Birlesik Dünya Arastırma BD-CENTER Innovasyon ve Yayıncılık Merkezi

Cypriot Journal of Educational Sciences

Volume 17, Issue 7, (2022) 2447-2461

CJES Cypriot Journal of Educational Sciences

www.cjes.eu

Students' perceptions toward a smart equation exam system for students with and without handwriting difficulties

Ahmad M. D. (Assa'd) Jaber [a]*, Al-Ahliyya Amman University, Department of Basic Sciences, Amman 19328, Jordan, https://orcid.org/0000-0001-6616-0478

Joseph A. Bawalsah [b], Al-Ahliyya Amman University, Faculty of Arts and Sciences, Department of Special Education, Amman 19328, Jordan, https://orcid.org/ 0000-0003-0386-3023

Mohammad O. Hiari [c], Al-Ahliyya Amman University, Faculty of Arts and Sciences, Faculty of Information Technology, Department of Computer Science Amman 19328, Jordan, https://orcid.org/0000-0003-1740-6843

Mohammad Musleh [d], Al-Ahliyya Amman University, Department of Basic Sciences, Amman 19328, Jordan, https://orcid.org/0000-0001-6616-0478

Talal Haimur [f], Al-Ahliyya Amman University, Department of Basic Sciences, Amman 19328, Jordan, https://orcid.org/0000-0002-6908-2855

Suggested Citation:

Ahmad M. D. (Assa'd) Jaber, Joseph A. Bawalsah, Mohammad O. Hiari, Mohammad Musleh & Talal Haimur (2022). Students' perceptions toward a smart equation exam system for students with and without handwriting difficulties. *Cypriot Journal of Educational Science*. *17*(7), 2447-2461 https://doi.org/10.18844/cjes.v17i7.7644

Received from December 27,2021; revised from April 16, 2022; accepted from July 10, 2022 .

Abstract

This study suggests a digital assessment tool - Smart Equation Exam System (SEED) - as a substitute for traditional multiple-choice and paper and pen exams. SEED includes a question bank, an answer platform, mathematical equations, and physics formulae. The novelty of SEED is that it allows all students with or without physical disabilities via creation of an equal and non-discriminatory platform to solve the physics questions step by step and submit all the solution steps as well as the final answer. The study population was composed of students enrolled in the General Physics (II) course at university level. The sample consisted of fifty students who were selected randomly. The results showed that more than eighty presents of the participants had a positive perception of SEED compared to traditional exams, and they found it more flexible in reviewing solution steps, and getting feedback, especially for the student with handwriting disabilities.

Keywords: Assistive technology; computer software; disabilities education; physics education; digital assessment;

* ADDRESS FOR CORRESPONDENCE: Ahmad M. D. (Assa'd) Jaber, Al-Ahliyya Amman University, Department of Basic Sciences, Amman 19328, Jordan,

E-mail address: ajaber@ammanu.edu.jo / Tel.: +962798014347

1. Introduction

In the academic community, it is imperative for lecturers to know how well students understand their lessons. They also need to assess each student at the end of the semester and give a final grade that reflects their comprehension of the lessons. Formative or summative assessments can be employed by lecturers to grade and monitor students' understanding and progress.

Formative assessment includes quizzes, assignments, and any in-class activities that can help lecturers to monitor their students' progress and the efficacy of their own practice (Nicol and Macfarlane-Dick, 2006; Safer and Fleischman, 2005; Theall and Franklin, 2010; Trumbull and Lash, 2013).

Summative assessment is employed to evaluate and grade students' understanding at the end of the course. Summative assessment includes the midterm, final exam, and final project assessments (Black and Wiliam, 2009; Gikandi et al., 2011). Due to the COVID-19 pandemic, most educational institutions resorted to e-learning as a more suitable alternative for the continuation of the educational process given the prevailing circumstance (Iqbal et al., 2020). E-learning can provide students with an equal and participatory learning experience that meets their needs inside and outside the classroom (Blasco-Arcas et al., 2013; Burwell et al., 2013; Saadé et al., 2012).

In a similar vein, e-learning can also provide all students with disabilities the opportunity to learn independently and gain additional psychological benefits through increased self-esteem and confidence. Taking into cognizance the fact that each individual is a special learner and that differences exist among learners, inclusive education tends to promote respect and value for diversity and seeks to combat discriminatory attitudes in society from an educational perspective. Therefore, curricula, teaching and assessment methods must be designed and adapted to the needs of all students.

Standardised tests must be replaced with flexible and diverse methods of assessments and instruments (Alruwais et al., 2018). In this regard, students with disabilities must receive the support they need to be effectively educated. This should be made feasible through the universal availability of educational services and facilities. Such educational services and facilities may include, but not limited to alternative materials, provision of handouts in alternative formats, employing assistive technology, and allowing students more time to complete academic tasks (Barber, 2012; Gelbar et al., 2015; Malik and Anton, 2013).

Taking into cognizance the fact that each student can be considered as a unique learner with special educational needs, we should prepare appropriate educational technology for science education to provide all students with the same opportunities for learning and assessment (Gokaydin et al 2020; Talyzina et al., 1988). This technology should be one that would help to improve the understanding of tasks and problem solving skills (Talyzina et al., 1988). In a study, Talyzinova hinted that "...without problems, without tasks, neither skills nor knowledge can be acquired" (Talyzina et al., 1988).

1.1. Related Research

A variety of computer applications have been developed and used in physics education to improve students learning level (Aleven et al., 2003; Dervić et al., 2018; Gikas and Grant, 2013; Pol et al., 2005; Trna et al., 2010). The use of interactive computer programs could be a viable way to promote the acquisition of problem-solving skills in science. Therefore, the need for a digital evaluation tool and computer applications that can be employed in physics education has become a necessity. Moreover, students with mechanical handwriting difficulties induced by cerebral palsy (CP) have a variety of problems in solving questions with pen and paper (Barcala, et al., 2019; Spiller et al. 2019). This can be observed in their problem-solving ability; most of them try to avoid this problem by seeking the help of others to write the answers on their answer sheets. Therefore, digital assessment tools have become an integral part of the online learning system for lecturers. Moreover, digital assessments can be a replacement for the formative and summative assessments when students are not in the classroom.

