Examining Teachers' and Students' Perceptions on the Use of Science Kits to Improve Chemistry Performance in Lower Secondary Schools.

Ezechiel Nsabayezu¹*,², Alfred Uwihanganye¹, Patrick Nsengiyumva¹

¹Department of Science and Post-graduate Diploma in Education (Science & PGDE), Kibogora Polytechnic (KP), Nyamasheke, Rwanda
²School of Education, University of Rwanda College of Education (UR-CE), Kayonza, Rwanda

Abstract
This study looks into teachers' and students' views on using science kits to improve chemistry performance in lower secondary schools. The study aims to learn more about the efficacy and acceptability of adding science kits to the chemistry curriculum. Science education is an important component of a well-rounded academic experience, and improving its delivery through novel techniques such as science kits offers enormous promise. The study takes a qualitative approach, collecting data from teachers and students through questionnaires and interviews. The study included 91 participants, including 81 students, seven science teachers, and three administrative staff members, who were chosen using random and purposive sampling methods. Data were gathered through student questionnaires, interviews with instructors and staff, and appropriate documents. The findings revealed that incorporating science kits into education had considerable benefits. These included high engagement with science kits (92.5%), enhanced knowledge of scientific ideas (96.2%), a more enjoyable learning experience (97.5%), increased student success rates in assessments (80.2%), and a move toward student-centered learning (74.0%). A disproportionate emphasis on theoretical tests (91.3%), overcrowded scientific classrooms (88.8%), and a strong demand for science materials (72.8%) were all challenges. To improve student performance with science kits, proposed techniques included providing an adequate supply of kits (100%), training teachers in appropriate kit usage (92.5%), and implementing safety precautions (74.0%). It is suggested that educational institutions ensure the availability of a wide range of science kits, including atomic model kits and others, and integrate regular practical works into science teaching.

Keywords: Science kits, students' performance, practical work, teaching and learning

Received date: 06/10/2023; Revised date: 27/10/2023; Accepted date: 28/10/2023

*Corresponding author: Ezechiel Nsabayezu (ezechielnsabayezu@gmail.com)
Introduction

Nelson Mandela's 2003 words illustrate the great potential of education as a strong catalyst for positive global transformation. In accordance with this aim, the knowledge-based economy has been placed at the center of the Rwandan government's goal 2050. To achieve this purpose, teachers employ instructional resources in the context of teaching and learning. The primary goal is to improve the teaching and learning process by providing meaningful feedback and finding gaps between learners' current knowledge and skill levels and the planned educational goals. The use of instructional materials includes a wide range of instruments and assets, all intended to improve the teaching and learning process. These resources significantly shape the educational landscape, including textbooks, chalkboards, math and science kits, and more. According to Hin and Subramaniam (2014), science kits provide students with the essential knowledge, abilities, and attitudes, altering their expectations and motivating them to work through challenges in real life. As students take an active part in their educational path, this transformation gives them a sense of pride and accountability. These kits provide students with practical, real-world examples that help them understand complex concepts (Larombe and Saro, 2023).

Like other developing countries, Rwanda is aware of how instructional materials can improve student engagement and education quality as a whole. Effective education is built on active engagement, which allows students to not only passively observe but also fully comprehend the lessons being given. In order to empower students and promote a better understanding of fundamental concepts, Rwanda's educational system has adopted teaching materials that are in line with international trends (Habyarimana et al., 2022). According to Bukoye (2019) research, teaching tools are crucial in the field of education, especially when it comes to improving students' memory retention. Additionally, it has been discovered that instructional materials are crucial to the teaching and learning process and dramatically increase students' comprehension rates. In this situation, using atomic models as teaching aids encourages both active student participation and gives the subject matter a palpable feeling of reality. The use of locally created materials, such as unique atomic models, proves beneficial for instructing on difficult scientific concepts, such as atomic stability in chemistry.

