The Impact of Advance Organizers in Virtual Classrooms on the Development of Integrated Science Process Skills during the Crises

Abstract

The current study aimed to identify the impact of advance organizers in virtual classrooms on the development of integrated science process skills at the time of disasters. The sample of the study consisted of 64 master's students in vocational education techniques. They were randomly divided into two equal groups. The two groups through virtual classrooms studied the "Research Project" course, with the use of advance organizers with the first group, and without the use of advance organizers with the second group. The Card of Integrated Science Processes Skills Assessment was utilized as a tool to accomplish the aim of this study. The findings indicated that the use of advance organizers in the virtual classes had an impact on the development of the skills axes of integrative science operations (procedural definition, identification and control of variables, questions and hypotheses, procedures and experimentation, and interpretation of results), and on the skills of integrative science operations as a whole.

Keywords: virtual classrooms; advance organizers; integrative science; integrative science processes skills; Covid-19

Introduction

Closing institutions of education is a non-drug measure employed in several nations dealing with epidemics. [1]. The option is to switch from traditional education to online learning since students are not permitted to attend educational establishments [2]. Virtual classrooms are one of the main forms of e-learning that share some similarities with real classrooms [2, 3]. It is a flexible, practical and accessible online learning environment that is not restricted by location [4, 5].

Najran University also provides its employees with Learning Management System, which is the Blackboard. This system is characterized by its ability to retain the content of the course. It also allows synchronous and asynchronous discussions, through which electronic tests can be conducted, and various multimedia files can be utilized [6]. Virtual classes are one of the e-learning tools available in the university's Blackboard system. A virtual classroom is defined as an electronic classroom that can be expanded in time, space, and content [7, 8]. It offers various environments of learning that are largely characterized by enabling video and audio broadcasts and discussion boards [9]. It is called virtual since it overcomes spatial constraints (users can attend the virtual class from different locations), and time constraints (the virtual session can be recorded and made available to users for viewing at any time) [10, 11]. The use of virtual classrooms in the teaching and learning processes has many advantages, such as removing geographical barriers, ease of entry and recording of the session, reducing anxiety and enhancing motivation to learn, and improving communication and collaboration [12-15].

It is worth noting that the concept of advance organizers was first proposed by Ausubel in the 1960s [12]. It is a term that refers to the introductory material that is presented before the training material [16]. In order to integrate new knowledge to the students' prior knowledge, advance organizers give information in the form of concepts and linkages between concepts prior to learning [17, 18]. In brief, the ability to recall and combine existing knowledge with new information offered in learning

Comment[Author1]: I think just 'during Crises' would be better.

Comment[Author2]: Problems with tense here. Either 'the study aimed' or 'the current study aims'. Ensure tense is consistent throughout.

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Comment[Author3]: 'Non-drug' is not the right term. Perhaps 'non-medical' would be better.

Comment[Author4]: More than several - many.

Comment[Author5]: I would state where Najran University is. This may be obvious to you but might not be to international readers.

Comment[Author6]: Some good definitions of terms in this paragraph.

situations is referred to as advance organization [19]. It is mainly used to activate the learner's prior knowledge in order to better understand its similarity with the new information under study [20]. Advance organizers can also be used to stimulate task practice by creating meaning for the learner, as it can clarify the learning objective and provide a context in which the learner is motivated to learn how to accomplish the task [21]. Advance organizers also have commendable advantages for positively influencing students' acquisition of concepts [22]. In addition, any advance organizers include a set of procedures represented in providing previous knowledge, establishing clear links between previous knowledge and new information, teaching new vocabulary in the same context, and highlighting key vocabulary [23].