Digital assessment can be used for online assessments of a large number of students; it is fast, easy, accurate, and very secure (Gikandi, et al., 2011; Sorensen, 2013). Universities adopted e-assessment in order to achieve a robust, accurate and faster method of assessing students, rather than relying on conventional paper exams (Alruwais et al., 2018). One of the most commonly used forms of digital assessments is the Multiple-Choice Questions (MCQs). The multiple-choice questions (MCQs) format is commonly employed to assess students' knowledge as it can accommodate a large number of participants. The advantages of MCQs are that they are easy to handle, and the results can be obtained quickly (Et.al et al., 2021). In the MCQs exam, students are asked to read and provide answers for the questions by choosing the alternative they believe is correct from other given choices. Unfortunately, if the student gives a wrong answer, he/she loses the mark allotted to that question. Even if he/she has tried hard and gone through the solution steps, the mark of the question will still be assigned to the final answer. Therefore, the need for a digital assessment tool that takes into account both the solution steps and the final answer in grading is essential nowadays.

1.2. The present study

The main objective of the present study is to propose a digital assessment tool (SEED) that can replace conventional pen and paper and MCQs exams and can assess both the solution steps and the final answer. In this digital tool, the mark allotted to the question is distributed according to the steps taken to solve the question, and not according to the last answer given (as in the MCQs style of examination). The other objective is to help students with physical disabilities (handwriting difficulties) to solve physics tasks (university level) employing mobile devices such as smartphones, tablets, and laptops (with touch screen).

The research questions (RQs) of the study are specified as follows:

- RQ1: Can the proposed assessment tool be an efficient alternative to traditional paper and pen exams?
- RQ2: What are students' perceptions toward the proposed digital assessment (SEED) for conventional of traditional pen and paper exams?
- RQ3: Could the digital assessment tool "SEED" help students with handwriting difficulties surmount the challenges of solving physics problems without external help?

To answer RQ1 and RQ2, SEED was introduced to the participants and a set of questions were asked the students to elicit the participants' perceptions of SEED. To answer RQ3, one student with handwriting difficulties was invited to a follow-up interview to elicit his perceptions of SEED and his need for SEED.

SEED is the proposed digital assessment tool that can be used as a substitute for assessment of students' academic performance in lieu of traditional pen and paper and MCQ exams. SEED includes a question bank, an answer platform, an information sheet with all the constants, mathematical equations, and physics formulae. The users can employ any mobile devices like smartphones, tablets, laptops, computer mouse or touchpads to drag the correct formula from the information sheet to the answer platform. For the purpose of the current study, SEED efficiency was expressed in degrees based on the data obtained from the questionnaire and interview results.

Handwriting difficulties are the permanent condition in which an individual experiences difficulty in the mechanical aspects of handwriting skills such as holding and grasping pen and adjusting paper for writing. Such difficulties are mainly associated with cerebral palsy (CP), a neurological damage to the motor areas of the brain prior to maturity, which results in stiff movements especially for fine motor skills such as handwriting, disturbs sense of balance and depth perception, and involuntary and uncontrolled motions. CP is defined as neurological damage to the motor areas of the brain prior to brain maturation (most cases of CP occur before, during, or shortly after birth). The most common types are (1) spastic, in which the person moves stiffly and with difficulty, (2) ataxic, which is characterized by an impaired sense of balance and depth perception, and (3) athetoid, characterized by involuntary and uncontrolled movements. Most CP cases are a combination of the three types. Due to CP, the student had serious difficulties in gross and fine motor skills and perpetually depended on assistance for walking and a shadow teacher to help with writing skills owing to the difficulty experienced by the student with handwriting, holding paper, and grasping pens (Karlsson et al., 2017; Taherian and Davies, 2017).

1.3. Purpose of the study

The aim of this study is to present a new digital assessment tool that can be employed as an alternative for traditional pen and paper and MCQ exams. This tool is applicable to all mobile devices making it more accessible to all students and can help to eliminate barriers such as time limits and place restrictions. Furthermore, this study investigates the students' perceptions of the proposed digital assessment tool (SEED).

Students with handwriting disabilities face serious challenges in handling traditional paper and pen exams, and to overcome these challenges, another teacher or colleague is assigned to these students to help them complete their exams by writing the answers. Such practices will deprive the students of their independence in thinking and writing freely and might be considered as a source of bias in evaluating their academic achievement. Furthermore, due to the wide use of smart devices, students might feel uncomfortable doing their exams in the traditional approaches perceiving it as a step backward.

2. Methods and materials

This study employed a survey questionnaire to collect and analyse the students' perceptions of the proposed digital assessment (SEED). This study was approved by the research ethics committee of the researchers' university- Al-Ahliyya Amman University, Jordan.

2.1. Research Model

The digital evaluation tool (SEED) was programmed using the C# programming language and can be edited on PC and a web server computer. The digital tool has both an instructor and a student interface. The instructor interface is for administrative purposes and allows the instructor to add the following:

1- Student names,

2- Physics formulae,

3- Questions, figures

4- Assign questions to students,

5- Solution steps and the grade for each step.

Figure 1 shows a screenshot of a front page of the instructor interface. The front page consists of a toolbar, the main rules, the location where questions are saved (Exam), the location where a new question is written (Question), and an assistance toolbar (Inter symbol, Clear, Upload Picture).