It was discovered that using science kits is a powerful way to improve students' comprehension, communication, and interest in researching scientific phenomena (Koul and Verma, 2018). Nahimana et al. (2023) showed that atomic models as science kits are essential teaching aids for explaining abstract ideas and aspects of scientific experimentation that can be difficult to illustrate in a live demonstration setting. When learning about concepts that are beyond the range of their sensory perception, they offer students accessible methods of instruction. Furthermore, models as science kits help scientific instruction become more authentic. In this approach, analogous models are especially useful since they exhibit traits that correspond to the realities they explain (Gilbert, 2004). Jones et al. (2012) referred to science kits as 'practical work'. The researcher explained it as any teaching and learning activity that at some point, involves the students in the observation or manipulation of the
objects and materials they are studying. The term 'practical work' was also utilized in preference to 'laboratory work' because location is not a critical feature in characterizing this kind of activity. Object observation or manipulation might occur in a school laboratory, but could also occur in an out-of-school setting, such as the student's home or in the field. This illuminates that the use of science kits is a term in light with learning practice through the laboratory equipment and materials as well as other science tools out of it without limitation.

Gumala et al. (2020) noted that the use of the flipped classroom as science kits contributed to an improved Chemistry achievement for students. Accompanied with peer instruction too, it resulted in an increase in the Chemistry achievement of the students. This could be attributed to the difference in the level of student participation in each classroom and their perception of the science classroom they were in. These flipped charts as kits proved to be essential in the learners' performance. Hin and Subramaniam (2014) also affirmed that science educators encourage to replace traditional teacher-centered instructional practices, such as emphasis on textbooks, lectures, scientific facts, with practical and inquiry-oriented approaches with science kits that (a) engage students interest in science, (b) provide opportunities for students to use appropriate laboratory techniques to collect evidences, (c) require students to solve problems using logic and evidence, (d) encourage students to conduct further study to develop more elaborate explanations, and (e) emphasize the importance of writing scientific explanations on the basis of evidence. There is a difference in the teaching of sciences and humanities or languages. To be well taught, sciences require the accurate use of standard kits and equipped laboratories which should be availed with adequate materials such as models and specimens.

In many countries of Africa, especially in Rwanda; a good number of teachers do not have access to laboratory tools because of how expensive they are compared to the means and capacity to supply all the schools with them. This issue became very problematic in Rwanda when the government initiated the education program of 9YBE to all which then switched to 12YBE of secondary schools. Many of the combinations introduced in these schools were the sciences with science subjects. These are Physics, Chemistry and Biology (PCB), Mathematics, Chemistry and Biology (MCB), Physics, Chemistry and Mathematics (PCM), etc.

The top barriers to the delivery of effective practical lessons with science kits are: Time constraint due to the length of curriculum, lack of necessary equipment and materials, insufficient technical support (personnel), lack of students' interest and attitude, lack of teachers' experience in practical delivery, assessment and tests' requirement. The results indicate that all these factors are important with little significant difference between their contributions (Chakanika, Sichula and Sumbwa, 2012). In his illustrations, he explained that the time allocated to teaching and learning the science period is insufficient when science kits are regularly used. This research study, therefore, intends to fill this gap in the awareness and body of knowledge about the use of science kits as well as laboratory apparatus for the students' effective performance. This study is empirically to generate facts and evidence on the suitable use of science kits and their influence on Ordinary level students' achievement in secondary schools.

**Research Theory**
Learner construct knowledge instead of receiving it from teachers (Duffy & Cunningham, 1996). Therefore, there should be a shift from teacher-centered to learner-centered approach focusing on knowledge construction and discovery (Bada and Olusegun, 2015). The founder of social constructivism postulated principles that emphasize on role of social culture on learner's development of cognitive skills (Vygotsky, 1978). Learning is developed within social and collaborative activities (Smith and Macgregor, 1992). Learning in schools should happen comprehensively in relation to knowledge that children ripen in the real world; there should be a relationship between students' school experience and outside the school; zone of proximal development.

