Original Article
ISSN (Online): 2350-0530
ISSN (Print): 2394-3629

International Journal of Research - GRANTHAALAYAH
May 2021 9(5), 86–103

SCIENCE AND MATH EDUCATORS AND THEIR STUDENTS' PERCEPTIONS OF ONLINE TEACHING AND LEARNING: CASE OF THE LEBANESE UNIVERSITY

Eman Shaaban[1]

[1]Faculty of Education, Lebanese University, Lebanon

Received 1 May 2021
Revised 20 May 2021
Published 31 May 2021

Corresponding Author
Eman Shaaban, eman_shaaban19@hotmail.com

DOI 10.29121/granthaalayah.v9.i5.2021.3918

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

This study investigated the perceptions of science and math educators and their students at the Lebanese University related to online teaching and learning during the Covid-19 lockdown. For this purpose, two questionnaires were elaborated and validated based on two theoretical frameworks: The Community of inquiry for online learning environments and the Online collaborative learning theory. 35 educators (14 math and 21 science) and 245 students (109 math and 136 science) participated. Results showed that both science and math educators, with no significant difference between them, adjusted their courses for online teaching utilizing new resources shared with students. Online teaching allowed them to create an interactive community that encouraged students to explore concepts, construct explanations, apply and reflect on their learning. Both science and math students agreed that online learning enabled them to be more independent to explore new ideas and reflect on them with the instructor playing the role of a tutor rather than a knowledge transformer. The findings imply that online environment can allow active learning, and can provide the opportunity for students to acquire skills like, problem solving, critical thinking and collaboration. Further research is recommended related to critical thinking in online environment.

Keywords: Online Teaching and Learning, Community of Inquiry, Online Collaborative Learning, Perception

1. INTRODUCTION

Due to COVID-19 pandemic, higher education institutions canceled all face-to-face classes and shifted to online learning Carrillo and Flores (2020). Online learning is a subset of distance education and embraces a wide set of technology applications and learning processes including: e-learning, computer-based learning, web-based learning, and virtual classrooms. Before the pandemic a large number of colleges and universities across the United States were transitioning traditional face-to-face classes into fully online, blended, or web-facilitated courses Keengwe and Kidd (2010). Blended learning is a learning which combines online and face-to-face approaches. Within blended and online learning, we should look at the opportunities technologies provide for transformational education enabling deep learning. Research is required to investigate how educators working in blended courses might take advantage of the technology tools and infrastructure to develop educational experiences which promote connection, communication, collaboration, and critical thinking in addition to a deeper understanding of key concepts Kim et al. (2015). However, the shift to blending face-to-face and online learning requires the development of new strategic plans, goals, objectives, and methods. The explosive growth of online learning in higher education necessitates guidelines for online educators Martin et al. (2019).

The Lebanese University (LU) is the only governmental university that gives almost free higher education to Lebanese citizens in several areas. The concept of virtual universities, distance education, and blended Learning did not exist in Lebanon before COVID-19 lockdown. The authorization of distance learning or online learning programs is not granted by the Ministry of Education and Higher Education (MEHE). In the present system of the Lebanese University teaching is mainly done in the traditional classroom where lectures are delivered to a large audience with hardly any communication taking place between educators and their students El-Husseini and Taha (2017). Blended learning can be a solution to the Lebanese University's problems, academic and national. When the university closes for whatever reason, students can still take the initiative and exploit their time in learning their subjects on their own time and pace and in the best way that suits their learning styles.

After the total lockdown at the end of February 2020, MEHE in Lebanon decided to resume the academic year 2019-2020 through online learning. Similarly, the president of the Lebanese University declared that all faculties should shift to online learning starting from 23 March, 2020 using mainly the platform Microsoft teams. Lebanese University educators and students found themselves obliged to cope with online teaching and learning regardless of their readiness, attitude, experience, background, interest, expectations, etc…

1.1 THEORETICAL FRAMEWORK

For the purpose of this research a new model was elaborated integrating two basic theoretical frameworks: The Community of inquiry (CoI) for online learning environments developed by Garrison et al. (1999); and the Online collaborative learning (OCL) theory proposed by Linda Harasim (2012). Community of inquiry CoI model is one of the most popular models for blended and online courses that are designed as active learning environment where learning occurs through the interaction among three elements: social, cognitive, and teaching presence Garrison and

Arbaugh (2007). Although social and cognitive presences are required, the creation of a learning community can occur only through effective teaching presence. Teaching presence (what the teacher does) may have a significant impact on cognitive presence (level of student thinking and understanding) but it has yet to be empirically demonstrated Garrison et al. (2010). Garrison and Cleveland-Innes (2005) suggested that the role of teaching presence is significant in the development of critical thinking and knowledge construction through dialogue. Social presence is the ability of learners to integrate themselves affectively in the learning community, and to project their personal characteristics into the community of inquiry Rourke et al. (2001). In this study educators' and students' perceptions of teaching presence and cognitive presence in online environment was investigated.