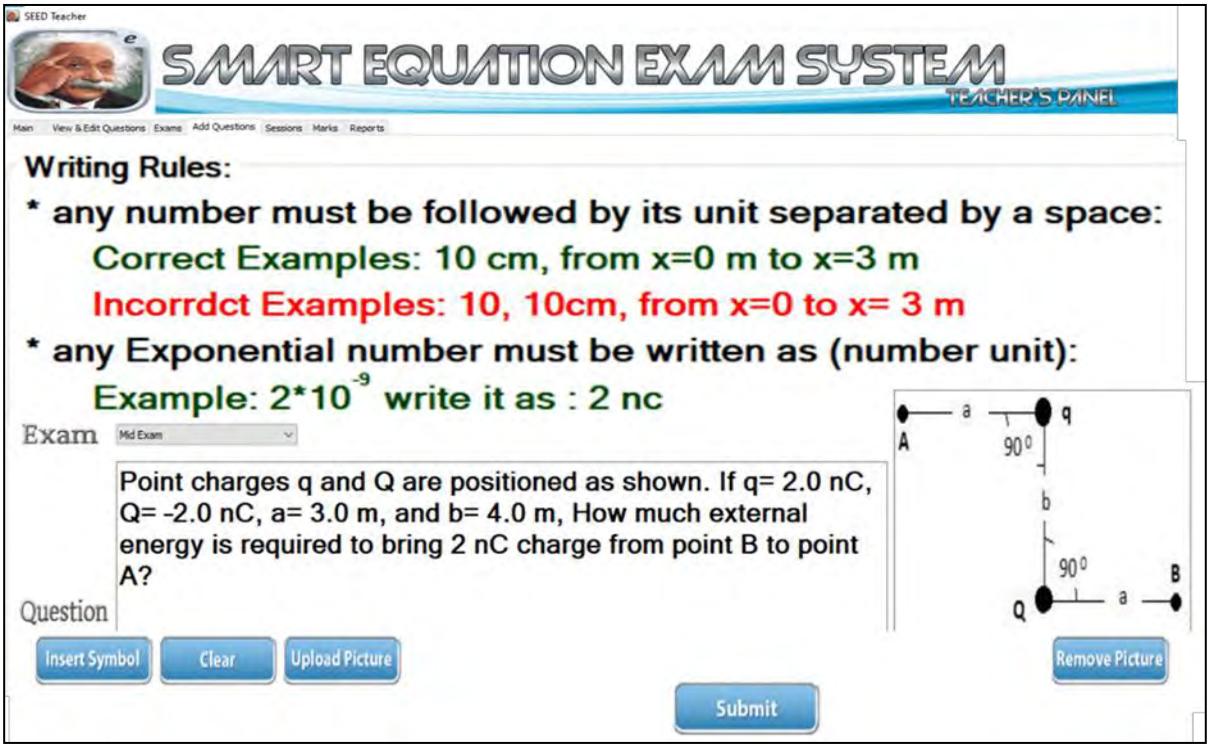

Figure 1. An instructor interface front page of SEED program.

The steps involved in adding a question by the instructor to the program:

1- Writing the question text.

2- Designing the solution strategy.

3- Adding the solution steps (to compare with the student's solution).

4- Marking each solution step and assigning mark to each question as well as the total mark for the exam (Figure 2).

In this program, marks for questions are distributed according to the steps taken to solve them, and not according to the final answer (as in the MCQ style of examination).

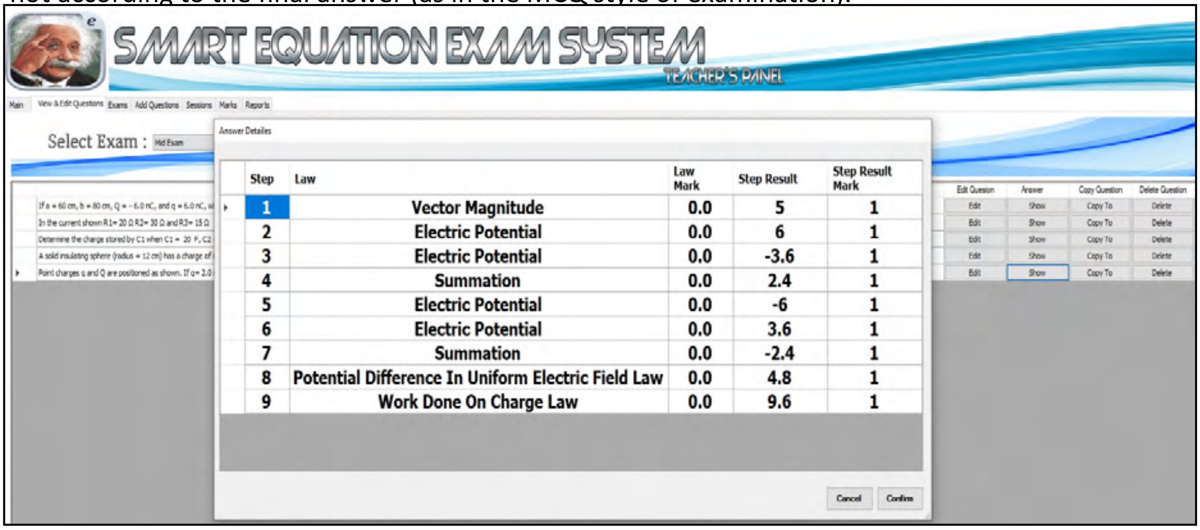

Figure 2. How the question mark is distributed on the solution's steps on SEED program

The students' interface is user-friendly and allows the students to log in and displays a list of questions that have been assigned to them. Once the student selects a question, the form in Figure 3 appears. Figure 3 shows the text of the question at the top of the page. Below the question text are the solutions and result areas. The constant quantities and prefix are on the right side of the page. The formulae and equations are at the bottom of the page. These formulae and equations can be classified according to their subject areas (as taught in the textbook chapters).

