Teaching Research Methods for Computer Science Students using Virtual Learning: A Case Study

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Abstract: Research skills are crucial for education, and overall scientific prosperity. In Saudi Arabia, a gap exists in the research skills and knowledge necessary for higher education students. This paper highlights the current state of university curricula in terms of teaching scientific research skills and methods in Saudi Arabia. Also, it presents a low-cost learning model, called ASA research camp, that was applied to bridge the knowledge gap. This exhibits a virtual class that combine qualities of both VLEs and MOOCs. The course spanned three months in two phases: theoretical for listening and discussion, and practical for guided paper writing. Surveys show that the 200 participants had maximum learning value with minimal cost. Moreover, on finishing the course, the members of the practical part, 16 students, were able to publish three papers in Springer Lecture Notes in its Computer Science book series as a result of the guided paper writing phase.

1 INTRODUCTION

The trend towards online learning starting from virtual learning environments (VLEs) and advancing to massive open online courses (MOOCs) has recently expanded greatly. VLEs are systems such as Blackboard and Moodle used in the context of universities and other Higher Education Institutions. They are usually included with courses whose instructors are able to give feedback and directly mark up the papers of a limited number of students. In contrast, MOOCs are open educational systems that can be offered from universities but are independent and vast in terms of the student base. Examples of MOOCs are edX, Coursera, Udemy, and Udacity. Worldwide, MOOC courses are offered to thousands and hundreds of thousands of students. This raises the possibility of offering higher education to a wider base of students with minimum to no fees bridging the gap between privileged and disadvantaged learners (Kay et al., 2013; Zheng et al., 2015). MOOCs give students a great chance to learn from leaders and elite scientists directly. However, there are some issues related to it, such as a high dropout rate (Panagiotis Adamopoulos, n.d.; Zheng et al., 2015), or what Clow calls (Clow, 2013) the 'funnel of participation', starting with thousands of students and ending the course with only a few, resulting in a 5% passing rate in some cases (Kay et al., 2013).

Several studies were conducted to measure the effectiveness of virtual classes as opposed to traditional face-to-face classes. A marked study was done in King Abdulaziz University, Saudi Arabia (Al-Nuaim, 2012). The study shows that courses done by the Deanship of Distance Learning proved successful in terms of providing a comparable educational experience as opposed to traditional courses. Another study carried out on 122 students in a Greek university shows that the limited mobile access could affect using Moodle as an active learning tool rather than a document repository (Papadakis et al., 2017). This issue is not widely problematic in Saudi Arabia as the internet pentation rate is 93% (Simon Kemp, n.d.) and the mobile penetration is 126% (CITC, n.d.) as of 2020 and 2019 respectively. This is a success factor to the learning model we propose. In our learning model, we mix the VLE and MOOC styles. That is, we open the course to the public, but at the same time, we provide a chance for direct contact with instructors. In this case study, we will review the process and results of our virtual class (ASA Research Camp). The camp teaches and gives practice in scientific research

methods and skills for computer science college students.

This was motivated by the minimal exposure that students receive to scientific research methods and techniques in many universities in Saudi Arabia. This is evident from a review we conducted on the programs of 10 computing colleges in the largest Saudi universities in terms of enrolled students. These 10 computing colleges had a total of 35 computer majors. Each major contained an average of 40 courses in their programs. There were no courses dedicated to research methods and skills in 30 out of the 35 majors, and in the 5 remaining ones there was at most one course as shown in Table 1. The following universities are under consideration: King Faisal University (KFU), King Abdulaziz University (KAU), Al Imam Muhammad Ibn Saud Islamic University (IMSIU), Umm Al Qura University (UQU), Qassim Univesity (QU), Taif University (TU), Taibah University (TaibahU), King Khalid University (KKU), Jazan University (JazanU), King Saud University (KSU). In addition to the scarcity of courses focusing on scientific research, students rarely have opportunities to be mentored by experienced researchers, despite the importance of such opportunities in developing their research skills (Gonzalez, Cristina, n.d.). On this basis, the goals of the research camp are as follows:

1) promoting awareness of scientific research practices between college students; 2) sharing experiences between attendees and instructors; 3) providing an easily accessible learning experience from the premises and comfort of homes in the field of scientific research; 4) teaching scientific paper writing through direct mentoring and experiential learning. 5) providing a complete compressed course on scientific research concepts starting from idea selection, to paper writing, and ending with the paper's publication and presentation.

This paper sheds light on the research camp approach, organization and operation. The challenges experienced by the camp leaders are discussed. Finally, the reflections and conclusions are mentioned.

2 RESEARCH CAMP APPROACH

Through the implementation of the ASA research camp, we sought to answer the following research questions:

1) Would the camp successfully support learning the main scientific research concepts in a virtual learning environment?

Table 1: Number of Scientific Research Courses in the largest 10 Universities in Saudi Arabia.

University	# students	# Computer Majors	#Research courses in all Majors
KFU	161,204	4	0
KAU	156,505	3	0
IMSIU	107,609	4	1
UQU	102,237	4	1
QU	67,822	3	0
TU	61,138	3	0
TaibahU	57,744	3	0
KKU	56,466	4	2
JazanU	54,306	3	0
KSU	49,501	4	1
TOTAL		35	5

Table 2: Research Camp Timetable.

Time	Date	Phase	Levels
6:00-9:00 PM	1 Oct	Theory	Level 1: Introduction to scientific paper writing
9:00 PM	7 Oct		Proposal submission
6:00-9:00 PM	8 Oct		Level 2: Presentation techniques
6:00-9:00 PM	15 Oct	Practice	Level 3: Present accepted proposals
-	22 Oct - 30 Nov		Level 4: Guided paper writing
-	30 Nov		Submit paper for review

Table 3: Registration form questions.