Teaching presence is the work of the teacher before, during, and after the course. Before the course commences the teacher, acting as instructional designer, plans and prepares the course of studies, during the course the instructor facilitates the discourse and provides direct instruction when required, and after the course the instructor implements various forms of assessment and reflection. Usually a formal distance education course consists of much more than dialogue between and among teacher and students and includes course readings, web explorations, exercises, and collaborative projects Anderson et al. (2001). Teaching presence requires the instructor to focus on the learner, the learning materials, and the content. Garrison and Arbaugh (2007) stressed that instructors should master both content and pedagogy. According to Garrison et al. (1999) teaching presence has three categories: design and organization, facilitating discourse, and direct instruction. Each category includes the following indicators:

- Indicators for design and organization: Setting curriculum; designing methods; establishing interaction; making macro-level comments about course content; setting parameters for the inquiry.
- Indicators for facilitating discourse: Seeking to reach consensus/understanding; encouraging, acknowledging, or reinforcing student contributions; setting climate for learning; prompting discussion; assessing the efficacy of the process.
- Indicators for direct instruction: Presenting content/questions; summing up discussions; confirming understanding through assessment and explanatory feedback; responding to technical concerns; providing steps to solutions.

On the other hand, cognitive presence is defined as the extent to which learners are able to construct and confirm meaning through continuous reflection in a critical community of inquiry Garrison et al. (1999). Cognitive presence is the key element in critical thinking Kanuka and Garrison (2004). And the development of critical thinking is an important rationale for higher education Hidayati and Sinaga (2019). According to Redmond (2011) teaching presence can be found in a range of places beyond online discussion, it does change over time, and it can impact on students' cognitive presence and critical thinking in a course. Cognitive presence was more elaborated by the Practical Inquiry (PI) model Garrison et al. (2001). This model described the process of developing cognitive presence in four phases: Triggering event, exploration, integration, and resolution. Triggering event is the initiating stage, where students are engaged in an attempt to locate and describe the problem. The second phase focuses on understanding the nature of the problem where students explore various resources searching for relevant information to generate possible explanations or solutions. In exploration students do not identify the relationships among information. In the third phase students start to make sense of the information by identifying relationships and constructing meanings. The fourth phase is a testing phase for the effectiveness of a solution/hypothesis in the real world. Each category includes the following indicators:

- Triggering event: Sense of puzzlement by asking questions; describing and stating the problem.
- Exploration: Brain storming, search for insights, and exchange of information.
- Integration: Connecting ideas, computations, justifying, comparing, contrasting, logical reasoning, elaborating, or explaining, and creating solutions.
- Resolution: Achieving solution, analyzing solution, testing solution, implementation through observation or experimentation.

In the elaborated model for this research we added reflection as an indicator in the resolution phase which includes reflection on the learning outcomes and reflection on the learning processes Redmond (2011). The term reflection does not appear within the categories or indicators of the practical inquiry model. However, there are many elements of cognitive presence that are associated with reflection: reflective reading, reflective questioning, and reflective discussion including attentive listening.

The second model adapted is the Online Collaborative Learning (OCL) model proposed by Linda Harasim (2012) that focuses on the facilities of the Internet to provide learning environments that foster collaboration and knowledge building. OCL is a form of constructivist teaching that takes the form of instructor-led group learning online. In OCL, students are encouraged to collaboratively solve problems through discourse instead of remembering correct answers. The teacher plays a crucial role as a facilitator as well as a member of the knowledge community under study. According to Harasim, there exist three phases of knowledge construction through discourse in a group:

- Idea generating: the brainstorming phase where divergent thoughts are gathered.
- Idea organizing: the phase where ideas are compared, analyzed and sorted through discussion and argument.
- Intellectual convergence: the phase where intellectual synthesis and consensus occur, including agreeing to disagree, usually through an assignment, essay, or other joint piece of work.

Harasim believes that the teacher is critical to this knowledge construction, not only through facilitating the process and providing resources to the group, but also through ensuring that the core concepts and practices of the subject domain are fully integrated. The teacher is here understood to be a representative of the knowledge community or subject domain under study.

According to the new elaborated model for online teaching and learning represented in Figure 1 the courses are considered as learning communities based on the interaction between three constructs: teaching presence, cognitive presence, and collaborative activities, in addition to the assessment tools used.