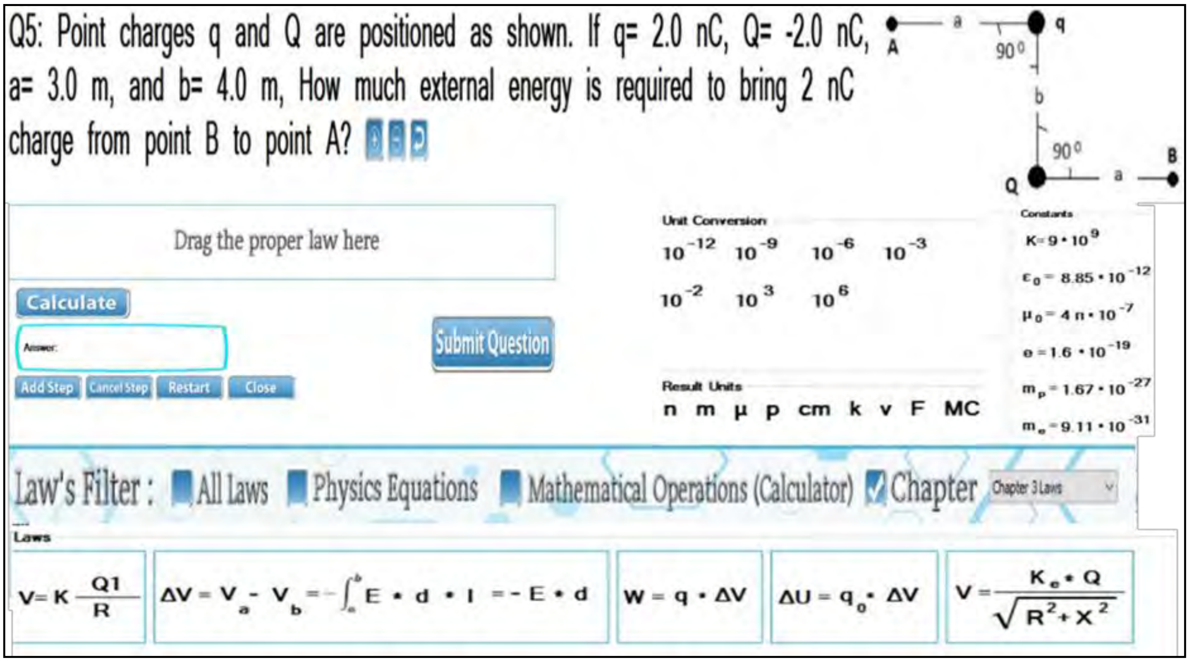

Figure 3. The students' interface front page of SEED program

The following example was used to calculate the total work (W) required to move a point charge from point A to point B under the influence of the electric potentials, Va and Vb of two charges (Q and q). The point charges q and Q are arranged as shown above. If q = 2.0 nC, Q = -2.0 nC, a = 3.0 m, and b = 4.0 m, what amount of external energy is required to move a charge of 2 nC from point B to point A? (Young and Freedman, 2020).

The solution steps:

$$W = q_o \times \Delta V_{ab} \quad (1)$$

$$\Delta V_{ab} = V_a - V_b \quad (2)$$

$$V_a = k\frac{Q}{r} + k\frac{q}{a} \quad (3)$$

$$V_b = k\frac{Q}{a} + k\frac{q}{r} \quad (4)$$

$$r = \sqrt{a^2 + b^2} = \sqrt{3^2 + 4^2} = 5m \quad (5)$$

$$V_a = 9x\ 10^9 \times \frac{(-2\times10^{-9})}{5} + 9x\ 10^9 \times \frac{(2\times10^{-9})}{3} \quad (6)$$

$$V_a = -3.6 + 6 = 2.4\ V \quad (7)$$

$$V_b = 9x\ 10^9 \times \frac{(-2\times10^{-9})}{3} + 9x\ 10^9 \times \frac{(2\times10^{-9})}{5} \quad (8)$$

$$V_b = -6 + 3.6 = -2.4\ V \quad (9)$$

$$\Delta V_{ab} = 2.4 - (-2.4) = 4.8\ V \quad (10)$$

$$W = 2x\ 10^{-9} \times 4.8 = 9.6x\ 10^{-9} J \quad (11)$$

Solving the above example employing SEED:

1. After the student selects a problem, it appears as shown in Figure 3.
2. The student reads the problem and brings his knowledge to bear in analysing the problem. This would pave the way for him to arrange the solution steps in his mind.
3. The student would select the correct formula for each step from the formulae area at the bottom of the page and drag it to the solution area.
4. For example, the procedures for executing part of step number (6) in the above example is as follows: the student first calculates the electric potential (Va) at point a of the point charge Q by dragging the formula to the solution area, as shown in Figure 4. The student then replaces the variables with the correct quantities from the question text as outlined in the previous step. As can be seen, the formula has a constant value (K) and a prefix (nanometers). Therefore, the student should replace these letters with numbers, as shown in Figure 5. This could be done by dragging and dropping the quantity from the constant and prefix areas into the formula. Then, the student

can press the "Calculate" button to have the answer shown in the "Answer" area. This step is repeated to compute all the solution steps in the above example.

5. When the student completes his solution steps and obtain the final answer, the results of all the steps would appear in the result area, as shown in Figure 6. The student can then press the "Submit" button to submit his final answer.

6. Figure 7 shows the solution steps taken by students to solve the assigned question

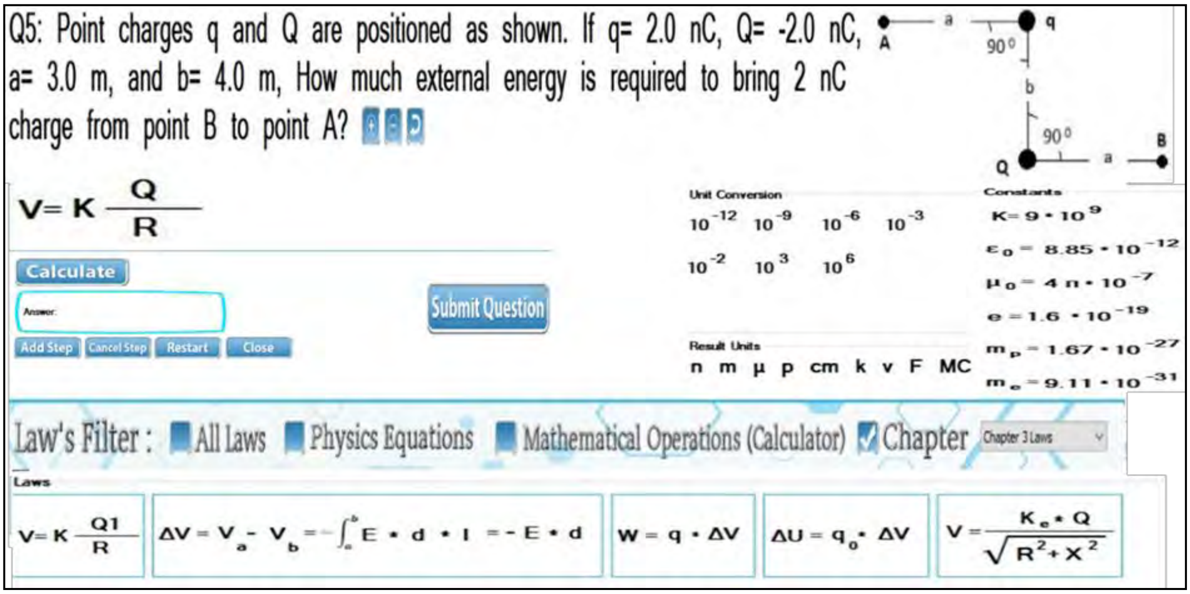

Figure 4. Using SEED to execute step no. 6 in solution step's part (A).

