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# Supporting Construction Technology Students' Outside-of-classroom Teaching and Learning Physics at one Rwanda Polytechnic College using a Screencast Application

**Jean Claude Uwayezu**

Rwanda Polytechnic, Rwanda, basanande2014@gmail.com

**Tharcisse Renzahoduke**

Rwanda Polytechnic, Rwanda, renzath1981@gmail.com

**Abstract:** *The use of information and communication technology in teaching and learning science is appreciated to enhance students' learning process by allowing teachers to create virtual environments and this has been among sustainable solutions since the outbreak of covid-19 pandemic. This study aimed to assess the extent to which screencast application's learning materials support construction technology students' outside-of-classroom learning in physics at one Rwanda Polytechnic College. It was a quantitative case study conducted on 128 students who were undertaking the course of physics fundamentals. Screencast application's learning materials about the topic of thermodynamics were provided during a period of five weeks in parallel with usual teaching and learning and students used them for outside-of-classroom learning. At the end of this intervention, a Likert scale questionnaire was administered to participating students to assess their satisfaction on the support they have received. Only 80 students successively responded to all the questionnaire items and their responses were analysed using percentage frequencies and arithmetic means of Likert scale point scores. The results indicated that students' satisfaction on the received support was relatively good for collaborative learning (M=4.02, SD=0.04), motivation to learn physics (M=4.14, SD=0.07), independent learning in physics (M=4.13, SD=0.07) and understanding of the topic of thermodynamics (M=4.04, SD=0.08). At the studied College, it was concluded that screencast application's learning materials support first-year construction technology students' in their outside-of-classroom learning in physics in good help and good gain category. Scientific studies on the effect of screencast applications on students' performance in physics are also recommended for large samples in Rwanda Polytechnic College*

**Keywords**: *Outside-of-classroom learning; Screencast application; VSDC screen recorder*

## Introduction

### Background of the study

Physics subject is very essential in the engineering and technology education. Engineering students need to use different physics laws and principles in problem solving while developing new systems for real-life applications (Jalil et al., 2020). In this regard, physics is considered as a universal language in the engineering community (Denisova, 2020). Due to this importance, physics subject has been included in almost all engineering and technology curricula, across the world, as a fundamental science subject. However, in some contexts, engineering students do not confidently connect what they learn in physics to the applications in engineering and this can lead to less students' focus in learning physics (Gouripeddi et al., 2018). In a study conducted in a Chilean university, engineering students showed less appreciation on the importance of physics and mathematics in their courses and their professional career (Zavala & Dominguez, 2016). Particularly in structural engineering, in another study, Peñaranda et al. (2020) have related this lack of connection to inadequate teaching strategies and propose the teaching of physics that connect students' common sense and the required expert knowledge in structural engineering. They suggest the use of visual, auditory and tactile resources in teaching physics.

Thermodynamics is one of the difficult physics topics for engineering students. Due to the abstract nature of the concepts of heat and temperature involved in this topic, some students develop misconceptions about it (Ahmad & Salleh, 2021). Particularly, civil engineering students are among students who showed misconceptions on concepts of heat transfer and thermodynamics and this has been linked to poor teaching strategies used by some instructors (Yang et al., 2020). The inadequate teaching may discourage students in learning this topic and their failure may lead to their less interest in learning thermodynamics. In the survey conducted at different universities in seven (7) countries, it was found that the majority of engineering students find thermodynamics not-so-interesting or boring (Ugursal & Cruickshank, 2015). However, in the same study, it was highlighted that the reality is that this topic is very interesting for those who understand it. Thus, authors advise teachers to use strategies which will make thermodynamics interesting and exciting.

At Integrated Polytechnic Regional Colleges (IPRCs) in Rwanda Polytechnic (RP), thermodynamics is one of the topics in physics fundamentals taught in most of engineering options. Particularly, construction technology students do not have other related modules to deepen this topic. With the usual teaching learning, the time allocated for classroom meetings cannot suffice each individual student in terms of practical exercises and problem-solving activities. In fact, the need for outside-of-classroom learning is important for both independent and collaborative learning. However, the use of virtual reality technologies in IPRCs, for classroom practices, is still with less focus (JICA, 2021). Usually, students use handouts, library textbooks learning videos and written homeworks for learning off-campus. This is in contrast with the great demand of blended learning model during and after covid19 era.

**Objective of the study**

This study aimed to assess the extent to which screencast application's learning materials support first year construction technology students' outside-of-classroom teaching and learning in physics at one IPRC. This study is the benchmark for distance education for science subjects, in RP.