Integrated Science Process Skills

Science process skills are abilities that enable students to conduct valid research by acting and thinking as scientists [24-26]. Science process skills can be classified into two basic models. The first model refers to basic skills (including prediction, measurement, classification, and observation). The second model refers to the skills of integrative science process (includes procedural definition, identification and control of variables, questions and hypotheses, procedures and experimentation, and interpretation of results) [27]. Providing students with integrated science process skills is of a great advantage, as these skills help the students in searching for new knowledge and solving problems in different situations, and encourage them to gain knowledge from practice [28]. In addition, students' use of these skills enables them to process and structure scientific information and understand the nature of the science they are studying [29, 30]. Given that integrated science processes skills offer various ways and means to access scientific information, they can help students to think scientifically [31-33]. There are also some university courses, such as the "Research Project" course, that depend mainly on the skills of integrated science processes, and therefore the needs of the learners must be met by developing these skills.

Empirical studies also found that advance organizers (as one of the methods of providing educational material to the learner) help increase students' achievement and enhance their ability to learn, and lead to the retention of learning [34-36]. Accordingly, researchers believe that advance organizers developed in the context of the virtual classroom may be useful for developing the skills of integrated science process of the "Research Project" course, which are not well explored or understood.

It is noteworthy that this study came during the spread of the new Corona pandemic (Covid-19) in most countries of the world. In addition, the subsequent closure of educational institutions in the Kingdom of Saudi Arabia as a non-drug measure applied by many countries to limit the spread of the epidemic, and if digital transformation is a strategic goal for many universities in general. This transformation becomes an urgent necessity in times of epidemics to continue the educational process. Bearing in mind that the "Research Project" course relies mainly on the skills of integrated science processes.

Methodology

The researchers used an experimental approach with semi-experimental designs, which purposes to examine the effect of the independent variable on the dependent variable, and this required the use of a semi-experimental design, as in the following table.

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Comment[Author7]: Very clear and welcome explanation of AO in this paragraph.

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Comment[Author8]: Another very astute explanation of terms/concepts.

Comment[Author9]: It's unclear to me the significance of this course. This is the course that the students attend at Najran University? Make this clearer nearer where you explain the purpose of this study.

Comment[Author10]: This I presume is your research gap. I would discuss a little more the literature on this area. I know you're limited in terms of time here, but perhaps you could cut back slightly on the conceptual explanations above and produce a bigger paragraph on the empirical basis for AO in virtual classroom contexts and why it is lacking.

Comment[Author11]: This section needs to be bigger and set out more clearly the rationale behind your study, its aims and perhaps some research questions. I know you've touched on these in your abstract but your abstract serves to summarise the content in your essay - it doesn't substitute what is said in the introduction but summarises it.

You need to set out in your introduction: what your research topic is (you've done that), why it is important to study (I think you've done that as well), what you hope to achieve through it (your aims - are you closing a research gap, recommending policy, etc.), and your objectives/research questions (specifically, what does this study measure or ask).

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Comment[Author12]: Do you mean 'proposes'? There are quite a few word choices in the essay that are not quite right. It reads as though it was perhaps written by someone whose first language is not English. This could be improved through closer proof-reading.

Table 1.

Research tool (Integrated science process skills Assessment card)

The researchers designed a card to assess the skills of integrated science process, by looking at the educational literature and referring to previous studies that dealt with the skills of integrated science process, such as Elfeky and Elbyaly [37], Hernawati, Amin [38], JUHJİ and NUANGCHALERM [39], Sharma [40], Elfeky and Elbyaly [41]. To confirm the authenticity of the evaluation card, it was shown to a panel of experts and specialists. Where the arbitrators were asked to express their opinions on the evaluation card in terms of the appropriateness of the sub-skills to measure each domain that represents a skill of the integrated science operations skills.

The extent of the clarity of the phrases and the soundness of their linguistic formulation, and what can be added or deleted from those phrases, and any other observations or suggestions. In its final form, the card consisted of five domains, each domain expressing a main skill and one of the skills of integrative science operations (procedural definition, identification and control of variables, questions and hypotheses, procedures and experimentation, and interpretation of results). The first and second domains of the evaluation card included five sub-skills in each of them. While the third and fourth domains included 6 sub-skills in each of them. The last domain included four sub-skills. WA five-point Likert scale (1 = very little to 5 = very much) was used for each of the sub-skills on the card. In addition, by using Cronbach's Alpha for the internal consistency of the paragraphs, the stability of the scorecard was verified. This is done by applying the card to the research plans of a sample of female students not included in the actual study (30 female students). The stability coefficient value was (0.88) for the card as a whole. Thus, the card is ready to evaluate the students' final research plans (after the experiment) by three specialized and impartial faculty members. That is, each research plan is evaluated three times with three degrees, after which the researchers calculate the average score of the three evaluators for each research plan to be the final score for each student.

