, and mentees in 2 weeks. In week one, the questionnaire was administered to the supervisors (who were science educators) in the seven colleges of education in the AshBa zone. In the second week, the questionnaire was administered to mentors and mentees in their respective basic schools. The data collected was analysed to answer the research question in the following forms, to establish the factors contributing to the effective use of TLM in teaching science in basic schools and determine any difference that exists among supervisors, mentors, and mentees on perceived effective use of TLM.

3. Results

3.1 Factors contributing to Effective Use of TLM

To determine the factors contributing to the effective use of TLM in science lessons in the basic schools, factor analysis was conducted. Initially, the data from QEUTLM was subjected to Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) analysis to establish the suitability of the data for factor analysis. The calculated KMO value was 0.842 and Bartlett's test of sphericity (5.019E3) was significant ($p = 0.000$, $df = 780$). This gave a hint that the data was suitable for factor analysis. In an attempt to extract the factors, the principal component analysis (PCA) was used. The exploration was done using Kaiser's criterion, scree plot, and parallel analysis. The results in Table 2 show that the data can be reduced to 11 components with eigenvalues above 1.0.

Table 2. Extraction of sums of squared loadings

Component	Total	% of variances	Cumulative %
1	10.847	27.118	27.118
2	3.607	9.017	36.135
3	2.161	5.402	41.537
4	1.774	4.436	45.972
5	1.533	3.831	49.804
6	1.490	3.724	53.528
7	1.222	3.056	56.584
8	1.144	2.860	59.444
9	1.128	2.820	62.264
10	1.046	2.614	64.878
11	1.024	2.560	67.436

However, the 11 components explained 67.436% of the variance and hence, there was the need to examine the scree plot to appreciate the number of components to retain. The results of the scree plot are presented in Fig. 1.

The results in Fig. 1 show that there were three components of the 11 components that should be retained as factors contributing to the effective use of TLM in teaching science in basic school. This is because Components 1, 2, and 3 explained more of the variance than the remaining components though there was another break at Component 6. To be more certain of the number of components to be retained, parallel analysis (PA) was conducted. The results of the PA are presented in Table 3.