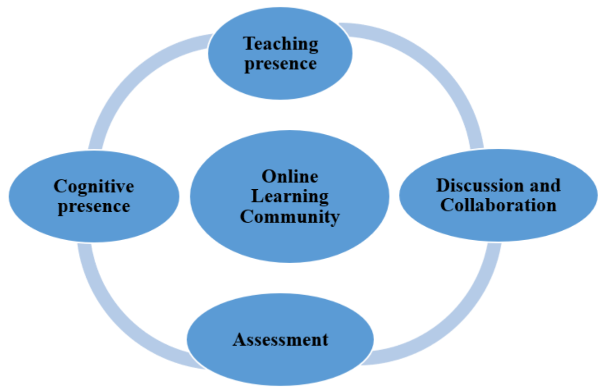

Figure 1 Elaborated Model for OnlineTeaching and Learning

1.2 SIGNIFICANCE OF THE STUDY

In the Lebanese University context, instructors were forced to deliver their courses online without any preparation. The online environment was a new experience for both instructors and students. Research is required to investigate the perceptions of both instructors and their students about their experience. The findings of this study will explore the essential elements of online higher education teaching and learning experience based on the two theoretical frameworks.

1.3 PURPOSE

The purpose of this research was to investigate the perceptions of science and math educators and their students at the Lebanese University, faculty of education related to online teaching and learning. The research addressed the following questions:

1. What are the science and math educators' perceptions- at the faculty of education of Lebanese University- of online teaching and learning related to teaching presence, cognitive presence, collaborative activities and assessments? How do perceptions of math and science educators compare?
2. What are the science and math students' perception- at the faculty of education of Lebanese University- of online teaching and learning related to teaching

presence, cognitive presence, collaborative activities and assessments? How do perceptions of science and math students compare?

2. MATERIALS AND METHODS

In this research a quantitative approach was implemented using a descriptive design to investigate the perceptions of science and math educators and their students at the Lebanese University, faculty of education, towards online teaching and learning during the quarantine due to COVID-19. More precisely, this study focused on determining educators and students' perceptions related to teaching presence, cognitive presence, collaborative activity and assessment methods used.

2.1 PARTICIPANTS

The participants of this study were the faculty of education members of the science department at the Lebanese University in the first, second, and Deanery branch. In addition, both undergraduate and graduate, French and English educated students / pre-service teachers with science and math as major or minor participated in the study. A total of 35 educators: 14 math educators and 21 science educators, and 245 students: 109 math students and 136 science students which constitutes around 60 % of the total population at this faculty participated in the study.

2.2 ETHICAL ISSUES

The participant educators voluntarily and anonymously answered the questionnaire that was sent by e-mail for all faculty members explaining the purpose of the research. Similarly, the student voluntarily and anonymously answered the google form of the questionnaire sent to them via whatsapp groups. Instructions were given to students to answer the questionnaire based on their general experience during online teaching and not on a specific course or instructor. If students were to respond while having in mind one course only, they would be directed to evaluate the instructor which is not the aim of this study.

2.3 DATA COLLECTION TOOLS

Two questionnaires for educators and students were constructed, validated by several tests, and piloted by a collaborative work among three researchers, two math educators and one science educator at the faculty of education, Lebanese University Shehayeb et al. (n.d.).

The items were designed to take into consideration students' perceptions about their experience and instructors' perceptions about their experience and readiness based on their online teaching Linjawi and Alfadda (2018). The two questionnaires constituted of five parts with similar items for comparative purpose:

1. Demographic information: gender, certificate, major/specialty, class standing/teaching experience, language
2. Technology skills: Technology skills, obstacles and e-learning experience
3. Perception measurement items: for teaching presence (10 items for instructor's questionnaire and 7 items for students' questionnaire), cognitive presence (16 items for the instructors' questionnaire and 15 items for the students' questionnaires) and collaboration (5 items for instructors' questionnaire and 4 items for students' questionnaire).
4. Assessment methods used
5. Reflection on the online teaching/ learning experience

A four point Likert scale was used for the perception measurement items mainly because they can be evenly split into simple dichotomies: Agree and Disagree. Each item was ranked from one to four in the following way: 1 = strongly disagree; 2 = disagree; 3 = agree and 4 = strongly agree. For the assessment methods and the reflection on online teaching / learning experience Checkboxes question were used in order to allow the participants to select multiple answers from a list of choices.

The data was collected from the online questionnaires prepared as Google Form through Excel Spreadsheets. The researcher later on imported that data into the Statistical Package for the Social Sciences (SPSS) and used descriptive and inferential analysis.

3. RESULTS AND DISCUSSIONS

3.1 PARTICIPANTS' PROFILE

The educators who participated in this study had the following profile: 34% females compared to 66% males; 40% math educators compared to 60% science educators; 71.5% assistant professors compared to 28.5% professors; 3% with teaching experience for less than 5 years, 31% between 5 and 10 years and 66% more than 10 years. Related to technology proficiency, 43% declared that they are not good in technology, 54% are good and only 3% are very good; 40% use video conferencing always compared to 60% that use it sometimes or rarely.