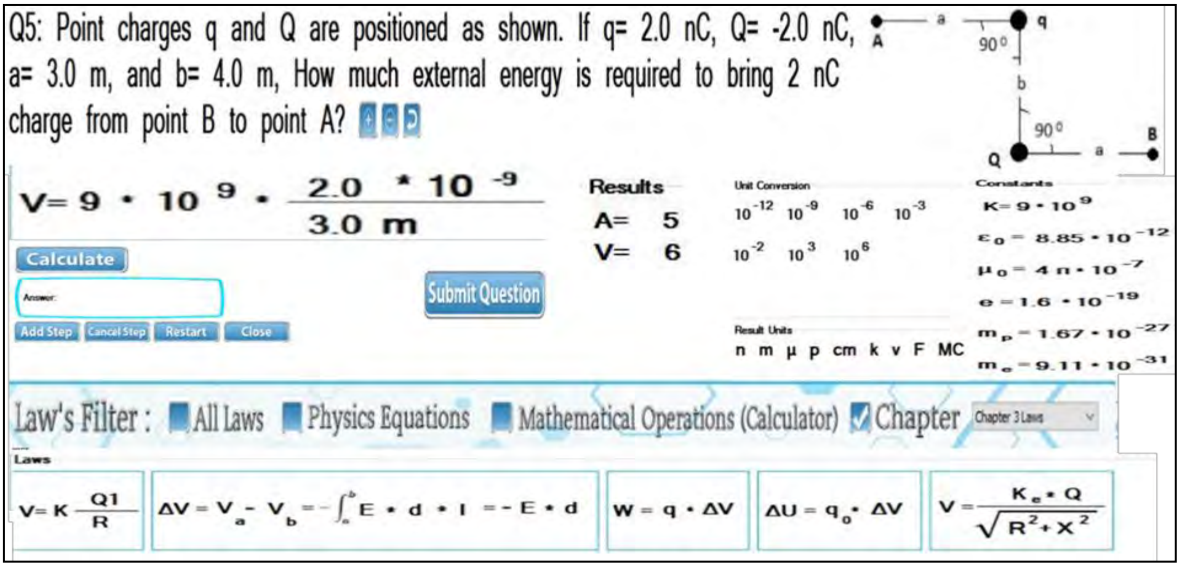

Figure 5. Dragging the variables from the question text to the variables in the equation to execute step no. 6.

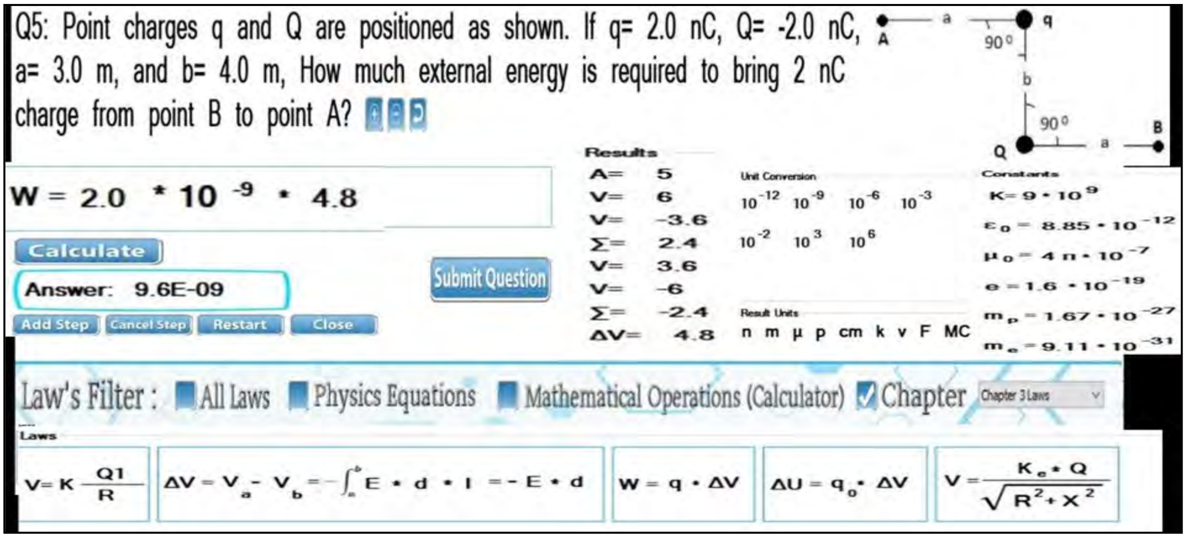

Figure 6. All the executed steps results shown in the results area and the final result shown in the answer box.

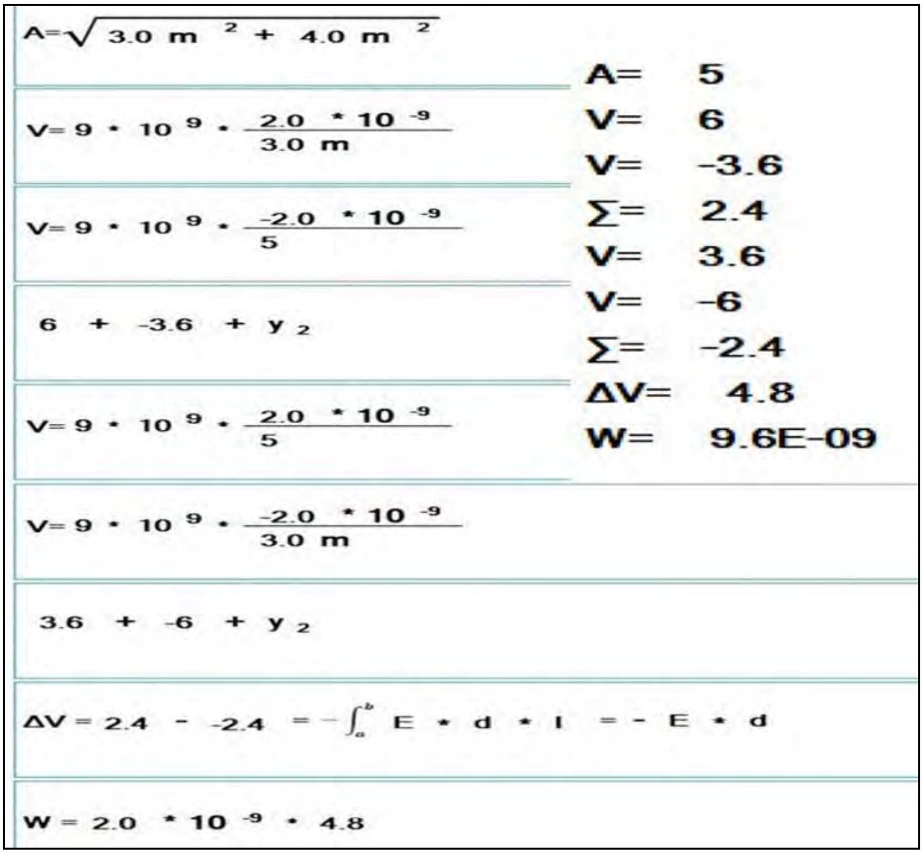

Figure 7. All the solution steps taken by students to solve the assigned question.