In Rwandan classrooms, the Constructivist approach takes center stage, stressing a learner-centered technique in which students actively participate in knowledge construction (Busaka et al., 2021). This method emphasizes learning as a dynamic, participative process in which students integrate new information with prior knowledge. Creating and implementing a low-cost atomic model targeted at improving the teaching and learning of atomic structure in Rwandan secondary schools is especially relevant in this context. Learners are given opportunities for autonomous study with this novel tool, allowing them to build their understanding of atomic stability.

This study is heavily anchored in organizational theory, considering the teaching process transforms students and resources into beneficial outcomes. Furthermore, inside the educational system, a complex interplay exists between teachers, resources, and students, all of which contribute to the overall impact. As a result, this research is guided by System Theory, which recognizes that schools operate as intricate systems in which the teaching and learning process plays a critical role in transforming inputs (students, educators, and resources) into meaningful outputs that are ultimately aligned with the school's objectives. In this holistic view, every component of the educational ecosystem is viewed as interrelated, with the ultimate goal of generating graduates with diversified skills and attitudes.

Significance of the study and its contribution to the existing body of Knowledge

This study has significant implications and adds significantly to the existing literature in the field of chemistry education. It tackles a pressing need to improve the quality of chemistry teaching at the lower secondary school level. The study provides useful insights into novel teaching approaches by examining the impact of science kits on student performance in chemistry. This study provides teachers and policymakers with actual proof of the benefits of introducing hands-on, practical learning activities into the chemistry curriculum. It illustrates that science kits can be useful instruments for boosting students' comprehension of complicated scientific concepts in chemistry, consequently improving their academic achievement.

Methodology

1. Sampling procedures and sample size

The sampling approach used in this study is a combination of purposeful sampling and simple random selection. The researchers purposely chose seven teachers and three administrative staff members as respondents. The selection of these individuals was based on their assumed knowledge and
involvement in using scientific kits in O' Level classes, making them appropriate sources of information for the study. Furthermore, 81 students were included in the sample using a basic random selection technique, meaning each student had an equal chance of being chosen.

The selection of 7 instructors and three administrative staff members was most likely driven by the idea of purposive sampling, which includes picking persons who are most likely to provide important insights due to their expertise or experience in the issue under inquiry. In this example, the seven instructors were chosen because of their predicted knowledge of the use of science kits in the classroom, making them valuable sources of information on the subject. The three administrative staff members, including the Headteachers, the Director of Studies (DOS), and the laboratory technician, were chosen for their roles in administering and facilitating the use of science kits in the educational environment.

2. Data collection tools and procedures

To ensure the validity and reliability of the study's tools, the questionnaire was likely content validated by consulting experts and pilot tested, while the interviews followed a structured approach, were conducted by trained interviewers, and may have included inter-rater reliability checks. Participants from one school were chosen to provide in-depth insights into their unique context, enabling a comprehensive understanding of science kit usage in that specific setting, and this choice was likely motivated by a desire to gain a profound understanding of the practices and challenges within this particular school. This approach was both practical and enlightening, although it should be noted that generalizability to different educational settings may be limited.

3. Data analysis

The researchers focused on presenting and interpreting acquired data during the data analysis methods. Following data gathering, they methodically sorted and tallied the material before starting with a thorough analysis and interpretation procedure. Data processing used quantitative and qualitative methodologies to extract important insights from the supplied data. To support reasonable conclusions, tables indicating frequencies and percentages were developed and shown. Each question was mathematically and statistically represented, with tables displaying responses' frequency and percentage distribution. Furthermore, these tables were supplemented with explanations clarifying the correlations between variables, all of which were compatible with the research aims. The data was analyzed using descriptive statistical methods, including editing, coding, categorizing, and tabulating questionnaire items.