Review of the literature

**Instructional scaffolding in physics teaching and learning:** Efficient pedagogies are hoped to tackle the problem of learning difficulties in physics, shifting from traditional and inefficient ones, as reported in many studies seeking to improve teaching and learning physics. One of the promising strategies, as investigated in many studies about teaching and learning physics, is the instructional scaffolding. Instructional scaffolding is the instructional strategy in which students are supported to learn and complete different learning tasks beyond the knowledge and skills acquired previously (Bileya & Comfort, 2021). Saputri (2017) argues that the efficient physics learning occurs when students are supported to complete different tasks that they have never learned before. This strategy has provided students with opportunities to construct knowledge and skills in physics through independent and collaborative learning. In the study conducted to evaluate the support of scaffolds to the development of scientific skills in physics during scientific inquiry, it was observed that students in the experimental group were well helped by the designed scaffolds compared to the control group (Ferreira-Bautista & Pifarré, 2019).

Different models of scaffolding have been used in physics teaching and learning. One scaffolding modality that supports the information and communication technology (ICT) integration in physics teaching and learning is the computer-based scaffolding for which the supports to students are given in the form of computer-stored materials (Ferreira-Bautista & Pifarré, 2019). Interestingly, these computer-prepared materials provide support to the interaction that can even occur outside the classroom. This form of scaffolding has been used in physics education and has positively impacted students' physics learning (Kim et al., 2018; Saputri, 2021; Sobirin et al., 2018).

Screen capture technologies in physics teaching and learning: Different screen capture applications are appreciated to support students' learning mostly in the flipped classroom settings. In the study conducted to explore the flipping science classroom and examine its merits, issues and pedagogy, it is argued that the use of computer screen recordings can help physics teachers to prepare learning materials like derivation of formulas and explaining phenomena through simulations (Wan, 2014). In this study, it is also revealed that there are different free screen recording applications that can be used in teaching and learning physics. Screen captures can also be used during the power point presentation explaining important concepts (Bell et al., 2020).

On the other hand, a study was conducted to compare students' conceptual learning about gas properties when interacting with simulations and when observing screencasts (Martinez et al., 2021). This study was conducted in the Midwest region of USA and it showed significant learning gains for both modes of learning. However, it was revealed that it could be better if the use of screencasts precedes the use of simulation to improve learning.

Recently, after covid-19 pandemic outbreak and the closure of schools and colleges across the world, the use of screencasts has been another option to prepare and deliver teaching online. For example, in the study conducted to assess the usability of screencast in the first basic physics lectures during the covid-19 pandemic, the analysis of students' perceptions were all in high category and this ICT tool is seen to be effective in improving students' knowledge and skills (Susanti et al., 2021). However, this study did not investigate its pedagogical implications in special learning settings including scaffolding and flipped classrooms.

**Factors affecting students' outside-of-classroom learning in physics:** The outside-of-classroom learning in physics has received a notable attention especially in the form of flipped classroom and scaffolding strategies. The revision of this practice in order to establish meaningful learning is always important for physics instructors and this is pertained to their planning, implementation and evaluation of learning. In this line, different studies have elaborated a number of factors that can influence the outside-of-classroom learning in different settings. The course design and educator's role are two considerable factors that influence the outside-of-classroom learning. The course design affects students' satisfaction (Anne-Mannette, 2018). In physics teaching and learning students' satisfaction brings motivation and positive attitudes towards learning the subject. On the other hand, it is also claimed that course design affects students' perception (Anne-Mannette, 2018). This is an important dimension in modeling the meaningful learning in physics because positive perceptions lead to good students' decisions that they take for their own learning. The influence of the educator is due to the fact that the efficient teaching is when the educator facilitates learners through regular communication with students, providing consistent feedback to different students' queries and monitoring the learning process for the sake of guidance. Environment and peers are also recognized to have an influence on the students' outside-of-classroom learning in physics. In the study aimed to expand physics learning beyond the classroom boundaries using WhatsApp for secondary physics teaching and learning, it was found that the supporting atmosphere and learning community created by the teacher have improved the learning progress (Klieger & Goldsmith, 2020). Spaces and learning community have also been identified to be factors affecting the online learning in the form of blended learning (Anne-Manette, 2018). However, in this study it is argued that the absence of face-to-face environment in asynchronous online teaching may reduce the in-person interaction between students and the instructor. This is not a problem in the current study employing the instructional scaffolding because both face-to-face and continuous support have been provided. The WhatsApp group was used for communicating ideas while students can also meet physically to discuss different issues in the course. Students groups are considered as peers and this promotes collaborative learning.