On the other hand, the majority of the participant students were females (96%) distributed as follows: 68% undergraduate and 32% graduate; 55.5 % studying science 44.5 % studying math; 33.5% first year; 26.1% 2^{nd}year; 40.4 % 3^{rd} year; 48.6 % studying in French and 51.4 % studying in English.

3.2 PARTICIPANTS' PERCEPTIONS OF TEACHING PRESENCE

When it comes to perceptions, the answers were split into simple dichotomies: Agree and Disagree. Frequencies and percentages were calculated for all the items related to the three constructs based on the new model elaborated in the theoretical framework: Teaching presence; cognitive presence; and collaboration. In addition, Chi-square t- test was performed to determine any significant association between the independent variable teaching specialty/ major (science or math) and the dependent variable perceptions; and when the number of cells were below 5, Fisher exact t-test was performed.

The frequencies of the answers of math and science educators related to the items of teaching presence are presented in Table 1 .

Table 1 Educators' Perceptions about Teaching Presence (Frequency)

Items of Teaching Presence		Agree	Disagree
Course content should be adjusted	Math	14	0
	Science	21	0
New resources should be considered	Math	14	0
	Science	20	1
Course documents should be uploaded	Math	14	0
	Science	21	0
Course objectives should be shared with students	Math	14	0
	Science	21	0
Instructor can encourage students to explore new concepts	Math	14	2
	Science	21	0
The instructor can provide feedback on time	Math	11	3
	Science	20	1
Instructor can discuss assignments	Math	14	0
	Science	20	1
Instructor can trigger students to reflect on fundamental concepts	Math	11	3
	Science	21	0
Instructor can call up for students during the session	Math	13	1
	Science	21	0
Instructor can post assignments on the platform or using other media	Math	14	0
	Science	21	0

The data showed that the majority of science and math educators agreed that online teaching requires course adjustment (100%), elaboration of new resources (97.1%), and sharing of online documents with students (100%). They also agreed that online teaching allowed them to encourage students to explore (94.2 %) and reflect on new concepts (91.5%). In addition, they believed that online teaching enabled them to post assignments (100%) discuss them (97.2%) with their students and give them direct feedback (88.5%). For the items: course content should be adjusted; course documents should be uploaded; and instructors can pose assignments on platform or using other media, all participants answered agree (100%

agree and 0% disagree). So, there is no more a contingency two by two table (two columns with 0), consequently Chi square t-test cannot be performed for these items. So, both math and science educators believed that courses should be adjusted by adding new resources and references to fit online teaching and learning. On the other hand, statistical tests showed no significant differences between math and science educators related to the remaining items of the teaching presence. Thus, we infer that there is no significant association between teaching specialty (math or science) and educators' perceptions related to teaching presence.

Table 2 Students' Perceptions about Teaching Presence (Frequency)

Items of Teaching Presence		Agree	Disagree
Course content are adjusted to fit the online teaching	Math	81	28
	Science	101	35
The ideas/topics are clearly communicated	Math	89	20
	Science	120	16
Students are encouraged to explore new concepts	Math	76	33
	Science	100	36
Students receive instant feedback on their work	Math	77	32
	Science	105	31
Students receive constructive feedback on their work	Math	86	23
	Science	113	23
Students are asked to answer questions during the online sessions	Math	96	13
	Science	128	8
Assignments are posted on the platform or sent on other media when needed	Math	104	5
	Science	130	6

With respect to students' perception, the results presented in Table 2 showed that more than 70% of the students agreed on the teaching presence indicators. They agreed that the course content was adjusted to fit online teaching (74.2%), ideas were clearly communicated by their instructors (85.3%), and they were encouraged by their instructors to explore new ideas (71.8%). They received instant (74.2%) and constructive (81.2 %) feedback on their assignments that are posted on Microsoft Teams or on other media. 91.4% agreed that they were asked questions during online sessions, and 95.5% agreed that assignments were posted by instructors on Microsoft teams or other media. Statistical tests showed no significant difference between math and science students related to the items of teaching presence. Thus, we infer that there is no significant association between students' major and their perceptions about teaching presence.