Ensure That the Two Groups are Equal in Skills of Integrated Science Process

Each student participating in the study was assigned via an advertisement in the Blackboard e-learning management system at the beginning of the first week of the study (Sunday) with a research plan (to be completed within a week as a maximum) that includes procedural definition, identification and control of variables, questions and hypotheses, procedures and experimentation, and interpretation for results. In addition, by evaluating the initial research plans by an independent faculty member using the evaluation card, evidence of the pre-application of the skills of integrative science operations is obtained. ANOVA was used to analyze the data results through the SPSS version 24 program to identify the significance of the differences among the mean scores of the two experimental groups to verify their equivalence before the start of the experiment. Table (4) reveals the differences among the scores of the participants in the pre-application using the Integrated Science Processes Assessment Card.

Table 2.

The results presented in Table (2) show the differences in the mean scores between the two study groups when the integrated science processes assessment card was used as a pre-application. With regard to their skills in procedural definition, identification and control of variables, questions and hypotheses, procedures and experimentation,

Comment[Author13]: I've had a look at the table. It sets out the research design but I'm not sure what else it's supposed to show, if anything. If just the design, then it's fine.

Comment[Author14]: These names don't need to be fully capitalised.

Comment[Author15]: Who were this panel of experts and specialists, how did you come by them? Are they professors/lecturers in your university?

Comment[Author16]: Something that's not been discussed and should be discussed in a methodology is *why* you arrived at these methods. Why not other methods? Why not use a qualitative design and conduct interviews? If an experimental design, what are the hypotheses and how does the design test them? You need to set out what methods you've chosen and that you've chosen them because they can answer your research questions/test your hypothesis in a specific way.

Comment[Author17]: What are these sub-skills?

Comment[Author18]: Good mention of why you've included this, how it works, and what the result means. We need more explanations like this across the paper.

Comment[Author19]: This is more clear.

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Comment[Author20]: I'm unsure what this subheading is supposed to tell me. It seems more like an instruction than an indication of what the following section describes.

Comment[Author21]: A little more information on who the participants were would be welcome. What is their level of study (undergraduate or postgraduate), what is the gender split, etc. Was the sample randomised in any way or is it convenience/purposive? Why is this a good sample, can findings from it be generalised and why?

Comment[Author22]: This makes sense to me, good explanation.

Comment[Author23]: I can't see all tables, so I can't really judge if you're measuring the right things here or remarking upon their features accurately.

results interpretation, and the skills of integrative science processes as a whole. Not all of them are statistically significant at the level ($\alpha \leq 0.05$). That is, all participants were homogeneous and had equal abilities in the skills of integrative science operations before exposure to the experiment.

Experimental processing material

In order to present the content of the "Research Project" course through the virtual classes, the educational material was organized into 10 separate lectures to introduce the topics of procedural definition, identification and control of variables, questions and hypotheses, procedures and experimentation, and interpretation of results. Moreover, after analyzing several Instructional Design models for e-learning and coming up with a set of indicative steps to follow in the light of designing and producing those lectures in order to fulfill the goals of the current research. Where learners' characteristics were taken into account, goals and content were set, and educational activities were designed. Accordingly, the lectures were presented to the two research groups through synchronous virtual classes through the Collaborate Ultra Experience LTI application for virtual classes that was developed during the emerging Corona pandemic. Where it was implemented from the beginning of the summer semester for the year 2020 AD at the University of Najran by integrating it with the Blackboard e-learning management system. This application is a unique addition to teachers in universities that use the Blackboard system. It provides the possibility of holding virtual meetings, live lectures, and video conferencing, and the virtual classes through this application allowed the learners of the two study groups a chat room, live audio and video broadcasting, whiteboard, application sharing, synchronous web browsing, and feedback. The first group studied through virtual classrooms with utilize of advance organizers, and the second group studied without utilize of advance organizers.