Student identity is a crucial factor which affects many aspects of student learning in physics for both inside-of-classroom and outside-of-classroom. For example, self-regulation of learning is seen as a required competency for students to model their independent learning (Rohini et al., 2016). Physics learning requires a student self-efficacy, setting individual learning goals and always makes reflections on the learned materials. Self-regulated students are able to control their learning progress and pace. The outside of classroom is reach of many distractors which may attract students and they can lose concentration on learning. However, self-regulated students are able to control their surroundings and stay in the right track.

**Theoretical framework**

The current study was guided by the Vygotsky's scaffolding theory. According to this theory, the learning support received by a learner from the tutor or peer, is temporary and dynamic following the Zone of Proximal Development (ZPD) of the learner (Gonulal & Loewen, 2018). There must be the consideration of actual student's performance and his/her potential level in acquiring knowledge (Malik, 2017). In the current study, the screencast application's learning materials were prepared basing on the current students' knowledge and the prescribed performance criteria in the topic of thermodynamics. This practice is in accordance with the competence-based training and competence-based assessment (CBT and CBA) facilitation implemented in RP, where teachers are requested to monitor and evaluate the learning progress of each individual learner and provide necessary support until the learner fulfils the performance standards. Physics teachers consistently assessed the students' performance on different learning outcomes during the learning process in thermodynamics and prepared the supports accordingly.

## Methods

**Research design**

This research was a quantitative case study conducted at IPRC Gishari which was selected purposively As it was highlighted in the survey on technical and vocational education and training (TVET) in Rwanda, in 2021, IPRC Gishari came among four of eight RP Colleges in which the use of virtual reality (VR) in teaching and learning was not practiced (JICA, 2021). Considering the location and the presence of the option of construction technology, IPRC Gishari was a relevant choice for the current study.

Together with the usual teaching methods of CBT and CBA, adopted in RP, the integration of screencast application in the teaching and learning physics was done by physics teachers at the College, in the option of construction technology for five weeks. During this period, between May and June, the following topics were covered with the use of
Video Software Development Company (VSDC) screencast application:

1. Temperature measurement on a body
2. Heat measurement, transfer and effect on a body
3. Ideal gas laws
4. Application of laws of thermodynamics.

**Participants**

This study was targeting first-year construction technology students at one IPRC who were enrolled in the academic year of 2021/2022, totalling to 128 students and undertaking the course of physics fundamentals in the first semester, 2022. The studied students' group was abundantly composed of boys (89%) and very few girls (11%). Most students were in the age range between 20 and 25 years old
(79%). According to Hashim (2018), most of the participants were born between 1995 and 2010 and thus belongs to the Generation Z. Learners in this generation are friendly in using social media in communication and prefer flexible learning environments to avoid being bored.

**Data collection and analysis techniques**

In each week, apart from traditional classroom sessions, students received additional learning materials in the form of screencast on different learning outcomes about thermodynamics, in line with the competences

prescribed in the curriculum of construction technology option. These materials were prepared according to different students' queries and results of formative assessments about the topic. The VSDC Free Screen Recorder, version 1.3, was used for producing the recordings in moving picture expert group, layer 4 (MP4) format. The materials were focusing on the conceptual understanding and problem solving in thermodynamics for its application in engineering. The learning materials were shared using the usual WhatsApp group in collaboration with class representatives for each of three parallel classes.
A structured questionnaire with twenty (20) items in the form of Likert scale, was administered to the students at the end of the course. The questionnaire items intended to assess the learning support gained by students through the screencast application's learning materials. The support was reflected in four dimensions. These dimensions include learning physics outside of the classroom in terms of students' collaborative learning, students' motivation to learn, students' independent learning and students' confidence of mastering the topic. For example, in collaborative learning, students were asked how the screencast application has helped them to participate in group works for assigned home activities. For motivation to learn physics outside the classroom, one item was asking students about the support of the screencast application for their interests to plan for additional reading to satisfy their curiosities. The participants were also asked about the support of the screencast application in evaluating their weaknesses and strengths in learning physics, for independent learning. Finally, for student's confidence, one item was asking about the support of the screencast application to improve the ability to use appropriate formulas in solving problems in physics, especially in the topic of thermodynamics.
The questionnaire items have been adopted from two standard instruments, namely the "Student Assessment of Learning Gains (SALG)" and "Motivation Scale towards Physics Learning (MSPL)" which are found on the American physics education research assessments website: https://www.physport.org/assessments/. The questionnaire was administered in the online format using the Kobo toolbox server.