3.3 PARTICIPANTS' PERCEPTIONS OF COGNITIVE PRESENCE

Table 3 Instructors' Perceptions about Cognitive Presence Related to theTriggering and Exploration Phases (Frequency)

Items of cognitive Presence		Agree	Disagree
Instructor can design activities/ assignments to trigger students' curiosity	Math	13	1
	Science	21	0
Instructor can design problem situation that leads to students' cognitive conflict	Math	13	1
	Science	20	1
Instructor can use brainstorming	Math	11	3
	Science	18	3
Instructor can use discussion as a teaching strategy	Math	12	2
	Science	21	0
Instructor can use the inquiry method as a teaching strategy	Math	12	2
	Science	20	1
Instructor can deliver the course through the lecturing method only	Math	2	12
	Science	2	19
Instructor can pose problems that need variety of information sources to be solved	Math	12	2
	Science	21	0
Instructor can help students appreciate different perspectives	Math	12	2
	Science	21	0
Instructor can help students relieve their misconceptions	Math	14	0
	Science	21	1

The data collected based on the answers of the math and science educators to the items related to cognitive presence are presented in Table 3 and Table 4 (Frequencies). The analysis of answers related to the triggering and exploration phases (Table 3) showed that almost all the participant educators (97.1%) both math and science agreed that they can design assignments/ activities and problem situations that can be implemented online in order to trigger students' curiosity and place them in cognitive conflict. This represents the triggering phase of the cognitive presence. Moreover, the majority of participant educators agreed that they can use brain storming (82.8% of both math and science educators); discussion (100% for science educators and 85.7% for math educators); inquiry method (95.2% for science educators and 85.7% for math educators); and the majority disagreed that online courses can be delivered by lecturing only (90.5% for science educators and 85.7% for math educators). In addition, all science educators (100%) and the majority of math educators (85.7%) agreed that during online teaching they can pose problems that need variety of information sources to be solved, this can help students appreciate different

Table 4 Instructors' Perceptions about Cognitive Presence Related to theIntegration and Resolution Phases (Frequency)

Items of cognitive Presence		Agree	Disagree
Instructor can urge students to combine information to solve the problem	Math	13	1
	Science	21	0
Instructor can design activities to urge students to construct explanations/ solutions	Math	13	1
	Science	21	0
Instructor can provide the opportunity for students to make judgement on the procedure utilized in solving problems	Math	13	1
	Science	19	2
Instructor can provide the opportunity for students to practice reflection	Math	13	1
	Science	21	0
Instructor can provide the opportunity for students to apply the knowledge constructed	Math	12	2
	Science	21	0
Instructor can provide the opportunity for students to describe ways to test the knowledge constructed	Math	11	3
	Science	21	0
Instructor urges students to defend the procedure used	Math	13	1
	Science	21	0

perspectives. This represents the exploration phase of cognitive presence.

Moreover, the analysis of answers related to the integration and resolution phases (Table 4) showed that all science educators (100%) and the majority of math educators (92.8%) agreed that online teaching enabled them to urge students to combine information to solve problems and to construct explanations/ solutions to the problems posed by the activities/ assignments designed by them. This represents the integration phase of the cognitive presence. Moving to the phase of judging, defending, application, and reflection (the resolution phase of cognitive presence): the majority of both math and science educators (91. 4%) agreed that online teaching can provide the opportunity for students to make judgement on the procedure used in solving problems; describe the ways to test the constructed knowledge (100% for science educators and 78.6% for math educators); defend the procedure used to solve problems or construct new knowledge (100% for science educators and 92.8% for math educators; apply the knowledge constructed (100% for science educators and 85.7% for math educators); and practice reflection of the procedure and the process of knowledge constructed (100% for science educators and 92.8 % for math educators). This indicates that the math and science educators who participated in this study, believed that online teaching can allow them to engage students in the learning community, implement student centered teaching strategies giving the opportunity for students to explore, relate, exchange and connect information. In addition, students can construct explanations, describe and defend the process of construction, apply and reflect on their practices in an online environment.

However, despite the slight differences between the answers of math and science educators, the Chi-square t-test or Fisher exact t-test shows no significant difference, with p values >> 0.05, for all the items related to the cognitive presence. Thus, we infer that there is no significant association between the teaching specialty (math or science) and the perceptions related to cognitive presence.

Table 5 Students' Perceptions about Cognitive PresenceRelated to theTriggering and Exploration Phases (Frequency)

Items of cognitive Presence		Agree	Disagree
Questions are posed to allow the students to explore the course content	Math	88	21
	Science	122	14
The students are encouraged to search for references others than those sent by the instructor	Math	83	26
	Science	100	36
Discussions are implemented during online sessions	Math	95	14
	Science	122	14
Inquiry method is implemented during online sessions	Math	83	26
	Science	94	42
Lecturing is implemented during online sessions	Math	22	87
	Science	31	105
Course activities trigger the students' curiosity	Math	69	40
	Science	85	51
The students' misconceptions are identified	Math	68	41
	Science	96	40
Brainstorming is utilized during online sessions	Math	64	45
	Science	92	44