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Comment[Author24]: How are these lectures related to AO and the LMS? Explain their significance and why they are being mentioned/included in the study.

Comment[Author25]: This makes more sense to me. However, I'm uncertain how the first group studied using AOs. What was the nature of the intervention? I'm not clear on that part.

Results

The dimensional arithmetic mean scores of the research sample were extracted on the integrated science operations skills assessment card by group (first experimental, second experimental), then the Modified gain ratio was calculated. T. test for independent samples was utilized to compare the averages of the adjusted earnings ratio of the two groups, to see if these differences were statistically significant.

Comment[Author26]: A t-test seems appropriate to use here.

Table 3.

According to the previous table, the value of (T) for the variance in adjusted earning percentages for the procedural definition skill scores of the students in the two experimental groups was (4.740). Students in the first group had an average grade of (13.42), while those in the second group received an average grade of (11.02). That is, there are statistically significant differences among the two groups regarding the procedural definition skill in favor of the first group (higher on average). These differences ($p = 0.013 < 0.05$) indicate that the average adjusted earnings ratio of learners in the first group (who studied the course via virtual classes with the use of advance organizers) was higher than the average adjusted earnings ratio of learners in the second group (who studied the course through virtual classes without the use of advance organizers). Therefore, it can be strongly claimed that utilize of advance organizers in the virtual classroom had an impact on the procedural identification skill development of the learners enrolled in the course of "Research Project".

Comment[Author27]: Nice and clear interpretation of the results.

According to the previous table also, the value of (T) for the variance in adjusted earning percentages for the identifying and controlling variables skills scores of the students in the two experimental groups was (5.948). The first group of students' average score was (14.21). While students in the second group received an average score of (11.63). That is, there are statistically significant differences among the two groups regarding the skill of identifying and controlling variables in favor of the first group. These differences ($p = 0.021 < 0.05$) show that students in the first group had an average adjusted earnings ratio that was higher than students were in the second group. Thus, it can be said that utilize of advance organizers in the virtual classes had an impact on developing the skill of identifying and controlling variables for students.

Comment[Author28]: Where do earnings come into it? Are you sure you don't mean to use a different term here?

According to the previous table also, the value of (T) for the variance in adjusted earning percentages for the formulating questions and hypotheses skill scores of the students in the two experimental groups was (6.9). Students in the first group received an average score of (18.02), while those in the second group received an average score of (15.16). That is, there are statistically significant differences among the two groups regarding the skill of formulating questions and hypotheses in favor of the first group. These differences ($p = 0.034 < 0.05$) show that students in the first group had an average adjusted earnings ratio that was higher than students were in the second group. Thus, it can be said that utilize of advance organizers in the virtual classes had an impact on developing the skill of formulating questions and hypotheses for students.

According to the previous table also, the value of (T) for the variance in adjusted earning percentages for the skill of procedures and experimentation scores of the students in the two experimental groups was (5.4). Students in the first group received an average score of (17.06), while those in the second group received an average score of (14.70). That is, there are statistically significant differences among the two groups regarding the skill of procedures and experimentation in favor of the first group. These disparities ($p = 0.046 < 0.05$) show that students in the first group had an average adjusted earnings ratio that was higher than students were in the second group. Therefore, it can be said that utilize of advance organizers in the virtual classroom had an impact on the development of learners' procedures and experimentation skills.

Besides, according to the previous table, the value of (T) for the variance in adjusted earning percentages for the interpreting the results skill scores of the students in the two experimental groups was (3.457). Students in the first group scored an average of (11.49), while those in the second group scored an average of (10.09). That is, there are statistically significant differences among the two groups regarding the skill of interpreting the results in favor of the first group. These disparities ($p = 0.043 < 0.05$) show that students in the first group had an average adjusted earnings ratio that was higher than students were in the second group. Therefore, it can be said that utilize of advance organizers in the virtual classes had an impact on developing students' interpretation of results.