The questionnaire items were of two categories including items regarding the students' learning gain from the provided support and items regarding the help to the students' learning process from the provided support. In the former, for each question aspect, the student was asked to show the level of his/her learning gain with points 1=no gain (NG), 2=little gain (LG), 3= moderate gain (MG), 4= good gain (GG) and 5= great gain (GrG. In the latter, for each question aspect, the student was asked to show the level of help received with points 1=no help (NH), 2=little help (LH), 3= moderate help (MH), 4= good help (GH) and 5= great help (GrH). Only 80 respondents have returned the questionnaires and their responses were used in data analysis. Percentage frequencies and the arithmetic means on the Likert-type questionnaire responses were used to analyze the data in this study.

**Table 1**

*Scoring range of the Likert scale of the survey (Sözen & Güven, 2019)*

| Statement | Value | Range |
|---|---|---|
| No help/gain | 1 | 1.00-1.80 |
| Little help/gain | 2 | 1.81-2.60 |

| | | |
|---|---|---|
| Medium help/ gain | 3 | 2.61-3.40 |
| Good help/gain | 4 | 3.41-4.20 |
| Very good (great) help/gain | 5 | 4.21-5.00 |

## Results

The aim of this study was to assess the extent to which screencast application's learning materials support construction technology students' outside-of-classroom learning physics in Rwanda Polytechnic Colleges. To achieve this, the study intended to answer to the research question: to what extent do screencast application's learning materials support construction technology students' outside-of-classroom learning physics in Rwanda Polytechnic Colleges? First of all, it was needed to know how many times used the provided screencast application's learning materials in their outside of-classroom learning physics. The results are summarized in the pie chart presented in Figure1.

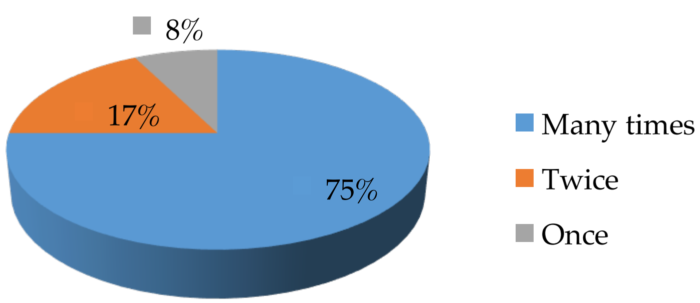


**Figure 1**

*Frequency of students' use of screencast application learning materials*.

Figure 1 shows that a big number of students (75%) used the provided screencast application's learning materials more than twice during their outside of classroom learning in physics. However, there are some few students who used the learning materials only twice (17%) and very few used it only once (8%).

On the other hand, researchers wanted to account for the extent to which the screencast application's learning materials supported construction technology students in collaborative learning in physics, outside of the classroom. Due to this, the first five (5) questionnaire items, grouped in section A, were prepared to allow respondents give their satisfactions on the support they have received from the

materials in collaborative learning. As it is for other sections, here the ranking was classified in five (5) levels, from the least to the best: no help, little help, moderate help, good help and great help. The corresponding results are presented in the Figure 2 below.