2.2. Participants

The study was conducted during the second semester of the 2020/2021 academic session in a General Physics (II) class at Al Ahliyya Amman University in Jordan. The sample consisted of fifty (50) students (participants), one of them had a disability, while the others were non-disabled students. They were randomly selected from two general physics (II) sections. The student with a disability had a medical history of cerebral palsy (CP). When answering standard exam questions, this student consistently asked for help, usually from other students or faculty members. Consent forms that explicitly and adequately explained the goal of the study were distributed to students and returned to the researcher after endorsement by the participating students.

On the basis of completion of the consent form, the participants received 6 lessons on how to best use SEED and all its features, 2 lessons per week, each slated for 2 hours. All the lessons were given to participants as a group to ensure that all the students gained the same skills on how to use SEED.

The participants were given several examples on various General Physics (II) problems to practice on SEED for four weeks. They became familiar with the program and practiced their problem solving skills using the mouse or touch screen. To achieve the goals of the study, after four weeks of practice, students were asked to respond to the questionnaire and their responses were guaranteed confidentiality.

2.3. Data Collection Tool

A questionnaire was composed of two parts: (1) demographic information; (2) perceptions toward SEED. The first part of the questionnaire elicited participants' background information including gender, age, educational level, frequency of employing digital devices. The second part of the questionnaire elicited participants' perceptions toward SEED. The instrument was comprised of 25 items divided into five subsections including: quality of the user interface, usefulness, learning opportunities, replacement of the traditional paper and MCQ examinations, accessibility of the learning materials and questions.

All items were based on a 5-point Likert scale, ranging from 1 (''Strongly disagree") to 5 (''Strongly agree"). Respondents were asked to read each item and check the degree applicable to them (total degree - 25 to 75).

To investigate the perceptions of the student with the handwriting difficulties, the student was interviewed. This interview was focused on two main themes: the usefulness of SEED for students with handwriting problems, and their need for the features of SEED. The student was asked three questions verbally.

1- Do you think SEED could help you in solving the questions independently?

2- State the usefulness of SEED.

3- How can we develop SEED to fulfil your needs in solving the questions independently?

2.4. Data analysis

The data collected were statistically treated. Simple percentage was used to investigate the students' perceptions toward a Smart Equation Exam System (SEED). A group of 8 professors were consulted as referees for content validity. A high agreement level was achieved for the accuracy of the items under each subsection. Internal consistency was obtained, and correlations for each item with total degree for the questionnaire ranged from 0.63 to 0.86; average inter-item correlation was 0.73

(Cronbach's α = 0.83). These reliability and validity coefficients were considered satisfactory based on the questionnaire employed for the current study.

3. Results

All the students completed the survey. Figure 8 shows students' responses to the survey questions. More than 85% of the participants agreed or strongly agreed that SEED was user-friendly and easy to use. More than 95% of the participants agreed or strongly agreed that the learning materials and questions in SEED were accessible.

More than 80% of the participants agreed or strongly agreed that SEED would be a good tool to practice solving problems in physics. Furthermore, more than 70% of the participants agreed or strongly agreed that the SEED program could replace the traditional paper exam. Finally, more than 90% preferred SEED to replace the MCQ exam, and more than 95% of the participants agreed and strongly agreed that SEED was a useful digital assessment tool for students with handwriting difficulties.

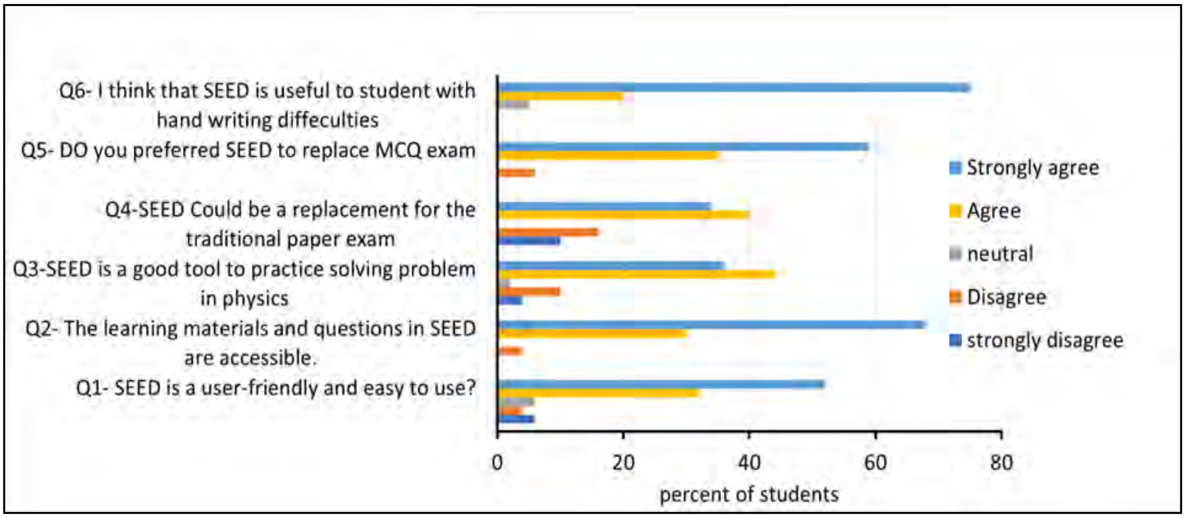

Figure 7. Students' responses to the survey questions.

4. Discussion

The findings of this study are discussed according to the three research questions.

RQ1: Can the proposed assessment tool be an efficient alternative to traditional paper and pen exams?

