EFFECTIVENESS OF LOCALLY MADE INSTRUCTIONAL MATERIALS ON STUDENTS' ACADEMIC PERFORMANCE AND RETENTION IN SCIENCE EDUCATION IN EASTERN PROVINCE OF RWANDA

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ABSTRACT

The role of well designed and prepared instructional materials in teaching sciences is imperative in view of the complex and abstract nature of some science subjects. It is argued that for science teachers to be more successful in their teachings, thus alleviating the unclear perception of the scientific concepts and theories. This study investigated the effectiveness of locally made instructional materials on students' academic performance and retention in science education in the eastern province of Rwanda. Two research questions were formulated, and the research design is known as a quasi-experimental research design, specifically the pretest post-test non-randomized control group design was used. The study was carried out among students of Senior Two A and B (SS2A and SS2B) in secondary schools located in the eastern province of Rwanda. Senior Two A (SS2A) students were treated as the control group, and senior two B (SS2B) were treated as the experimental group. Both groups were taught the same topic using standard instructional materials and assessed to measure their academic performance. Another topic was taught to both classes Senior Two A with standard instructional materials and Senior Two B With locally made materials. Again both groups were assessed to measure their academic performance. The sample of the study consisted of eighty-two students, forty two teachers, and four headteachers. Research instruments used in this study were observation, interviews, questionnaires, and tests to provide scores. The results showed that students in the control group failed compared to students in the experimental group taught by using locally made materials. It is authoritative that course instructors should be encouraged to admire the effectiveness of locally made instructional materials so as to motivate, encourage active participation thereby improving science students' overall academic performance.

Keyword: Standard instructional materials, locally made materials, control group, an experimental group, academic performance, science education

1. INTRODUCTION

Science is a dynamic human activity concerned with understanding the working of our world. Teaching sciences becomes meaningful when teachers organize lessons in a way that stimulates learners' interest and facilitates them to put what they learned into practice according to the context of their social environment and daily social living. The abstract nature of chemistry in secondary schools continuously indicates a major challenge for students to understand several concepts due to their complexity. On the other hand, students' performance has been regarded as an irreplaceable task of teachers, school administration, and parents as well as several stakeholders in education. Classroom assessment and external examiners are the ways forward to measure the understanding of students after instructions. Both teaching and learning can happen formally as well as informally within communities

In the eastern province of Rwanda, it has been clearly observed that students' performance in science subjects during external examinations is
generally not inspiring thus discouraging newly admitted students in secondary schools from following science subjects, for instance, chemistry and other natural sciences have been for a long time regarded as the most difficult lessons for students not only in the eastern part but also nationwide. In view of this problem, the failure of students in the national examination establishes a shameful feeling of some teachers. Teaching sciences requires sufficient knowledge on how to choose the appropriate teaching method, instructional materials, and other necessary pedagogical tools so that the lesson could be conducted successfully. In the field of education, various methods of teaching and learning have been investigated and employed to make teachings easier to be understood. For instance, Cooperative, concept mapping, inquiry, constructivist methods, and the use of environment have been identified and suggested for their effectiveness in teaching and learning by some researchers [1-4].

2. FACTORS CONTRIBUTING TO POOR PERFORMANCE IN THE EASTERN PROVINCE OF RWANDA

Various factors account for the poor performance of students in the eastern province of Rwanda. For instance, the following are the most encountered in this specific region

2.1. Socio-economic problems

Children from the families having low income are models in terms of learning outcomes and have low literacy levels, low retention rate problems, and more difficulty in their studies. They mostly display negative attitudes in their studies. It has been arguably found that many students could not manage to pay school fees in high rated schools due to the inability of their families that remain in the poverty state [5] as the majority of parents are farmers and depend on low income from agricultural products

2.2. The lack of adequate instructional materials in teaching and learning activities

The lack of instructional materials can lead to poor implementation of the chemistry curriculum. Previous studies suggested that the lack of adequate resources and facilities is one of the factors that lead to poor implementation of the curriculum in science teachings [6]

2.3. The lack of creativity, innovation and decision making among teachers and learners

Studies were conducted to evaluate the contribution of Self-Efficacy Theory which was put in place in 1981 Hackett and Betz, and this reflects on the ability of an individual to produce an intended result, and the theory comprises mastery experiences, vicarious experiences, verbal persuasion as well as a somatic and emotional state [7, 8]

Most of the teachers often use traditional teaching methods such as a stand and deliver method refers to as lecturing method) and concentrate on theories rather than practical work, and students are not motivated during the lesson. According to the self-efficacy theory suggests that for students to engage in science subjects fully have to independently decide whether they can enroll in them; otherwise, students may abandon the stream regardless of their capabilities to understand various concepts in science fields. On the other, the inability of teachers to creatively enrich and present their teachings continuously creates unconducive teaching and learning environment for science students not only in Rwanda but also in other parts of the world.