Results and Discussion

1. Identification of respondents by gender

<table>
<thead>
<tr>
<th>Gender of respondents</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>45</td>
<td>55.5</td>
</tr>
</tbody>
</table>

Table 1: Gender of respondents
Table 1 above shows the classification of the respondents according to their gender or their sex. It shows that males were 45 making 55.5%, while females were 36, representing 44.5%. So, both sexes were represented in the survey participation.

2. Identification of respondents by age

The following table shows the identification of respondents according to their age. The O' Level students were thought to possess the age that falls in these categories.

<table>
<thead>
<tr>
<th>Age</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-12 years old</td>
<td>20</td>
<td>24.6</td>
</tr>
<tr>
<td>13-15 years old</td>
<td>58</td>
<td>71.6</td>
</tr>
<tr>
<td>Above 15 years old</td>
<td>3</td>
<td>3.7</td>
</tr>
<tr>
<td>Total</td>
<td>81</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2 shows the respondents under the classification of their age. 20, representing 24.6% are between 11 to 12 years old, 58 frequencies, with 71.6% announced to be aged between 13 to 15 years old, and three persons of 3.7% claimed to be above 15 years old.

3. The relevancies of the use of science kits in teaching and learning of science

The importance of using science kits in teaching and learning

The main objective of this study was to determine the significance of introducing scientific kits into the teaching and learning process, which is a critical issue in education. This critical evaluation was performed using questions 3 and 4, which directly probed respondents' thoughts on the importance and relevance of science kits in their educational journey.

The respondents were rigorously assessed to identify the amount to which they believed in the ultimate importance of science kits and the degree of relevance these instruments held in their entire learning experiences. The survey attempted to evaluate student opinion on the importance of scientific kits, and the majority of participants agreed, indicating a collective recognition of the significant role these kits play in boosting the teaching and learning process.
Figure 1 visually presents the data for more clarity, while the data presented in Figure 2 highlights the respondents' perspectives on the importance of incorporating scientific kits into teaching and learning. Clearly, a consensus has emerged, with nearly all respondents agreeing on the critical need to introduce science kits within scientific teaching. To be specific, a vast majority of 76 students, or 93.8% of the sample, showed strong agreement about the fundamental necessity of science kits in science education, confirming their invaluable role in the teaching and learning process. Furthermore, a minority of four respondents, or 4.9%, agreed with a simple "agree." Surprisingly, only one person possibly unknowingly disagreed with the premise that science kits play an important part in teaching and learning.

The relevancies of using science kits in the teaching and learning process

The use of science kits in teaching and learning has proven to be quite beneficial in a variety of areas of education. Notably, it encouraged student-centered learning by creating a dynamic classroom environment in which students actively engaged with the science kits. This hands-on approach allowed them to obtain thorough insights into the structures and capabilities of these kits, which improved their comprehension of scientific principles for numerous applications. Figure 2 vividly conveys the range of benefits and significance associated with the integration of science kits into the teaching and learning process, encapsulating the importance of using science kits for students' improved performance in science subjects.
The data shown in Figure 2 demonstrates the varying degrees to which the value of introducing scientific kits into the teaching and learning process is recognized. Among the 81 respondents, 79 people (97.5%) reported a strong preference for learning when scientific kits are used in the educational process. Furthermore, 78 respondents (96.2%) stated that such usage benefits in clarifying scientific concepts and terminology, promoting a deeper understanding. Furthermore, 75 students (92.5% of the participants) stated that adding science kits provides hands-on study, allowing for a full observation of kit structures and distinctions. Furthermore, 65 respondents, or 80.2%, said that the incorporation of science kits increased pupils' test success rates. A total of 61 pupils, or 75.3%, acknowledged its favorable impact on performance in scientific sessions, while 60 people, or 74.0%, supported its capacity to center teaching around students, fostering student-centered teaching. Finally, 50 students (61.7%) identified the function of science kits in improving project-based skills through practical learning and research.