On the other hand, math and science students' perceptions related to cognitive presence are illustrated in Table 5 and Table 6 (Frequencies). The analysis of the answers related to the triggering and exploration phases (Table 5) showed that the majority of students agreed that "questions were posed" during online sessions in order to allow them to explore course content (89.7% for science students and 80.7% for math students), with a statistically significant difference in favor of science students (p= 0.039). This can be due to the empirical nature of science that necessitate defining problems in terms of questions to be answered while students are exploring information. In addition, 76.1% of the math students and 73.5% of the science students agree that they were encouraged to search for references other than those sent by the instructor. However, 37.1% of the students disagree that the course activities implemented during online sessions triggered their curiosity. This can be due to the lack of instructors' experience of online teaching. The majority of participant students agreed that during online sessions their instructors implemented: discussion (89.7% for science students and 87.1% for math students); inquiry method (69.1% for science students and 76.1% for math students, with a significant difference in favor of math students, p=0.021). This can be due to the fact that instructors tried to implement the inquiry method in math teaching online to engage the students in exploring the course concepts. The majority of students disagree that online sessions were delivered by lecturing only (90.5% for science educators and 85.7% for math educators). This underlines the implementation of various online teaching methods. 36.3% of students disagree that brainstorming was implemented during online sessions.

Table 6 Students'Perceptions about Cognitive Presence Related to the Integration and Resolution-Phases (Frequency)

Items of cognitive Presence		**Agree**	**Disagree**
Learning activities urge the students to	Math	74	35
	Science	111	25
The students are encouraged to reflect on	Math	70	39
	Science	99	37
The students are encouraged to test their constructed knowledge	Math	73	36
	Science	98	38
The students are capable of applying the constructed knowledge	Math	81	28
	Science	95	41
The students are encouraged to justify the procedure used during learning activities	Math	77	32
	Science	96	40
Students challenge themselves and others	Math	81	28
	Science	89	47
Students have the opportunity to make judgement about the strategy utilized in solving problems	Math	77	32
	Science	96	40

Similarly, the analysis of the answers related to the integration and resolution phases (Table 6) showed that students agreed that the learning activities implemented during online sessions urged them to construct explanations/ solutions (81.6% for science students and 67.8% for math students) with a significant difference in favor of science students (p= 0.04). This is due to the inquiry nature of science which requires the connection between ideas to construct explanations. Moving to the phase of judging, defending, application, and reflection (the resolution phase of cognitive presence). 70.6 % of both math and science students agree that they were given the opportunity to make judgement about the strategy utilized in solving problems, and were encouraged to justify the procedure used during learning activities. 72.0% of science students and 66.9% of math student participants agree that they were encouraged to test their constructed knowledge; 69.8% of science students and 74.3% of math students believed that they were capable of applying their constructed knowledge. 72.7% of science students compared to 64.2% of math students agreed that they were encouraged to reflect on the course content, with a statistically significant difference in favor of science students (p= 0.002). Again this is due to investigative nature of science that requires more reflection on the process of learning.

Statistical tests showed significant difference between math and science students related to certain items of the cognitive presence: questions posed during online sessions (triggering phase); implementation of inquiry method (exploration); construction of explanations and solutions (integration phase); and reflection on course content (resolution phase). Thus, there is an association between students' major and their perceptions related to these four indicators of cognitive presence mainly in favor of science students. This can be due to the fact that science and math students' academic experience is different depending on the nature of each subject. Science is derived from, and guided by, observation or experiment Folino (2001). This also conforms with Shi and Wang (2017) that found some differences in the views between science and math students related to observation and inference dimensions.

3.4 PARTICIPANTS PERCEPTIONS RELATED TO COLLABORATION

Regarding the participants' perception about collaboration in online environment, the results presented in Table 7 showed that the majority of math and science educators (94.3%) agreed that online teaching allows them to collaborate with colleagues to adjust their course content, and give the opportunity for students to exchange ideas with their peers and support each other. 88.5% of the educators believe that they can collaborate with their students to adjust the course content for online teaching. In addition, 100% of science educators much more than math educators (71.4%) believe that they can reinforce collaborative learning, with a significant statistical difference in favor of science educators (p=0.032). This indicates a significant association between teaching specialty and the perceptions related to collaborative learning. This can be due to the experimental nature of most science activities and projects that require more collaboration between instructors and students and between students themselves. Thus, the participant educators that represent the faculty members of the scientific department at the Lebanese University, faculty of education, agreed that online environment can provide the opportunity of collaboration between them and their students in addition to collaboration among students.