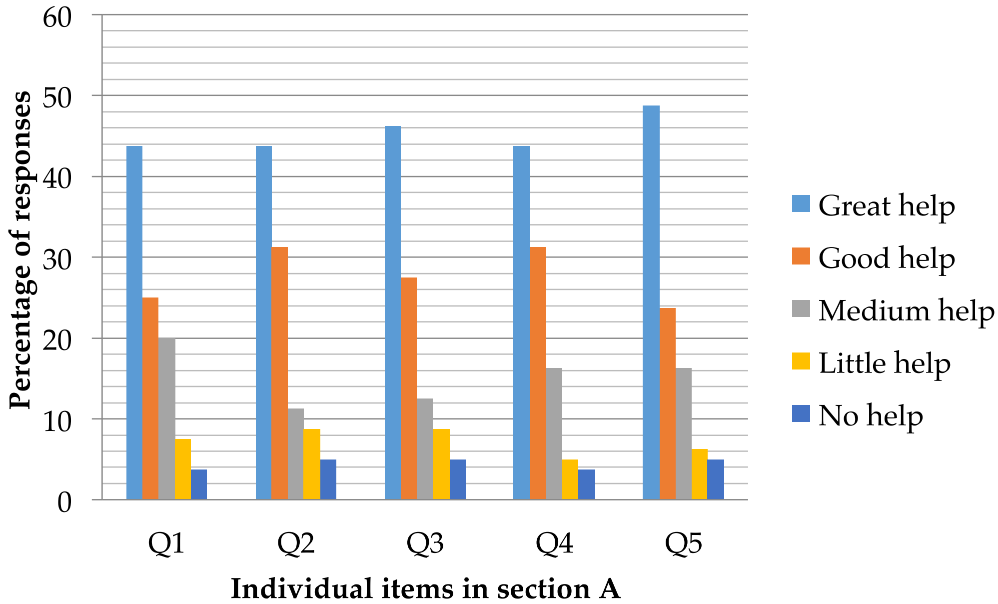


**Figure 2**

*Students' ranking on screencast application support to their collaborative learning*.

Figure 2 indicates that many students ranked the support about collaborative learning in physics in the "great help" category in all five. The highest percentage, 48.75%, is observed on the fifth item. This item intended to see the students' satisfaction on the help received from the screencast application's learning materials to help their classmates and engage them in the learning of physics outside the classroom. The lowest percentage, 44%), is observed on three items including item 1, item 2 and item 4. These items were on the students' ranking the help they received about their participation in group discussions, group work activities and hands-on activities for the success of the whole group respectively. Another information that can be read from Figure 2 is that the second highly ranked support is "good help" category which is in the range between 23.75% and 31.25%. Moreover, the category of "no help" has seen the least rank. The students' ranking for this category ranges from 3.75% to 5%. The average score point on students' perception was in the good help range (M=4.02, SD=0.04).

Another group of five (5) items was formed in section B. These items intended to figure out the extent to which the screencast application's learning materials improved students' motivation to learn physics outside the classroom. Students were asked to rank from no gain to great gain about their feeling on the received support. The results are presented in Figure 3.

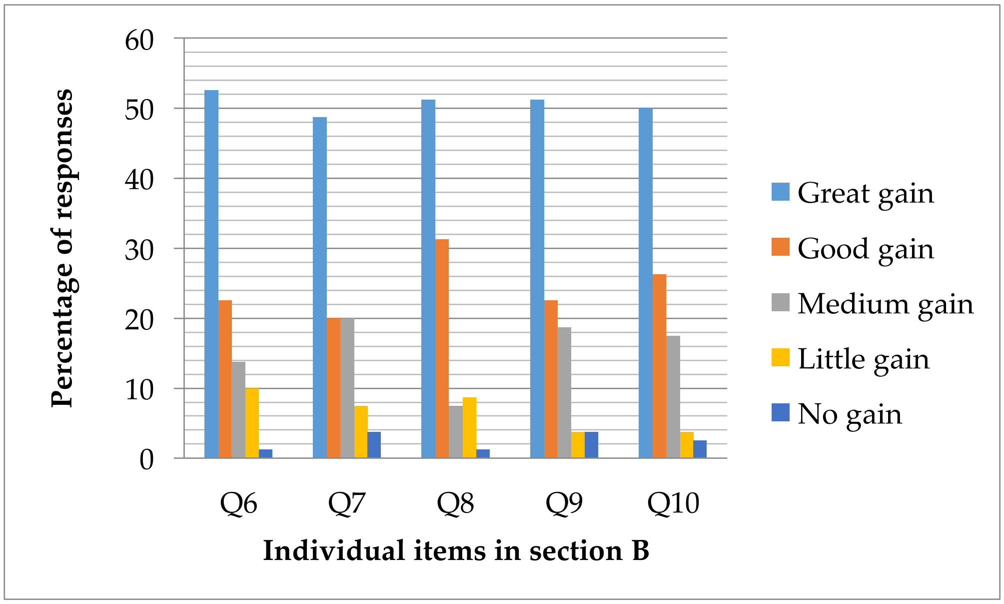


**Figure 3**

*Students' ranking on screencast application support to their motivation to learn physics.*

Figure 3 shows that many students ranked the received support from the screencast application's learning materials to their motivation to learn physics in the "great gain" category whose percentages range between 48.75% and 52.5% for all five (5) items. Particularly, item 6 which was asking students to rank the support received on doing their own reading or studying before coming to usual classroom, has received the highest ranking (52.5%). Similarly to the section A, the second highly ranked category in section B is "good gain" category whose percentages range from 20% to 31.25%. On the other hand, the categories of "no gain" and "little gain" have received lower ranking which ranges from 1.25% to 3.75% and from 3.75% to 10% respectively whereas the category of "medium gain" was ranked from 13.75% to 20%. In this category, the average score point was (M=4.14, SD=0.07), which is in the good gain range.