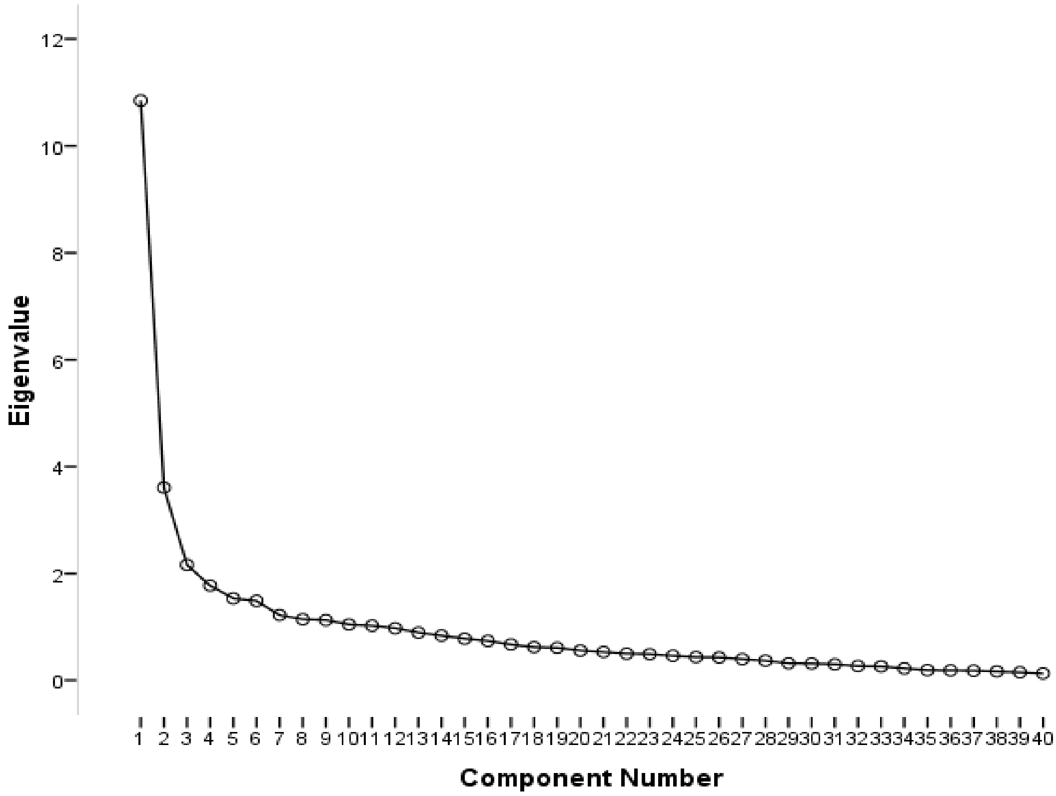

Fig. 1 - An illustration of components to retain on effective use of TLM

Table 3. Comparing eigenvalues from PCA to criterion values from PA

Component	Actual eigenvalue from PCA	Criterion value from PA	Decision
1	10.847	1.8514	accept
2	3.607	1.7530	accept
3	2.161	1.6777	accept
4	1.774	1.6125	accept
5	1.533	1.5565	reject
6	1.490	1.5001	reject

From Table 3, the results show that four components should be retained. Retaining four factors here means the earlier proposition of three factors from the scree plot should once be looked at. To achieve that the Component Matrix was considered. From the Component Matrix output, there was the decision to consider factors that loaded quite strongly. That is any item that loaded above 0.5 was retained and any item that cross or negative loaded was rejected. These together resulted in three components as seen from the scree plot. The result from the Component Matrix is presented in Table 4. From Table 4, there were only three items loaded above 0.5 under Component 4 and hence, the decision to reject it as a factor defining an effective use of TLM in teaching science in the basic schools.

Table 4. Factors evolving from component matrix

Statement	Component 1	2	3	4
Teacher use of TLM as a supplement of textbook	0.829			
Teacher use of TLM to arouse curiosity in students during a lesson		0.713		
Teacher use of TLM to establish two-way communication between teacher and students		0.713		
Teacher use of TLM in teaching in groups to offer students opportunity to support peers in learning		0.641		
Low level of the use of TLM by teachers in teaching results in ineffective classroom management	0.582			
Teacher use of TLM to assess students' learning in a lesson	0.545			
Teacher use of TLM to provide students with feedback	0.514			
Teacher use of TLM to encourage collaboration among students in a lesson	0.505			
Teacher selection and use of TLM to the developmental level of students in a lesson		0.629		
Teacher use of TLM in teaching science to sustain students' interest in a lesson		0.620		
Teacher holding general discussion with students after the use of TLM in a lesson			0.587	
Teacher use of TLM to help students predict the outcome of investigation before exploration		0.575		
Teacher use of TLM to encourage students to learn in a lesson		0.555		
Teacher use of TLM to cause students to think and make meaning in a lesson		0.553		
Teacher use of TLM to enable students to explore the subject matter		0.545		
Teacher monitoring of students' interactions with TLM in a lesson		0.531		
Teacher use TLM to bring about flexibility in learning among students				0.791
Teacher use TLM to help students gain confidence of their abilities in science				0.657
Teacher use TLM in teaching in groups to offer students opportunity of observing, classifying, and organising information				0.584
Teacher modify TLM to reflect needs of students in science lesson			0.558	
Teacher use of TLM to bring about self-directed learning among students			0.536	
Teacher use of TLM to encourage students to look carefully in learning			0.512	
Teacher use of TLM to help students confront their				

thinking that is correct scientific knowledge	0.675
Teacher use of TLM to meet students' needs in a lesson	0.595
Teacher use of TLM to ensure an improved student's performance	0.529

Comparatively, the other three components had a minimum of six items loading under each component. It was, therefore, proper to retain only three components with more loadings as the factors. Having agreed on three factors, there was the need to interpret them. The factors were rotated through Varimax rotation. From the Varimax rotation, Factors 1, 2, and 3 explained 41.537% of the variance. This is because Factor 1 explained 15.138%, Factor 2 explained 14.954%, and Factor 3 explained 11.444%. The total variance did not change after the rotation compared to that seen in Table 2. The three factors are sharing information; sharing authority (responsibility); and teacher facilitation.