Table 7 Educators' Perceptions about Collaborative Activities during Online Teachingand Learning (Frequency)

Items of Collaboration		Agree	Disagree
Instructor can collaborate with colleagues to adjust the course content for online teaching	Math	12	2
	Science	21	0
Instructor can collaborate with students to adjust the course content for online teaching	Math	11	3
	Science	20	1
Instructor can reinforce collaborative learning	Math	10	4
	Science	21	0
Instructor can provide the opportunity for students to support their peers and ask for support when needed	Math	13	1
	Science	20	1
Instructor can provide the opportunity for students to exchange ideas with their peers	Math	13	1
	Science	20	1

Table 8 students' Perceptions about Collaborative Activities during Online Teaching and Learning (Frequency)

Items of Collaboration		Agree	Disagree
Students provide support for their peers and ask for support when needed	Math	94	15
	Science	119	17
Working in small groups help students	Math	91	18
	Science	122	14
Students have the opportunity to exchange ideas with their peers	Math	93	16
	Science	131	5
Team work is emphasized	Math	86	23
	Science	110	26

Similarly, as presented in Table 8 the majority of participant students believed that online learning environment allowed them to work in groups (86.9%), support each other (86.9%), exchange ideas (91.4%) and work as a team (80.0%) to solve problems faced as presented in Table 8. The only item that shows significant difference between math and science students is about giving the opportunity for students to exchange ideas with their peers in favor of science teachers (p=0.021). This can be due to the fact that science activities favor exchange of ideas.

Thus, students agreed with their instructors that online environment favored teamwork and enhanced collaboration. This is in agreement with a study done on utilizing WhatsApp in teaching mathematics in a digital learning environment, where students highlighted the importance and the necessity of the students-teacher online interaction and collaboration Rouadi and Anouti (2020).

3.5 PARTICIPANTS' PERCEPTIONS RELATED TO ASSESSMENT

All participants (educators and students) mentioned a variety of assessment methods used during online teaching and learning like: Google Form quizzes (37.1% of educators and 35.9% of students); Microsoft Form quizzes (34.2% of educators and 28.1% of students); presentations (85.7% of educators and 88.2% of students); assignments (77.1% of educators and 84.5% of students); and projects (88.6% of educators and 93.9% of students). This indicates that projects and assignments done by students and presentations of their work were the main assessment tools used during online teaching and learning.

4. CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to explore the perceptions of science and math educators and their students about online teaching/learning experience during the COVID-19 lockdown.

Concerning the first question of research, both science and math educators, with no significant difference between them, emphasized that online teaching allowed them to create an interactive community that encouraged students to explore concepts in collaboration with their colleagues based on assignments and projects. This is in congruence with the theory of practice of online learning by Anderson (2008) which stressed that online environment allows learners to actively create their knowledge in a personally relevant and meaningful manner. Thus, the pedagogical approach underlying online learning is based on constructivism.

Moreover, the findings of this research fit with the study of Anderson et al. (2001) highlighting that online teaching requires course adjustment, new resources, discussions, assignments and projects mainly done by collaboration among students where the teacher plays the role of the facilitator.

Concerning the second question of the research, data analysis showed that math and science students believed that online learning allowed them to collaborate and support their peers to solve problems faced during assignments and projects that were mainly used to assess their work. According to participant students online learning enabled them to be more independent to explore course content, construct explanations, test, apply, and reflect on them.

On the other hand, the alignment between the items of the educators' and students' questionnaires showed that both of them agreed that the online learning environment provided the opportunity for learners to go through the process of constructing knowledge, inquiring, exploring, solving problems, and thinking critically. This is in agreement with the practical inquiry model Garrison et al. (2001).

Moreover, they believed that collaborative activities and group projects along with other methods can be used to assess students' performance. Thus, online environment facilitated collaboration and allowed active learning. Similarly, several researches suggested that social networking can promote interaction between learners allowing them to share, exchange, discuss and create information and knowledge in a collaborative way Devi et al. (2019).

Thus, both educators and students at the faculty of education at the Lebanese University believed that online environment enhanced the learning process enabling students to acquire learning skills like: critical thinking, problem solving, reflection, communication, and collaboration in addition to knowledge. This is in agreement with the study of Campbell (2004) which argued that the emphasis of online learning in higher education settings is on the development of metacognitive as well as reflective and collaborative learning Keengwe and Kidd (2010).

Finally, based on our findings we recommend that blended and online learning should be considered in higher education in the future, especially in Lebanon. The challenge now is for faculty members to gain the appropriate skills necessary ito become effective online instructors Keengwe and Kidd (2010).

5. ACKNOWLEDGEMENTS

The author of this research is a member of a research team in the Educational Studies & Research Centre of the Faculty of Education at the Lebanese University. Special thanks for my colleague Dr. Sanaa Shehayeb, a math educator at the Lebanese University, for her technical support in data analysis.

REFERENCES

Anderson, T. (2008). The theory and practice of online learning.

Anderson, T., Rourke, L., Garrison, R., & Archer, W. (2001). Assessing teaching presence in a computer conferencing context. *Journal of Asynchronous Learning Networks*, *5*(2), 1–17.