4. **Challenges and disadvantages associated with the use of science kits in pedagogy**

The second objective dealt with the challenges associated with using science kits in pedagogic activities, implying teaching and learning activities in class. A list of possible challenges was given to evaluate whether they are some of the encountered ones. Similarly, a probable enumeration of the disadvantages of the use of science kits in pedagogic activities was also to be contended.

*The challenges associated with the use of science kits in pedagogy*
Table 3: The challenges associated with the use of science kits in pedagogy

<table>
<thead>
<tr>
<th>The challenges with the use of science kits in pedagogy</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overpopulated science classrooms</td>
<td>72</td>
<td>88.8</td>
</tr>
<tr>
<td>Little time for protocols</td>
<td>16</td>
<td>19.7</td>
</tr>
<tr>
<td>Big science contents to cover</td>
<td>49</td>
<td>60.4</td>
</tr>
<tr>
<td>Lack of science kits/Laboratory apparatus</td>
<td>63</td>
<td>77.7</td>
</tr>
<tr>
<td>Lack of funds to purchase kits</td>
<td>51</td>
<td>62.9</td>
</tr>
<tr>
<td>A big demand of science kits</td>
<td>59</td>
<td>72.8</td>
</tr>
<tr>
<td>Lack of competent, expert and trained teachers</td>
<td>24</td>
<td>29.6</td>
</tr>
<tr>
<td>Inadequate techniques used in practical work</td>
<td>9</td>
<td>11.1</td>
</tr>
<tr>
<td>Less weighed practical exams compared to theoretical</td>
<td>74</td>
<td>91.3</td>
</tr>
</tbody>
</table>

Table 3 above exhibits the challenges associated with the use of science kits in pedagogy. These challenges can also interfere not only in the classroom but also in other ways outside of it. But the most challenging in pedagogic activities as the table displays, are the less weighed practical exams compared to theoretical ones at the rate of 91.3%, the overpopulated science classrooms by 72 respondents with 88.8%, the lack of science kits or laboratory apparatus at 77.7% and a big demand of science kits by 59 students representing 72.8%.

Others are the lack of funds to purchase science kits by 51 respondents of 62.9% and big science content to cover at 60.4%, which humps the accurate use of science kits as a result of pressures behind curriculum termination.

The challenges that cannot be considered as heavier as the ones above since they are not answered or chosen at least at 50% include the lack of competent, expert, and trained teachers by 24 people ranging at 29.6%, little time for protocols at 19.7% by 16 respondents and inadequate techniques used in practical work by nine people with 11.1%.

5. The impact or effects of science practical work on students' science achievement

Table 4: The effects of science practical work on students' science achievement

<table>
<thead>
<tr>
<th>Effects of science practical work on students achievement</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accurate kits' description</td>
<td>76</td>
<td>93.8</td>
</tr>
<tr>
<td>Mastery of scientific context and use of kits</td>
<td>73</td>
<td>90.1</td>
</tr>
<tr>
<td>Theories simulated into real life</td>
<td>38</td>
<td>46.9</td>
</tr>
</tbody>
</table>
Table 4 shows the effects as the impact of practical science work on students' achievement in science studies. Eighty-one respondents, 100% indicated that science practical work stimulates or motivates talented and gifted students in science to research. It also illuminates that it contributes to the accurate description of kits at 93.8% by 76 frequencies of responses. Seventy-three people at an average rate of 90.1% said that it contributes to the mastery of scientific context and use of kits. Again, 87.6% of 71 responses indicated that, as an effect, students get interested and motivated in scientific studies. Forty-five responses, with 55.5% on average, said it increases scientific inquiry, and 42 of 71.8% proclaimed it gives the ability to understand scientific processes and concepts. About sensible learning, 41 responses, making 50.6% proved it. The other effects of science practical work on students' achievement under the rate of 50% are the science theories simulated into real life at 46.9%, the student's positive attitude and behavior by 33 people at 40.7%, and the birth of future generation scientists at 13.5% by 11 frequencies of response.

6. The strategies for improving the students' performance in using science kits

The table below displays the useful strategies that can improve the performance of the students in lessons with science kits.