The results of one of the survey studies conducted in 2006 showed that 59% of the participants in Jordan University (Jordan) and 50% in Zayed University (UAE) preferred e-assessment (Tubaishat et al., 2006). However, the present study shows an increase in the acceptance of digital assessment tools among students in their exams. This can be attributed to the development of contemporary lifestyle characterised by possession of smart mobile phones by most students which has helped them to practice their problem-solving skills in physics. The researchers found that more than 90% of the participants preferred SEED as replacement for the MCQ exams because the mark of the questions is distributed among all the solution steps and the final results. This shows the novelty of SEED; it provides the platform for the student to revise his/her solution steps and eventually submit the answer.

RQ2: What are students' perceptions toward the proposed digital assessment tool (SEED) for replacement of the conventional pen and paper exams?

The findings in this study are in total agreement with those of (Eljinini et al., 2012 and Peterson, 2012), who reported that the students preferred digital assessment because they can have friendly interfaces and test as games and simulations. More than 85% of the students reported that SEED was very user-friendly, fast, and easy to use. However, 10% of the students had some minor difficulties in understanding and using the functions of the front page as well as dealing with the icons of the program. More training would help to overcome these difficulties.

More than 95% of the participants stated that SEED provides all the necessary physics formulae equations needed to solve the questions. Therefore, there was no need to spend time memorizing the required formulae, and this made students more comfortable during exam time, and as a result, the students spent more time grasping, analysing, and organising the solution steps before they started solving the questions.

The participants noticed that SEED gives the result and instant feedback on their answers immediately the exam ends. The participants liked this novel option as they can improve their learning level by revising their answers. This is in contrast to the traditional paper exam, in which the students must wait for the lecturer to grade the exam and show it to them after a few days. The preceding statements which are based on the results of the current study are in agreement with the reports of Crews and Curtis (2011) and Osuji Uchenna (2012). Furthermore, more than 80% of the participants found SEED to be a good tool for practicing solving of physics problems on their smart devices at their own time without requiring paperwork. Therefore, the use of SEED would result in less anxiety and pressure since it can be employed to take the exam in a more comfortable environment anywhere outside of the classroom using any device such as smartphones or tablets.

RQ3: Could the digital assessment tool "SEED" help students with handwriting difficulties surmount the challenges of solving physics problems without external help?

The present study showed that more than 95% of the participants were of the opinion that SEED is good for students with handwriting difficulties. The interview results for the student with handwriting difficulties showed that SEED was useful in surmounting his mechanical handwriting difficulties related to solving physics problems. Even though he was slower than his peers in employing SEED to solve the problems, he was nonetheless happy to use the touch screen PC and his smart mobile rather than paper and pen or asking for the help of others. He also expressed a wish that some icons on the student interface of SEED be larger to make it easier for him to drag and drop the formula into the answer area (box).

The student opined that SEED made problem-solving more attractive and fascinating. He became more active in class and was able to solve the assigned tasks on his own. In addition, the student expressed a sense of accomplishment when he managed to answer the exam questions independently without the assistance of others, and this self-dependency was deeply reflected in his self-esteem, equality with his classmates, and other significant personal and emotional aspects of his life.

5. Conclusion

The novelty of the proposed digital assessment tool SEED is that it allows all students (with and without disability) to solve physics questions step by step and to submit the final answer and all the solution steps. SEED can also mark each step and assign the final mark of the question. SEED was accepted by more than 85% of participants as a substitute for the traditional paper and MCQ exams.

SEED program has two parts: one for the students to solve the questions and the other for the instructor to add the questions and solution steps. The program depends on selection of the physics formula for each step and dragging it to the solution area (box) and replacing each symbol in the formula with the correct quantities in the question. The students become more active in the physics class and solve their assigned problems through the SEED program. SEED motivates students to practice their physics question solving skills. In addition, SEED can help students to improve their physics learning level. It can also enhance students' performance in the exam. Part of the novelty of SEED is that it allows students to revise their solution steps before submission. Ongoing and future research should be conducted to quantitatively analyse the improvement of students' problem-solving ability for physics questions after using the SEED program.

6. Recommendations.

It should be noted that the General Physics (II) course is a foundation course in Al-Ahliyya Amman University, and the number of students is limited to 75 students per semester. The sampling or population size can be increased to make the study more representative by expanding future studies in other universities. In addition, during the study period, only one student with handwriting difficulties was found at Al-Ahliyya Amman University. Therefore, the present study result cannot be generalised but it can give an indication of the needs of students with hand writing difficulties. In the future, it is possible to increase the sampling size and make it more representative by ensuring that studies in other universities are conducted involving more students with different disabilities.

Acknowledgements

This research was supported by Al Ahliyya Amman University, Project No. 1/20/2018-2019. Their support and consideration are highly appreciated.

References

Aleven, V., Stahl, E., Schworm, S., Fischer, F., & Wallace, R. (2003). Help seeking and help design in interactive learning environments. Review of Educational Research, 73(3), 277–320. https://doi.org/10.3102/00346543073003277

Alruwais, N., Wills, G., & Wald, M. (2018). Advantages and challenges of using e-assessment. International Journal of Information and Education Technology, 8(1), 34–37. https://doi.org/10.18178/ijiet.2018.8.1.1008

Barber, P. (n.d.). College students with disabilities: What factors influence successful degree completion? A case study. Disability and Work Research Report. Joint publication from the John J. Heldrich Center for Workforce Development and the Kessler Foundation. Available from https://www.heldrich.rutgers.edu/work/college-students-disabilities-what-factors-influence-successful-degree-completion-case-study.

Barcala, L., Politti, F., Artilheiro, M. C., Speciali, D. S., Garbelotti, S. A., Correa, J. C., & Lucareli, P. R. (2019). Adult dyskinetic cerebral palsy: upper limb movement and muscle function. Acta Neurologica Scandinavica, 139(6), 505–511. https://doi.org/10.1111/ane.13083.

Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. Educational Assessment, Evaluation and Accountability, 21(1), 5–31. https://doi.org/10.1007/s11092-008-9068-5.

Blasco-Arcas, L., Buil, I., Hernández-Ortega, B., & Sese, F. J. (2013). Using clickers in class: the role of interactivity, active collaborative learning and engagement in learning performance. Computers & Education, 62, 102–110. https://doi.org/10.1016/j.compedu.2012.10.019.

Burwell, N., Wessel, R. D. & Mulvihill T. (2013). Attendant care for college students with physical disabilities using wheelchairs: transitional issues and experiences. Journal of Postsecondary Education & Disability, 28(3), 293-307.