In section C, five (5) questionnaire items intended to measure the extent to which students feel to have been helped by the screencast application's learning materials during their independent learning in physics outside the classroom. The corresponding results for this section are summarized in Figure 4.

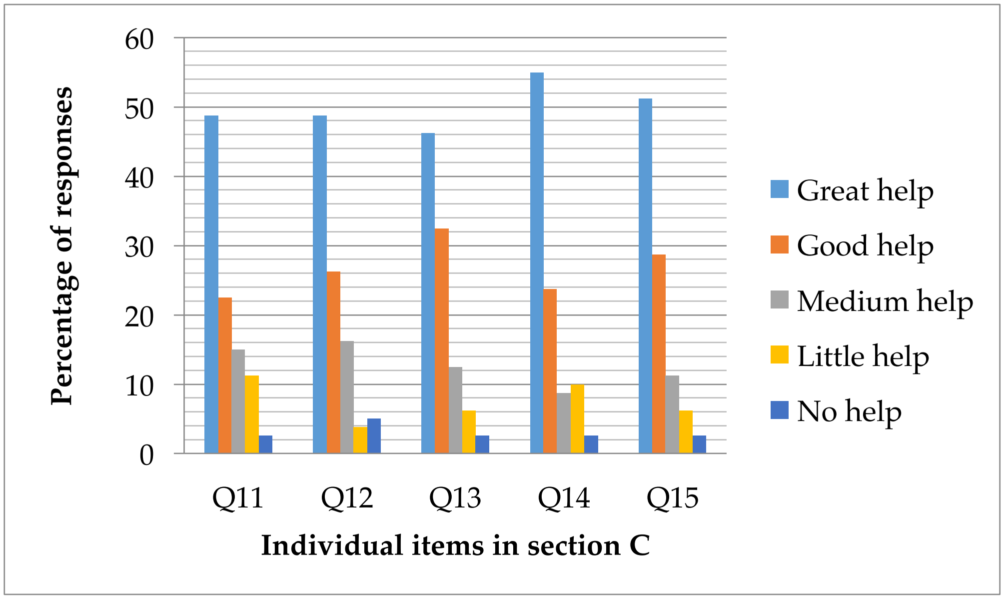


**Figure 4**

*Students' ranking on screencast application support to their independent learning.*

As it is revealed in Figure 4, the highest percentage of students ranked the received support in the "great help" category with the range being from 46.25% to 55%. Particularly on items 14 and 15 more than half of students (55% and 51.25%) felt that the screencast application's learning materials supported them in making their summary and know where they are weak and strong in physics
learning respectively. In this section, the category of "good help" is positioned on the second place of ranking, ranging from 22.5% to 32.5% of respondents. The third place is occupied by the category of "medium help" with the percentage of respondents ranging from 8.75% to 16.25%. The two other categories, "little help" and "no help", occupy the fourth and the last place respectively. The former has the respondent percentage within the range from 3.75% to11.25% whereas that for the latter is 2.5%5%. The average score point was (M=4.13, SD=0.07), classified in the good help range.

Lastly, another group of five (5) items was grouped in the last section, named D. These questions had the objective of probing students' level of satisfaction on how they think they have actively mastered the topic of apply thermodynamics with the support from the screencast application's learning materials. The questionnaire items in section D were targeting students' ranking on the support received to their understanding of thermodynamics, their awareness on application of thermodynamics in engineering, how they use formulas, how they use diagrams and appropriate laws in problem solving in thermodynamics. The results in this part are summarized in Figure 5.