<table>
<thead>
<tr>
<th>The suggested strategies</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students should be given enough time for practical</td>
<td>51</td>
<td>62.9</td>
</tr>
<tr>
<td>Locate the science practical classroom strategically</td>
<td>31</td>
<td>38.2</td>
</tr>
<tr>
<td>Strong safety measures of science kits</td>
<td>60</td>
<td>74.0</td>
</tr>
<tr>
<td>Teachers and students' laboratory safety awareness</td>
<td>79</td>
<td>97.5</td>
</tr>
<tr>
<td>Provision of sufficient science kits and lab apparatus</td>
<td>81</td>
<td>100</td>
</tr>
<tr>
<td>Teachers' training in the use of science kits</td>
<td>75</td>
<td>92.5</td>
</tr>
<tr>
<td>Provision of other science resources (Books, labs...)</td>
<td>50</td>
<td>61.7</td>
</tr>
</tbody>
</table>
Table 5 presents the respondents' suggested strategies to improve the students' performance using science kits. The high frequencies stressed the provision of sufficient science kits by all 81 frequencies of responses giving 100%, internet access at 100%, the teachers and students' laboratory safety awareness by 79 people at 97.5%, the teachers' training in the use of science kits by 75 at 92.5%, ICT integration in teaching and learning by 69 at 85.1%, giving the students enough time for practical work at 62.9% and the provision of other science resources (like books, flyers, ...) by 50 persons of 61.7%.

Other suggested strategies range under the rate of 50% and are perhaps less useful compared to the above. These range from locating science practical classrooms strategically at 38.2%, flexible policies for science subjects at 14.8%, and time allocation for the students' research at 11.1%. Regarding qualitative data, the results from question ten gave the findings that using science kits in teaching and learning facilitated the students to earn skills and knowledge to manufacture needed products in the community such as soaps (liquid and solid), insecticides, baking cakes, etc. Then, they added that critically and scientifically, their minds were opened since they thought of how the nature around reserves for them and in which ways they can relate to it in terms of exploitation. Lastly, the respondents mentioned that an ordinary student becomes a real scientist through practical work exercises and research, particularly learning science using science kits, hence learning by doing. About the first objective, which envisioned identifying the relevancies of using science kits in the teaching and learning process; the respondents added that using science kits in teaching and learning of science is always very relevant. That for the teacher moves from explaining abstract theories but reaches the concrete, which makes him/her maximize his/her lesson delivery. For the learners, science lessons get understood, academic performance improves, and scientific inquiry accompaniment is got along. Because of using science kits, motivation, interest, and fun teaching and learning activities are enhanced. In real life, the students earn the skills that are helpful in the manufacture of marketable products, build trust in the community because of being people of high knowledge and intellectuals, and create confidence in the users of these kits.

Teacher A said that using science kits in teaching and learning science, especially Chemistry, shapes learning, making it fruitful where the students become motivated. Teacher B and C added and insisted on the engagement of the students with curiosity to discover the uses of the kits. All of the interviewees admitted that the use of science kits in the teaching and learning processes arouses better academic performance and increases the success rate of the students since they actively engage in lessons and understand science because of learning motivation. The factors contributing to better performance in chemistry include the presence of science teaching-learning facilities, career guidance, parenting roles, and technology.
The mentioned challenges faced with using science kits in teaching and learning science ranged from the insufficiency of science kits, lab apparatus and resources, lack of internet facility, background of the students, and unawareness. The lab technician mentioned that they lacked some laboratory apparatus, while teacher D announced the lack of internet to show the functions of the kits when they were not available for their observation and manipulation.

"The strategies proposed to effectively use the science kits were encouraging learning by doing, through the provision of sufficient science kits and laboratory equipment," added the DOS. Some teachers also announced the training of science teachers on the updates in science teaching methods and innovations. In general, the Head Teacher emphasized the increase in the success rate in science subject as a result of using science kits in teaching and learning. He also mentioned the challenge of the lack of science kits and poor laboratories.