Comment[Author29]: These results would all be much stronger if they were related to specific hypotheses/RQs.

Finally, according to the previous table, the value of (T) for the variance in adjusted earning percentages for the scores of integrated science process skills as a whole of the students in the two experimental groups was (10.608). Students in the first group had an average grade of (74.19), while those in the second group received an average grade of (62.59). That is, there are statistically significant differences among the two groups regarding the skills of integrative science processes as a whole in favor of the first group. These differences ($p = 0.036 < 0.05$) show that students in the first group

had an average adjusted earnings ratio that was higher than students were in the second group. Therefore, it can be said that utilize of advance organizers in the virtual classes had an impact on the development of students' integrated science operations skills as a whole.

Discussion

The Integrative Science Processes skills of learners enrolled in the "Research Project" course were investigated. Where the results indicated that utilize of advance organizers in the virtual classes had an impact on the development of integrated science process skills and its main areas, namely procedural definition, identification and control of variables, questions and hypotheses, procedures and experimentation, and interpretation of results. The findings of the current research were consistent with those of earlier research that examined the effect of utilizing advance organizers on different learning outcomes. Among them is the study of Birabil [42], which found that the teaching strategy based on advance organizers improved the academic achievement of students. Advance organizers have also greatly enhanced retention. The research by Babaei, Izadpanah [43] also indicated the effectiveness of advance organizers in improving students' listening comprehension. Also the research of Van der Meij [16], which confirmed the effectiveness of advance organizers included in educational videos in developing students' programming skills. Nevisi, Hosseinpur [44] also confirmed the effectiveness of advance organizers in developing learners' ability to write an English abstract. This is additionally to the study of Susan and Oche [45], which in turn confirmed the impact of advance organizers on the development of students' attitude towards biology.

Comment[Author30]: Good discussion here within the context of the literature.

The effectiveness of many other methods and strategies in developing the skills of integrative science operations has also been verified. As in the research of Sharma [40], which confirmed the effectiveness of the seven-stage educational model 7E in developing the skills of integrative science operations for ninth grade students. In addition to the Harahap, Nasution [46] study, which supported the efficacy of the blended learning approach in fostering science operations abilities during plant tissue culture. Additionally, research by Prayitno, Corebima [47] also confirmed the inquiry-based, learning effectiveness on developing science process skills for seventh grade students.

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Recommendations

- Training faculty members on the skills of employing advance organizers in virtual classrooms.
- Using other technology products to develop the skills of integrated science processes among learners.
- Carrying out similar studies in other departments where boys and girls are allowed to enroll, to confirm the success of using advance organizers in virtual classes in other environments.
- Conducting studies to reveal the impact of other methods and strategies on developing the skills of integrative science operations during exceptional global circumstances.

Comment[Author31]: More discussion is required before you arrive at these recommendations. You may think it's obvious that the results should entail these recommendations but you need to connect the dots for the reader.

Conclusion

The current study aimed to identify the impact of advance organizers in virtual classrooms on the development of the skills of integrated science operations at the time of disasters. The Card of Integrated Science Processes Skills Assessment was utilized as a tool to accomplish the aim of this study. The findings indicated that the use of advance organizers in the virtual classes had an impact on the development of the skills axes of integrative science operations (procedural definition, identification and control of variables, questions and hypotheses, procedures and experimentation, and interpretation of results), and on the skills of integrative science operations as a whole. Research importance is benefit from the digital transformation of the educational process in the face of disasters and epidemics that our societies may be exposed to at any time. Besides, keeping pace with technological progress in the educational field, thus contributing to the optimal employment of e-learning systems in university education. Additionally, developing the skills of integrative science processes in the "research project" course for master's students in vocational education techniques.

Comment[Author32]: Try and vary the wording of this farther away from that of your abstract.

Comment[Author33]: These concluding sentences are worded poorly and don't really summarise what the study is saying. Think about its contributions and why these are significant.

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