Crews, T. B., & Curtis, D. F. (2011). Online course evaluations: faculty perspective and strategies for improved response rates. Assessment & Evaluation in Higher Education, 36(7), 865–878. https://doi.org/10.1080/02602938.2010.493970.

Dervić, D., Salibašić Glamočić, D., Gazibegović-Busuladžić, A., & Mešić, V. (2018). Teaching physics with simulations: teacher-centered versus student-centered approaches. Journal of Baltic Science Education, 17(2), 288–299. https://doi.org/10.33225/jbse/18.17.288.

Eljinini, M. A., Alsamarai, S., Hameed, S., & Amawi, A. (2012). The impact of e-assessments system on the success of the implementation process. International Journal of Modern Education and Computer Science, 4(11), 76–84. https://doi.org/10.5815/ijmecs.2012.11.08.

Gelbar, N. W., Madaus, J. W., Lombardi, A., Faggella-Luby, M., & Dukes, L. (2015). College students with physical disabilities: common on campus, uncommon in the literature. Physical Disabilities: Education and Related Services, 34(2), 14–31. https://doi.org/10.14434/pders.v34i2.19224.

Gikandi, J. W., Morrow, D., & Davis, N. E. (2011). Online formative assessment in higher education: a review of the literature. Computers & Education, 57(4), 2333–2351. https://doi.org/10.1016/j.compedu.2011.06.004.

Gikas, J., & Grant, M. M. (2013). Mobile Computing Devices in higher education: student perspectives on learning with cellphones, smartphones & social media. The Internet and Higher Education, 19, 18–26. https://doi.org/10.1016/j.iheduc.2013.06.002.

Gokaydin, B., Filippova, A. V., Sudakova, N. E., Sadovaya, V. V., Kochova, I. V., & Babieva, N. S. (2020). Technology-supported models for individuals with autism spectrum disorder. International Journal of Emerging Technologies in Learning (IJET), 15(23), 74. https://doi.org/10.3991/ijet.v15i23.18791.

Et.al, N. S. (2021). Assessing the quality of mcqs in the final examination of UUM Foundation Students. Turkish Journal of Computer and Mathematics Education (TURCOMAT), 12(3), 2368–2375. https://doi.org/10.17762/turcomat.v12i3.1221

Iqbal, M., Ahmed, F., Iqbal, A., & Uddin, Z. (2020). Teaching physics online through spreadsheets in a pandemic situation. Physics Education, 55(6), 063006. https://doi.org/10.1088/1361-6552/abb293

Karlsson, P., Allsop, A., Dee-Price, B.-J., & Wallen, M. (2017). Eye-Gaze Control Technology for children, adolescents and adults with cerebral palsy with significant physical disability: findings from a systematic review. Developmental Neurorehabilitation, 21(8), 497–505. https://doi.org/10.1080/17518423.2017.1362057

Malik, P.B. & Anton, P.W. (2013). Supporting Students with Severe Physical Disabilities: The Illinois Model. The Journal of College and University Student Housing, 40, 172-185.

Nicol, D., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: a model and seven principles of good feedback practice. Studies In Higher Education, 31(2), 199-218. https://doi.org/10.1080/03075070600572090.

Osuji Uchenna S. A. (2012). "The use of e-assessments in the Nigerian higher education system," Turkish Online J. Distance Education, 13(1), 140–152.

Peterson, D. (2012). Test design and delivery: Overview. Question mark. Available from https://www.questionmark.com/test-design-and-delivery-overview/

Pol, H., Harskamp, E., & Suhre, C. (2005). Solving physics problems with the help of computer-assisted instruction. International Journal of Science Education, 27(4), 451–469. https://doi.org/10.1080/0950069042000266164

Saadé, R. G., Morin, D., & Thomas, J. D. E. (2012). Critical thinking in e-learning environments. Computers in Human Behavior, 28(5), 1608–1617. https://doi.org/10.1016/j.chb.2012.03.025

Safer, N. & Fleischman, S. (2005). Research Matters / How Student Progress Monitoring Improves Instruction. Educational leadership, 62(5), 81-83.

https://www.quop.de/fileadmin/literatur/NancySafer_ResearchMatters.pdf

Sorensen, E. (2013). Implementation and student perceptions of e-assessment in a chemical engineering module. European Journal of Engineering Education, 38(2), 172–185. https://doi.org/10.1080/03043797.2012.760533

Spiller, M. G., Audi, M., & Braccialli, L. M. (2019). Motor performance of children and adolescents with cerebral palsy during the execution of computer tasks with different peripherals. Revista CEFAC, 21(4). https://doi.org/10.1590/1982-0216/20192140319

Taherian, S., & Davies, C. (2017). Multiple stakeholder perceptions of assistive technology for individuals with cerebral palsy in New Zealand. Disability and Rehabilitation: Assistive Technology, 13(7), 648–657. https://doi.org/10.1080/17483107.2017.1369585

Talyzina, N. F., Johnová Renata, & Švec Vlastimil. (1988). Utváření poznávacích činností žáků. SPN.

Theall, M., & Franklin. J.L. (2010). Assessing teaching practices and effectiveness for formative purposes. A guide to faculty development. Jossey Bass: San Francisco, CA. 135–150

Trna, J., Trnova, E., & Makydova, L. (2010), "Physics Learning Tasks for Students with Special Educational Needs: Disabled and Gifted," Conference: In: GIREP-ICPE-MPTL 2010. Teaching and Learning Physics Today: Challenges? Benefits? (pp. 196-202). Udine (Italy): University of Udine, 2014. ISBN 978-88-97311-32-4. At: Reims, France

Trumbull, E., & Lash, A. (2013). Understanding formative assessment insights from learning theory and measurement theory. - references - scientific research publishing. (n.d.). https://www.scirp.org/(S(351jmbntvnsjt1aadkposzje))/reference/referencespapers.aspx?referenceid=2072283

Tubaishat, A., Bhatti, A., & El-Qawasmeh, E. (2006). ICT experiences in two different middle eastern universities. Issues in Informing Science and Information Technology, 3, 667–678. https://doi.org/10.28945/922

Osuji Uchenna S. A. (2012). "The use of e-assessments in the Nigerian higher education system," Turkish Online J. Distance Education, 13(1), 140–152.

Young, H. D., Freedman, R. A., Ford, L. A., Sears, F. W., & Young, H. D. (2020). University physics with modern physics. Pearson Higher Education.