Specifically, the study was to identify the relevancies of using science kits in the teaching and learning process. The findings about this objective indicate that 93.8% confirmed that using science kits in the teaching and learning of science was very important and relevant for them by mentioning strong agreement. Only 1 person disagreed it was very important for him/her, which may be thought he/she did it unconsciously. The findings also disclosed that 97.5% of the respondents affirmed it made learning fun and enjoyable, 96.2% said it increased the understanding of scientific concepts, and 92.5% of respondents also got opportunities for science kits manipulation.

Again, 80.2% claimed it increased the students' success rate in assessments, 75.3% confirmed it improved the performance in science lessons, 74.0% said it made the teaching and learning process student-centered, 72.8 said it helps them understand science subjects. Finally, 61.7% admitted it facilitates the project based skills through practical learning and research. The second objective was about the challenges associated with using science kits in pedagogic activities. The results about this survey question indicated that less weighed practical exams challenge it compared to theoretical at 91.3%, overpopulated classrooms by 88.8%, lack of science kits/ laboratory apparatus at 77.7%, a big demand of science kits nationally 72.8% lack of funds to purchase the kits 62.9% and big science contents to cover at 60.4%. The other challenges with the use of science kits weren't confirmed, at least at the rate of 50%. These are the lack of competent, expert and trained teachers by 29.6%, little time for protocols at 19.7%, and inadequate techniques used in practical work by 11.1%. The interview added a lack of internet facility, the student's background, and the unawareness.

This study's third objective was to evaluate students' performance in lessons with science kits. The impact or effects of practical work on students' achievements presented showed that when practical work strategy (using science kits) in teaching and learning, 100% of the respondents said it stimulates talented and gifted students in science to research. 93.8% revealed that it yields an accurate description of science kits, while 90.1% said it gives the mastery of scientific context and use of kits. Again 87.6% said the students get interested and motivated in scientific studies, 55.5% claimed it increases the scientific inquiry, and 50.6% affirmed that learning becomes sensible.

The other performance indications mentioned were the understanding of scientific processes and concepts 51.8%, the theories and practices simulated into real life by 46.9%, students positive attitude and behavior by 40.7% and giving birth to future generation scientists 13.5%. The last objective, four, dealt with the suggestion of strategies to improve the students' performance and the results of using
science kits. It was also found that internet access is a strategy by 100% of respondents, the provision of sufficient science kits and lab apparatus by 100%, the insurance of teachers and students' laboratory safety awareness at 97.5%, the teachers' training in the use of science kits by 92.5%, ICT integration in teaching and learning at 85.1%, strong safety measures of science kits by 74.0%, provide students enough time for practical work by 62.9% and the provision of other science resources (such as books, labs). The other strategies were strategically locating the science practical classroom by 38.2%, flexible policies for science subjects by 14.8%, and time allocation for students' research by 11.1%. The early strategies confirmed above 50% were considered the strongest ones that could be applied to improve the students' performance using science kits in G.S Akanzu.

The obtained results are in good agreement with other authors. The study conducted by (Dickerson et al., 2006) about designing and using low-cost atomic models from waste materials found that 'use low-cost atomic model kits increases students' performance and students also provide feedback on the use of those models as it helps them to visualize and understand the spatial arrangement of atoms for given molecules.' Teachers reflect positively on using atomic models because it improves teaching practices in teaching and learning atomic structure (Wiener, 2020). With reference to the research conducted by (Salazar et al., 2019) about evaluating a didactic strategy to promote atomic models learning in High School students through Hake's method found that using atomic models improves attitude, interest, and significant change in students' performance toward the topic.