2.4. Students' inability to express themselves in English

Verbal expression is of paramount importance within an academic environment. Researchers contend that the adolescent’s value judgments are often influenced by fear of rejection by the group childhood and adolescence is the time of first encounters and intense experiences in the present [9].

Peer pressure results in negative decisions, rebellious and moody behavior, which in turn results in poor academic performance since they are not cooperating, and in the process, they waste a lot of time.

2.5. Lack of team working spirit

The identification of basic elements in cooperative learning such as small group, face to face interaction, individual accountability and interpersonal interaction has been reviewed in several studies and suggested that the lack of cooperation leads to the poor performance of learners [10]
3. STANDARD INSTRUCTIONAL MATERIALS AND LOCALLY AVAILABLE INSTRUCTIONAL MATERIALS

Instructional materials have been defined as materials that help the teacher to deliver instructions confidently and facilitate students the learning process without stress [11]. Instructional materials appeal to the senses of seeing, touching, smelling, feeling, and hearing. They include projected, non-projected, printed, and others, such as 3-dimensional objects that are produced through locally sourced materials.

Locally made materials in the context of teaching and learning are defined as materials and equipment obtainable from the local environment, or designed by the teacher or with the help of local resource personnel to enhance effective teaching and learning activities. This method of teaching is known as improvisation. Due to socio-economic problems, proper and standard instructional materials are not easily available in many developing countries; specifically, schools in the eastern province of Rwanda have demonstrated insufficient teaching and learning tools hence poor performance of secondary school students. Despite the effort and progress made by the Government of Rwanda in implementing the policy of education for all, the problem of equipment for science students still a burden for teachers to successfully achieve quality teaching and learning process. However, teachers could personally design and develop their own instructional materials from locally available resources through creativity and innovation to improve students' perception and retention of their teachings. The acquisition of knowledge and skills involves three educational domains, namely cognitive, affective and psychomotor domains, respectively, and the application of teaching aids obtainable from the direct environment could lead to changing complex concepts to simple and easier for students to master and apply in their daily situations.

Figure 1. Schematic representation of two groups of instructional materials

Figure 2. Advantages of locally available instructional materials
The fact that these locally available materials are made from raw materials makes them be accessible at a low cost as no transport is needed. In addition, these materials are made from materials found in the immediate environment, and they do not require high technology to use, and it is easier to replace them when damaged.

It has been emphasized that it is when original instructional materials are not available for use that other types and forms of instructional materials can be applied [12]. It has also been reported that factories produce teaching materials that are very expensive [13]. For instance, Chemistry apparatus, kits, hand-made models of chemical substances, charts, tables, textbooks.

Several kinds of literature indicate that learners are motivated when they participate actively in the teaching and learning activities and find interests in using teaching and learning materials directly used by their teachers. The results of this study could undoubtedly motivate both teachers and learners to develop and use locally available instructional materials. Importantly, various stakeholders in education and investors could understand the advantages of producing these inexpensive and easily accessible materials within the immediate environment, thereby lowering the cost on the side of MOE for the importation of teaching and learning tools. Finally, by using locally available materials not only will improve students’ performance but also will alleviate the country’s economic-financial problems.

4. RESEARCH OBJECTIVES

The overall objective of the present study is to explore the effectiveness of locally made instructional materials on students’ academic performance, and retention in science education in the eastern province of Rwanda and the following objectives were formulated:

➢ To find out the efficiency of locally made instructional materials on students’ academic performance in science education
➢ To show how can locally made materials be used as a substitute to expensive, standard instructional materials

5. RESEARCH QUESTIONS

➢ What is the efficiency of locally made instructional materials on students’ academic performance in science education?
➢ How can locally made materials be used as a substitute for expensive, standard instructional materials in science education?

6. RESEARCH METHODOLOGY

The research design adopted in this study is known as a quasi-experimental research design; specifically, the pretest post-test non-randomized control group design was used. The study was carried out among students of Senior Two A (SS2A and SS2B) in secondary schools located in the eastern province of Rwanda. Senior Two A students were treated as the control group, and senior two B were treated as the experimental group. The study population was composed of 128 individuals in total from which data were collected by using questionnaires, interview guides, and scores from tests as research tools.