Factor 1 (*sharing information*): explains that effective use of TLM is when the teacher uses the TLM to bring about a share of knowledge among teacher and student and student and student. For example, "teacher use of TLM to establish two-way communication between teacher and students" and "teacher use of TLM in teaching in groups to offer students opportunity to support peers in learning".

Factor 2 (*sharing authority*): explains that effective use of TLM is when the teacher uses the TLM to create a learning environment where the teacher and students share responsibility during teaching and learning sessions. For example, "teacher holding general discussion with students after the use of TLM in a lesson" and "teacher use of TLM to help students predict the outcome of the investigation before exploration".

Factor 3 (*teacher facilitation*): explains that effective use of TLM is when the teacher uses the LTM to guide students to learn science in basic schools. For example, "teacher use TLM to help students gain confidence of their abilities in science" and "teacher use TLM in teaching in groups to offer students opportunity of observing, classifying, and organising information".

3.2 Teacher Difference on Three Factors contributing to Effective Use of TLM

The research question was further explored to determine any difference existing among teachers on perceived three factors contributing to effective use of teaching and learning materials. In order to achieve this, a one-way between-group ANOVA was conducted. This is because the independent variable (teacher) of three levels (that is supervisors, mentors, and mentees) was explored against the dependent variable (perceived effective use). Also, the assumption of homogeneity of variance permitting the use of one-way ANOVA was not violated as the significance value for Levene's test was greater than 0.05. That is, the calculated significance value was 0.284. The results from the analysis of one-way between-groups ANOVA on teachers' perceived effective use of TLM are presented in Table 5.

Table 5. Results from One-way ANOVA on effective use of TLM

Teachers	**N**	**Mean**	**SD**	**F**	**p**
Supervisor	52	151.65	21.35	0.039	0.961*
Mentor	71	152.65	22.74		
Mentee	129	152.52	20.02		

* Not significant. P > 0.05

From Table 5, the results show that there was no significant difference at $p > 0.05$ level in the perceived effective use of TLM in teaching and learning of science among teachers. This is because the mean score ($M = 151.65$, $SD = 21.35$, $F (2/249) = 0.039$, $p = 0.961$) of supervisors was not statistically significantly different from the mean score of mentors ($M = 152.65$, $SD = 22.74$) and that of the mean score of mentees ($M = 152.52$, $SD = 20.02$).

4. Discussion

The use of TLM for effective teaching and learning of science in basic schools by teachers is seen in three dimensions. These are sharing information, sharing authority, and teacher facilitation. This is an indication that teachers involved in the research share that effective use of TLM by teachers help create a conducive learning environment for students to make meaning of science concepts (Bušljeta, 2013) at early stages of learning. In a conducive learning environment, students share knowledge through collaboration (Adu-Gyamfi et al., 2020; Sieber & Hatcher, 2012). This collaboration can be achieved in cooperative groups where students can interact with TLM (Boakye & Ampiah, 2017). The teachers (supervisors from college, mentors as in-service teachers in basic schools, and mentees being pre-service teachers) perceived that using TLM to teach cooperatively offers students the opportunity to peer support each other in learning (Drew & Rankin, 2004). If teachers are considered as experienced hands in a constructivist learning environment, then they could provide support for students by giving feedback to them through the use of TLM. A two-way communication during teaching and learning is a constructivist approach to facilitating meaning-making by students and the teachers involved in this research perceived that effective use of TLM promotes two-way communication between teacher and students in science lessons (Bušljeta, 2013).