Carrillo, C., & Flores, M. A. (2020). COVID-19 and teacher education: a literature review of online teaching and learning practices. *European Journal of Teacher Education*, *43*(4), 466–487. Retrieved from https://dx.doi.org/10.1080/02619768.2020.1821184 10.1080/02619768.2020.1821184

Devi, K., Gouthami, E., & Lakshmi, V. (2019). Role of social media in teaching - learning process. *Journal of Emerging Technologies and Innovative Research*, *6*(2), 96–103.

El-Husseini, A. A., & Taha, A. (2017). Blended learning: The possibilities of benefiting from others' experiences and problems of implementations at the Lebanese University. *International Journal of HIV/AIDS Prevention, Education and Behavioural Science*, *3*(6), 70–75.

Ferdig, R. E. (2007). Editorial: Examining social software in teacher education. *Journal of Technology and Teacher Education*, *15*(1), 5–10.

Folino, D. A. (2001). Stories and Anecdotes in the Chemistry Classroom. *Journal of Chemical Education*, *78*(12), 1615–1615. Retrieved from https://dx.doi.org/10.1021/ed078p1615 10.1021/ed078p1615

Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education. *The Internet and Higher Education*, *2*, 87–105. Retrieved from https://dx.doi.org/10.1016/s1096-7516(00)00016-6

10.1016/s1096-7516(00)00016-6

Garrison, D. R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education*, *15*(1), 7–23. Retrieved from https://dx.doi.org/10.1080/08923640109527071 10.1080/08923640109527071

Garrison, D. R., & Arbaugh, J. B. (2007). Researching the community of inquiry framework: Review, issues, and future directions. *The Internet and Higher Education*, *10*, 157–172. Retrieved from https://dx.doi.org/10.1016/j.iheduc.2007.04.001 10.1016/j.iheduc.2007.04.001

Garrison, D. R., & Cleveland-Innes, M. (2005). Facilitating Cognitive Presence in Online Learning: Interaction Is Not Enough. *American Journal of Distance Education*, *19*(3), 133–148. Retrieved from https://dx.doi.org/10.1207/s15389286ajde1903_2 10.1207/s15389286ajde1903_2

Garrison, D. R., Cleveland-Innes, M., & Fung, T. S. (2010). Exploring causal relationships among teaching, cognitive and social presence: Student perceptions of the community of inquiry framework. *The Internet and Higher Education*, *13*, 31–36. Retrieved from https://dx.doi.org/10.1016/j.iheduc.2009.10.002 10.1016/j.iheduc.2009.10.002

Harasim, L. (2012). Learning theory and online technologies. Routledge.

Hidayati, Y., & Sinaga, P. (2019). The profile of critical thinking skills students on science learning. *Journal of Physics: Conference Series*, *1402*(4), 044075–044075. Retrieved from https://dx.doi.org/10.1088/1742-6596/1402/4/044075 10.1088/1742-6596/1402/4/044075

Kanuka, H., & Garrison, D. R. (2004). Cognitive presence in online learning. *Journal of Computing in Higher Education*, *15*(2), 21–39. Retrieved from https://dx.doi.org/10.1007/bf02940928 10.1007/bf02940928

Keengwe, J., & Kidd, T. T. (2010). Towards best practices in online learning and teaching in higher education. *Journal of Online Learning and Teaching*, *6*(2), 533–541.

Kim, J. H., Baylen, D. M., Leh, A., & Lin, L. (2015). Blended Learning in Teacher Education: Uncovering its Transformative Potential for Teacher Preparation Programs. *Handbook of Research on Enhancing Teacher Education with Advanced Instructional Technologies*, 166–185.

Linjawi, A. I., & Alfadda, L. S. (2018). Students' perception, attitudes, and readiness toward online learning in dental education in Saudi Arabia: A cohort study. *Advances in Medical Education and Practice*, *9*, 855–863.

Martin, F., Budhrani, K., Kumar, S., & Ritzhaupt, A. (2019). Award-winning faculty online teaching practices: Roles and competencies. *Online Learning*, *23*, 184–205.

Redmond, P. (2011). *Exploring teaching and cognitive presence in blended learning: promoting pre-service teachers' critical thinking*. Australia.

Rouadi, N., & Anouti, M. (2020). Teaching counting in mathematics in a digital learning environment, a case study in a private school in Beirut. *International Journal of Advanced Research in Science, Engineering and Technology*, *7*(5), 13949–13970.

Rourke, L., Anderson, T., Garrison, R. D., & Archer, W. (2001). Assessing social presence in asynchronous, text-based computer conferencing. *Journal of Distance Education*, *14*(3), 51–70.

Shehayeb, S., Shaaban, E., & Haifa, N. (n.d.). Construction and validation of an instrument to explore instructors' and students' perceptions of online teaching.

Shi, W. Z., & Wang, J. (2017). Comparison on views of nature of science between math and physics students. *Journal of Baltic Science Education*, *16*(1), 77–77.