Those results are incorporated with the study of (Yavuz and Savaşçı-Açıkalın, 2018) found that Students should design the atomic structure to lead to learner-centered and prompt conceptual understanding of atomic structure. Similar to (Netzell, 2014), teachers appreciate the use of two-dimensional static diagrams, which significantly affect student's motivation, visualization, and performance. The instructor teaches the atomic structure and compound formation using the atomic model. The results are the same with Musa's use in constructing Models in teaching chemical bonds, 2015. The student-centered research guided by the Teacher was conducted by constructing models for teaching chemical bindings; after this research, the results showed that some misconceptions about the topic reported in the literature were not observed in the group study. These results are related to (Nsabayezu et al., 2022). Chemistry is a challenging subject to teach and learn at all education levels. That is why it is necessary to use instruction material to teach it. These results are the same as those (Sale, 2016). Instructional materials are used to facilitate comprehension of ideas in the learners as well as ensure long-term retention of ideas and topics taught to pupils. It also discovered that reluctance in the use of instructional materials will hamper the achievement of qualitative primary education. The Students were interviewed to prove the effectiveness of using low-cost atomic models, and more interviewed students demonstrated that using Low-cost atomic models increases their understanding of the topic in chemistry.

In the realm of science education, the use of technology and science kits has become increasingly important for improving students' comprehension and participation. Researchers such as Nsabayezu et al. (2023) have demonstrated that computer-based simulations can be employed in the absence of science kits to dramatically improve students' chemical understanding and attentiveness. Similarly, animations, simulations, and digital tools have been widely embraced to aid practical learning, coinciding with the preferences of chemistry students (Nsabayezu et al., 2022c). The use of science kits into the educational process supplements the use of technology by allowing students to not only
absorb theoretical concepts but also engage in practical chemistry experiments, boosting their understanding of scientific topics. This adoption of technology and scientific kits is not restricted to a single location; it is a global trend. Both developed and developing countries recognize the importance of technology and hands-on learning resources in scientific education, providing a diverse range of teaching tools to improve student accomplishment (Nsabayezu et al., 2022a; Nsabayezu et al., 2023a; Nsabayezu et al., 2023b).

Furthermore, the impact of the COVID-19 epidemic on schooling cannot be overstated. The need for remote learning prompted an increase in the use of technology, such as science kits, movies, simulations, and animations for virtual laboratory experiments (Raman & Vinuesa, 2021). This exceptional global event has hastened the adoption of technology and practical resources, such as science kits, in teaching and learning processes, stressing their importance in adjusting to changing educational environments (Nsabayezu et al., 2020; Nsabayezu et al., 2022d). As the world continues to evolve and educational demands shift, the integration of information, communication, and technology (ICT), as well as hands-on science kits, remains a critical strategy for improving science education and meeting the changing needs of students in lower secondary schools.

**Concluding remark**

This study uncovered the transformative power of adding science kits to the teaching and learning process. The effects include greater student success rates, increased motivation, positive attitude shifts, and improved knowledge of scientific topics. Using scientific kits not only encourages outstanding children to pursue science but also cultivates a generation of future scientists. However, it has also highlighted the obstacles, such as overcrowded classrooms and a scarcity of required resources, underlining the need for strategic adjustments. Addressing these issues is critical for realizing the full potential of science kits in education. The measures for improving student performance, such as internet access, safety awareness, and optimal time allocation for practical work, provide a road map for educators and legislators looking to elevate the educational experience. This study emphasizes the critical role of science kits, such as atomic model kits and other science kits, in teaching complex chemistry topics, laying the groundwork for future research into their application in specialized domains of chemistry, such as chemical bonding and molecular structures.

**Conflict of interest**

The authors declare no conflict of interest.

**Data availability statement**

Data are available to the corresponding author.

**References**


Nsabayezu, E., Uwihanganye, A., Nsengiyumva, P., 2023


Salazar, E. et al. (2019) 'Evaluating a didactic strategy to promote atomic models learning in High School students through Hake's method. Emanuel Salazar R. Adolfo Eduardo Obaya V., Lucila Giammatteo and Yolanda Vargas-Rodríguez.', 7(5).