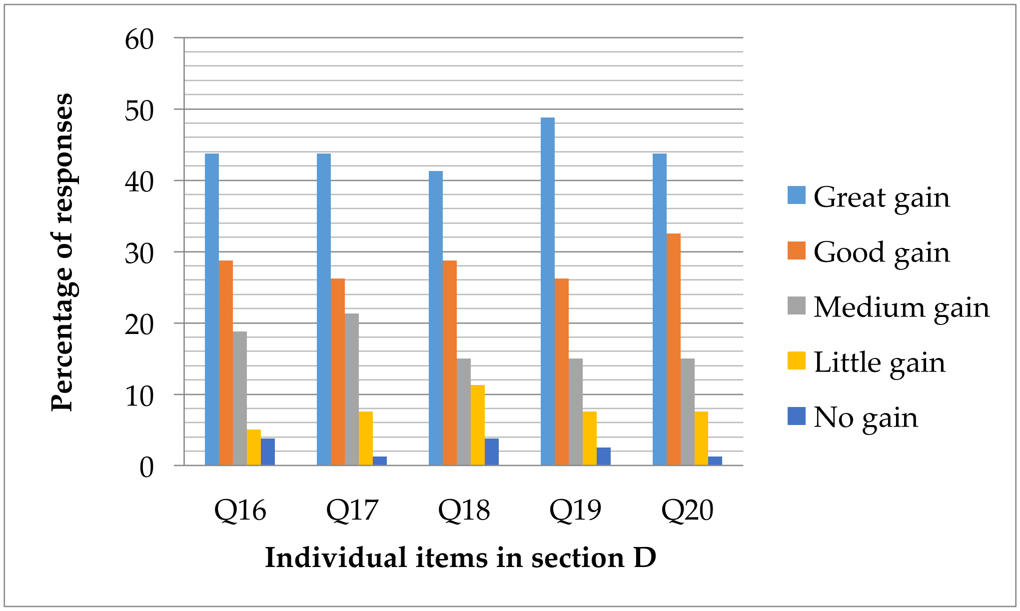


**Figure 5**

*Students' ranking on screencast application's support to their active mastery of thermodynamics.*

Figure 5 reveals that the highest percentage of students is for the category of "great gain" in all five items. It ranges from 41.25% to 48.75%. The category of "good gain" is the second highly scored by students with the respondents' percentage ranging from 26.25% to 32.5%. The third place is taken by the category of "medium gain" in the percentage range of 15%-21.25%. On the other hand, the fourth and last places are occupied by the categories of "little gain" and "no gain" whose students' percentage ranking them is in the range of 5%-11.25% and 1.25-3.75% respectively. Finally, the average score point for questions related to understanding of physics was (M=4.04, SD=0.08), in the good gain range.

## Discussions

The aim of this study was to assess the extent to which the screencast application' learning materials support first-year construction technology students' outside-of-classroom learning in physics at one IPRC. After a five-week of teaching the topic of thermodynamics, a questionnaire was administered to the research participants. It was grouped in four dimensions: support regarding collaborative learning, independent learning, motivation to learn physics and understanding of physics. The results have been summarized in the findings section. Although the current study involved a higher percentage of males than females, findings are discussed irrespective of gender as some previous studies have shown no significant difference in students' performance between genders in the blended learning environments (Gambari et al., 2017; Keržič et al., 2019; Zhang et al., 2022). However, the dominant participants' age group has been considered in the discussion.

### Support of screencast application' learning materials to students' collaborative learning in physics

Results about the support of screencast application's learning materials to students' collaborative learning in physics outside of the classroom showed that a high percentage of students classified the support in first three categories: great help, good help and medium help. In total, this group has got the minimum of 78.75% of students' choice on the support on collaborative learning and it shows that on five questionnaire items, a maximum of 21.25% of students perceived that the support was not appropriate in their learning. In general, the average score point in this category, which is (M=4.02, SD=0.04), indicated that students had good satisfaction on the support of screencast application' learning materials to their collaborative learning in physics outside the classroom. These findings can be associated with the characteristics of the participants. Hashim (2018) describes the Gen-Z as learners who like to learn by collaborating through small teams or groups. On the other hand, the use of recorded videos has been seen to be essential in creating collaborative learning environments (Murillo-Zamorano et al., 2019), which is reflecting the results in the current study. Collaborative learning in physics outside the classroom, as captured in this study, considers group discussions, active participation in group works, supporting and engaging classmates in learning physics as well as doing hands-on activities in order to find solutions to group work problems for the success of the whole group. In fact, through the use of screencast application's learning materials in the outside of classroom learning physics, many students have overcome different learning difficulties and became active learners in their groups. The findings about collaborative learning in this study are in agreement with some similar studies. Andersen and Korpås (2022) argue that students engage themselves to work together when they pay attention to the learning materials played on the screen of a computer.

**Support of screencast application's learning materials to students' motivation to learn physics**

The second section of the questionnaire comprised five (5) items asking students to rank the support received in terms of the gain in motivation to learn physics. The high students' percentage (minimum of 82.5% on all five items), have positively admitted the support of screencast application's learning materials to their motivation to learn physics. The average score point, (M=4.14, SD=0.07), has also confirmed it. On the other hand, a maximum of 17.5% have not positively admitted the support. In this section, it is clear that students were well motivated to learn physics through the use of this ICT tool. These findings reflect the IPRC Kigali students' perception on the importance of using ICT in their learning process as reported in the study conducted by Rwamasirabo (2019). This study has shown that 83.33% of 18 participating students perceived that ICT use could increase their interest in courses. Moreover, given that the current study involved students' use of smartphones to access and share the learning materials, the findings are in accordance with the conclusions in the investigation about the use of smartphones by TVET students in South Africa (Shava et al., 2016). In this investigation, it is highlighted that smartphones are considered as supporting tools in cultivating desire to learn. Similarly, the study conducted by Eveline et al. (2019) on scaffolding approaches assisted by PhET simulations found that the use of computer simulations with scaffolding affects positively students' interest in learning. As it is described, the students' motivation increases and they become active learners.