Table 1: Activity scheduling

<table>
<thead>
<tr>
<th>Task</th>
<th>Interventions/Strategies</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification of research problems and adopting strategies to solve them</td>
<td>Conducting interview and preparing questionnaires for respondents to investigate the extent at which locally made materials are used by teachers and understanding of the perception of these materials by students</td>
<td>Researcher, students, teachers, and school administration</td>
</tr>
</tbody>
</table>
Teaching two classes SS2A and SS2B by using different instructional materials

Encouraging students to participate in their own designed experiment by using locally made materials

Preparing a general test for the control group (SS2A) and experimental group (SS2B) and comparing their results

Implementation of strategies and measuring its effectiveness

- Analyzing data from an interview conducted with students and from questionnaires given to students, teachers and other staff members
- Applying grouping techniques and assigning activities for both experimental and control group
- Preparing tests to measure the effectiveness of applied strategies

8. FINDINGS AND DISCUSSION

8.1. Presentation of findings

Table 2. Findings from diagnostic test

<table>
<thead>
<tr>
<th>% intervals</th>
<th>[90-80]</th>
<th>[80-70]</th>
<th>[70-60]</th>
<th>[60-50]</th>
<th>[50-40]</th>
<th>[40-30]</th>
<th>Average %</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>3</td>
<td>13</td>
<td>12</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>56.00</td>
<td>40</td>
</tr>
<tr>
<td>Experimental group</td>
<td>2</td>
<td>5</td>
<td>7</td>
<td>13</td>
<td>8</td>
<td>7</td>
<td>50.4</td>
<td>42</td>
</tr>
</tbody>
</table>

Source: Primary data

Table 3: Findings from the test given to both control and experimental groups after being exposed to similar teaching methods

<table>
<thead>
<tr>
<th>% intervals</th>
<th>[90-80]</th>
<th>[80-70]</th>
<th>[70-60]</th>
<th>[60-50]</th>
<th>[50-40]</th>
<th>[40-30]</th>
<th>Average %</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>15</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>60.00</td>
<td>40</td>
</tr>
<tr>
<td>Experimental group</td>
<td>11</td>
<td>9</td>
<td>11</td>
<td>3</td>
<td>6</td>
<td>2</td>
<td>60.5</td>
<td>42</td>
</tr>
</tbody>
</table>
Source: Primary data

Table 4: Findings from the test given to both control and experimental groups after being taught with different instructional materials

<table>
<thead>
<tr>
<th>% intervals</th>
<th>[100-90]</th>
<th>[90-80]</th>
<th>[80-70]</th>
<th>[70-60]</th>
<th>[60-50]</th>
<th>[50-40]</th>
<th>[40-30]</th>
<th>Average %</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>0</td>
<td>12</td>
<td>5</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>59.7</td>
<td>40</td>
</tr>
<tr>
<td>Experimental group</td>
<td>3</td>
<td>16</td>
<td>7</td>
<td>5</td>
<td>8</td>
<td>3</td>
<td>0</td>
<td>70.2</td>
<td>42</td>
</tr>
</tbody>
</table>

Source: Primary data

Table 5: Findings from questionnaires given to students

<table>
<thead>
<tr>
<th>Asked questions</th>
<th>Answers</th>
<th>Respondents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is it good and helpful to use locally made materials in teaching and learning activities?</td>
<td>Strongly agree</td>
<td>60</td>
<td>73.17</td>
</tr>
<tr>
<td></td>
<td>Disagree</td>
<td>18</td>
<td>21.95</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>4</td>
<td>4.87</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>82</td>
<td>100</td>
</tr>
<tr>
<td>Do your science teachers engage you in experiments requiring the use of locally made materials?</td>
<td>Strongly agree</td>
<td>25</td>
<td>30.48</td>
</tr>
<tr>
<td></td>
<td>Disagree</td>
<td>57</td>
<td>69.51</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>82</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Primary data

Table 6: Findings from an interview with teachers

<table>
<thead>
<tr>
<th>Does Teaching aids make a chemistry lesson more understandable for students?</th>
<th>Answers</th>
<th>Respondents</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>42</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

All interviewed teachers agreed that locally made materials could make science lessons understandable and when they are asked about problems they meet in teaching sciences, they said that the main challenge they encounter is the lack of teaching aids. On the other hand, during the interview with students, 74 students corresponding to 90% said that they enjoy learning sciences, and when asked about the problems they encounter in their learning, great emphasis was put on the lack of teaching and learning materials. We wanted also to know if science teachers engage students in performing their own experiment. From the interview with students, 68% students corresponding to 83% said that their science teachers rarely allow them to manipulate laboratory equipment by carrying out practical works.