Teachers most at times in teaching science are seen to take absolute control over the teaching and learning process. However, effective use of TLM is perceived could break this autonomy of science teachers. When science teachers share their autonomy, it will bring about flexibility in learning (Andresen, 2015; Bakar, 2017). Science teachers could share their authority in lessons with students by allowing them to predict an outcome of an investigation prior to it and this could be achieved through effective use of TLM by teachers. Effective use of TLM could help students to explore science concepts instead of relying on their teachers for everything and this is another way for teachers to share authority with students. College tutors should, therefore, prepare pre-service teachers in such a way that they will develop the knowledge and skills needed to create a conducive learning environment with TLM (Okpechi & Chiaka, 2017) where students share authority with their teachers. This should not seem to science teachers that their classroom authority is taken away from them but is a way of creating a conducive learning environment for students.

Effective use of TLM in teaching and learning science in basic schools was seen in terms of the facilitation of lessons. In this case, the supervisors, mentors, and mentees perceived that students are guided to make meaning in a self-directed learning environment through effective use of TLM. In such a learning environment, students could be involved in scientific inquiry where they observe, classify, and organise knowledge leading to the solution of the identified problem. When science teachers serve as facilitators in lessons, they provide students with the opportunity to make meaning of scientific concepts on their own. That is, they encourage students to reflect on their learning and then modify the instructional strategies to help students confront their thinking leading to meaning making. Thus, the teachers involved in this research share that effective use of TLM could help teachers to facilitate science lessons in basic schools as a new direction to be advocated for by the planners of the new Ghanaian science curriculum. The Ministry of Education through the Ghana Education Service and

National Teaching Council should as a matter of urgency provide basic schools with computer- and internet-based TLM that teachers find difficult to access (Harris, 2005) to help teachers facilitate science lessons.

The supervisors, mentors, and mentees involved in this research did not differ on the three factors contributing to the effective use of TLM in teaching and learning of science in basic schools. This could be attributed to the fact that the teachers shared in the constructivist point of view that allowing students to interact with TLM help them to make meaning of concepts (USDOE, 2005). And students in their early stages construct knowledge better when provided with the opportunity to interact (Bukoye, 2019). Effective use of TLM could help in this direction. If the three categories of teacher do not differ on effective use of TLM, but there is a shortfall in using TLM to stimulate student learning of science, then it could be that teachers involved in this research only pay lip service to effective use of TLM but they themselves do not use TLM effectively in lessons (Bukoye, 2019). Science educators and researchers should further look into the usage of TLM in science lessons to further assure society and the science community what actually teachers do with TLM when teaching science. Units of the Ministry of Education interested in teacher and teacher education should organise workshops and seminars for the three groups of teachers involved in this research to continuously share best practices on effective use of TLM to enhance the learning of science concepts in basic schools. This is because in developing a 21st-century science teachers will require the acquisition of skills of creativity, critical thinking, problem-solving, and collaborating in using TLM effectively in an instruction (Ibrahim et al., 2019)

5. Conclusion

Effective use of teaching and learning materials (TLM) is seen as the one used to help teachers share information and authority with students and to facilitate their learning in science at the basic school level by teachers. On these three factors (sharing information, sharing authority, and teacher facilitation), the teachers (supervisors, mentors, and mentees) did not differ in the effective use of TLM. It is, therefore, recommended that science educators should provide pre-service teachers with experiences in the effective use of TLM in teaching science in basic schools. Also, policy-makers should provide curriculum materials that would help pre-service teachers use TLM effectively to enhance learning.

6. Co-Author Contribution

Author1 conceptualised the paper, developed the Introduction and was involved in the Data Collection in the Bono and Ahafo Regions. Author2 wrote the Research Methods and Data Analysis, was involved in Data Collection in the Ashanti Region, and was the corresponding author.

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