**Support of screencast application's learning materials to students' independent learning in physics**

Results in section C about students' ranking on the support of screencast application's learning materials to their independent learning in physics outside the classroom indicated that more than 77.5% participating students classified the support in the first three categories described as positive support. This is again confirmed by the average score point of (M=4.13, SD=0.07) in the good help category. This shows that students believed that they were well supported to learn physics independently outside the classroom. The findings in this section are in agreement with other recent studies across the world and in the region. For example, Oktavianti et al. (2018) found that the e-scaffolding supports students' independent and collaborative learning in blended physics learning. In another study about problem-centred STEM education, Kim et al. (2020) similarly found that computer-based scaffolding affects positively the students' individual learning in problem solving. Moreover, the scaffolding strategy used with PhET simulations in physics teaching has been recorded a meaningful improvement on Indonesian high school students' learning independence (Eveline et al., 2019).

**Support of screencast application's learning materials to students' understanding of physics**

The last section of the questionnaire was targeting students' confidence on their understanding of physics, especially on the topic of thermodynamics. Students were asked to rank their level of gain in understanding this topic for different aspects covered in five (5) questions. The results in this category showed that a high percentage of students ranked the support of screencast application's learning materials in the first three categories as it was in the previous sections. In the first three categories, considered in this study as positive support, we found 82.5% of students whereas 17.5% classified the support in the negative category of little gain and no gain. The average score point in this section, (M=4.04, SD=0.08), has also indicated that participating students have ranked the support to the understanding of thermodynamics in the category of good gain. As the ranking of students indicates, there are opportunities to consider with the support of screencast application's learning materials in comparison with other studies. In physics teaching and learning, the use of ICT in scaffolding develops more scientific skills in students as found in in the study by Ferreira-Bautista and Pifarré (2019). Further, the e-scaffolding in physics teaching provides students with opportunities to improve their ability in problem solving (Saputri & Wilujeng, 2017). Moreover, using web-based e-scaffolding, Sarah et al. (2022) found that e-scaffolding improve students' learning outcomes and understanding in physics due to attractive learning materials and learning experience faced. These findings are closely in line with students' level of confidence as they have ranked their understanding of physics through the screencast application's learning materials' support. The questions in this category reflected on students' understanding of physics concepts, use of diagrams, equations and graphs in problem solving in the topic of thermodynamics.

## Conclusion

The aim of this study was to assess the extent to which the screencast application's learning materials support construction technology students' outside-of-classroom learning in physics. The study involved first-year construction technology students at one IPRC. On the five point Likert scale questionnaire, results of this study indicated that in all four dimensions students were positively satisfied with the support provided by the teacher through screencast application’s learning materials. In all four cases, a high percentage of students was at least above 77.5%, in the first three levels: great help or great gain, good help or good gain and medium help or medium gain. Moreover, the average point scores on the Likert scale in all four learning dimensions showed that students had positive ranking on the received support, in the range of good help or good gain.

## Recommendations

The sampled students were only first-year construction technology at one IPRC. This has limited researchers to generalize the findings to the whole Rwanda Polytechnic students’ community. Moreover, the study had only considered students’ satisfaction on a questionnaire and no other aspects of measurement in the learning process. Thus, researchers recommend future studies to consider large samples including all students who study physics or other science subjects in Rwanda Polytechnic. Studies which can also assess the effect of screencast application’s learning materials on student performance in physics are encouraged in order to use these applications in daily teaching and learning physics and science subjects at Rwanda Polytechnic. Future studies also are recommended to create an online system where the screencast application's learning materials can store and students can download them any time on different occasions.

## The limitation of the study

The current study encountered some limitations including the handling of student-teacher interaction with more than 100 students who were included in the study. It was challenging to give feedback to every participant in a convenient time and this could have affected the learning process. Moreover, sharing the learning materials with WhatsApp was seen to be not as sustainable as it could be. Sometimes, students had the problems with their smart phones and they could lose the materials. This has hindered the efficiency of teaching and learning.

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