Based on this problem of insufficient teaching and learning materials, chemistry teachers rarely give...
the opportunity to students to carry out chemistry experiments on their own pace.

8.2. Interpretation of findings

This interpretation focused on three main tests done by students of both control and experimental groups which are diagnostic test as shown in table 2, the test given to both control and experimental groups after being exposed to similar teaching methods shown in table 3 and the test given to both control and experimental groups after being taught with different instructional materials as shown in table 4.

These tests showed the remarkable improvement on the academic performance of students in the experimental group from the diagnostic test in which they had a percentage of 50.4% and after being taught by the means of locally made instructional materials their performance increased up to 60.5% and finally to 70.2% in the last test while learners in control group demonstrated discouraging performance with negligible improvement from 56% through 60% in the next assessment. The inefficiency of using old fashion in teaching sciences could even lead to a sudden decline in performance. Based on these findings, we believe that a significant improvement in performance for learners in the experimental group was a result of using locally made instructional materials while the poor performance of students in the control group was attributed to the lack of innovation and creativity in teaching them. The table below shows the progression of marks from the diagnostic tests done at the beginning up to the last test done at the end of this study.

Table 7 Progression of students' academic performance

<table>
<thead>
<tr>
<th>Diagnostic test</th>
<th>Continuous assessment tests</th>
<th>Continuous assessment tests)</th>
<th>participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>56%</td>
<td>60%</td>
<td>59.7%</td>
<td>40</td>
</tr>
<tr>
<td>50.4%</td>
<td>60.5%</td>
<td>70.2%</td>
<td>42</td>
</tr>
</tbody>
</table>

9. CONCLUSION AND RECOMMENDATIONS

9.1. Conclusion

Teaching sciences, especially in developing countries like Rwanda, requires teachers to be creative with innovative solutions. The use of locally made materials as the own developed instructional materials is an alternative solution when standard teaching aids are in shortage.

In this study, we have discussed the advantages of using locally made materials in teaching and learning activities and clearly demonstrated how they could enhance students’ academic performance when applied in teaching and learning situations. More importantly, locally made materials are easy to produce, access, and buy. These materials facilitate learners to learn with easy without stress, and during the classroom sessions, learners are highly motivated, interested, and teachers can adequately demonstrate their teachings. Locally made materials are likely to be used in teaching chemistry and other sciences to improve the performance of students.

9.2. Recommendations

The following recommendations and suggestions are given according to the researcher’s objectives and addressed to learners, parents, in-service and pre-service teachers, Ministry of Education, Government, and for further research.

9.2.1. Recommendation to learners

Learners should have the spirit of creativity for maximizing the use of locally available materials (inexpensive instructional materials) in their learning process, and they should appreciate the advantages of using these materials in teaching and learning activities. It is in this angle that one way of making lessons enjoyable, understandable, and arousing the interest of learners is to use effectively locally made materials.

9.2.2. Recommendation for parents
On the side of parents, they should encourage their children to use materials available at home during their studies on holidays.

9.2.3. Recommendation to in-service and pre-service teachers

In-service and pre-service teachers should appreciate the use of locally made materials as teaching aids in their teaching activities. In addition to this, chemistry teachers and all science teachers should use varying instructional materials and methods to make their lessons enjoyable to learners and understandable for use in their daily life without difficulties. It is in this way that competent persons will be produced. This will help to reduce the complexity of science subjects.

Teachers should have the spirit of creativity and innovation in their teaching style, and in the scarcity of teaching aids, they can seek assistance from others.

9.2.4. Recommendation to the Ministry of Education and school administration

Regular workshops should be organized for serving teachers to broaden their knowledge of the use of locally made materials. Such workshops may enable science teachers to be resourceful by knowing where and how they can obtain locally made materials for using them in teaching activities. They should help teachers of sciences to have study trips in order to share the experience with students from other schools.

9.2.5. Recommendation to the Ministry of Education

If possible, the Government should assist in the supply of those materials that are locally made. This will help to reduce the abstract nature of the chemistry subject and to ensure quality education.

9.2.6. Recommendation for further research

I recommend future researchers to work again on this topic and discover other causes of poor performance and suggest ways to continuously improve students' performance.

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