Questions		
1. Arabic Full name	6. University	11. Did you read scientific papers before?
2. English Full name	7. Country	12. Did you write a scientific paper before?
3. Email	8. Level	13. Why join?
4. Mobile	9. Major	14. Your expectation
5. GPA	10. English Proficiency	15. I'm able to attend online on the specified dates and the information I provided here is correct.

2) Would the students be able to reach the goal of writing a research paper? In the following section, the camp organization and operation are explained.

2.1 Research Camp Organization

ASA stands for Arabic sentiment analysis and it is the name of the research group that held the camp, with the primary investigator being the camp leader and the first author of this paper. The research camp was organized into two administrative phases and four educational levels, Table 2. The administrative phases include advertisement and registration. The advertisement was done through a tweet from the ASA research group's Twitter account with more than 1,000 followers and through WhatsApp messaging. By the fourth day of announcing the camp, more than 200 applicants had applied. The registration form questions are listed in Table 3. The registered applicants were divided into two groups, campers and listeners. Campers attended and participated in all levels, whereas listeners attended the first two levels. Upon analysing the registration form, campers were selected according to several criteria related to their answers to questions 10-15. After finishing the camp levels and upon successful paper compilation, the campers submitted the paper for review and publication.

2.2 Research Camp Operation

The camp started with 200 virtual participants between listeners and campers. The participants were given a three-hour crash course on scientific research methods, including idea selection and scrutiny, and paper structure and writing. The course was facilitated by WebEx, a web conferencing tool. This tool offers different functions for students like rise hand for voice participation and asking questions, applause, and text chat for communicating issues like questions or comments. Those functions aid in the students' interaction and learning process. A more complex set of function and tools is offered to the course instructor those include application sharing, polls, break-out sessions for breaking students into smaller groups, and session recording and ending. In order to move to the next level, campers where asked to submit a research proposal or select one from the ideas presented to them and lead by the mentors, and in both cases, write a brief proposal around it. On level 2, essential presentation skills are described to help scientists and researchers who have excellent work but lack the ability to promote their projects. At the close of that session, listeners were thanked for attending, and given a feedback form to fill. Also, subgroups of participants, campers, were pulled out into separate virtual classrooms for a tentative proposal discussion and formation, each group with a senior researcher mentor. The work on the proposal continued asynchronously until the time of level 3, when each group had the chance to present its proposal. Next, each group had a separate meeting to setup the communication policy for the next two months. Meetings to write the paper were continued until the paper of each group was submitted to the publication venue.

3 RESEARCH CAMP ANALYSIS

The camp applicants were coming from four different countries, and from more than 10 universities. The majority are from Saudi Arabia, as shown in Figure 1. Also, applicants were graduates or studying in one of the universities shown in Figure 2 with the majority being from IMSIU. This was expected as the research group offering the camp is based in IMSIU. The applicants' educational backgrounds varied, with the majority (58%) still studying for their bachelor's or having earned it, while 42% were postgraduate students, Figure 3. The academic majors of applicants were mainly computer science (CS), at 47%. This was probable as the reach of advertisement was propagated dominantly by the research group members, who are mostly majoring in CS. Coming next was information systems (IS) at 33%, followed by 15% of the participants majoring in information technology (IT).

Ninety nine percent of the participants were female. This was understandable as the camp was organised and held by faculty from the female section, as all universities in Saudi Arabia are split into two mostly identical sections, males and females.

Also, this could be explained by the ease of attendance for female participants: at the time the camp was held, woman were not allowed to drive in Saudi Arabia, thus the online camp provided a rare chance to learn from home with no need to arrange suitable transportation to participate and attend. On analysing the feedback forms, the feedback we received was 90% highly positive on the first two levels that were presented to both listeners and campers, Table 4.

The levels were satisfactory to most of the participants. This could be explained as listeners and campers were offered rich information in an open discussion manner.

Table 4: Part of the feedback messages.

- thank you, I rarely find someone to guide and mentor me closely.
- Great start! I've learned more than what I expected. Thank you so much.
- I learned many things such as how to motivate myself, steps to write a paper, how to know the best journals.
- I learned the basics of academic writing, publishing venues and evaluating them, how to go about exploring a research problem.
- all the course content is excellent and important.
- this course gave a push to endure research problems and made me realise that I'm not alone in that.

Presenting them a rare chance to ask and interact with experienced researchers with no cost at all. Even the cost of attending a real class in terms of transportation and time was deducted. Delivering the course in a virtual learning environment provides a chance for both synchronous and asynchronous communication. This potentially provides deeper and varied forms of dialogue and interaction between students and mentors and among peers. This fulfils socially situated learning, one of the seven eLearning applied theories described by (Conole et al., 2004).

In the practical part of the course, the campers had the chance to experience and reflect on scientific research fundamentals while being mentored to write a whole paper, fulfilling experiential learning (Conole et al., 2004). On finishing the camp, the campers had worked in three groups and written three different papers with the guidance of a senior researcher in each group. The papers resulting from those groups were all published in Springer Lecture Notes in its Computer Science book series (Almuqren et al., 2017; AlNegheimish et al., 2017; Alowisheq et al., 2017).

4 RESEARCH CAMP CHALLENGES

Employing a virtual methodology for teaching the introduction to scientific research and providing the means for potential authors to experience writing a paper with guided mentorship and peer collaboration had positive outcomes. This however, faced several challenges, which are as follows: First, given that the campers group was composed of virtual teams whose members have not met in person and are from varying backgrounds having to work on a rigorous scientific writing project that needed synchronisation and high coordination, this required a huge leadership effort
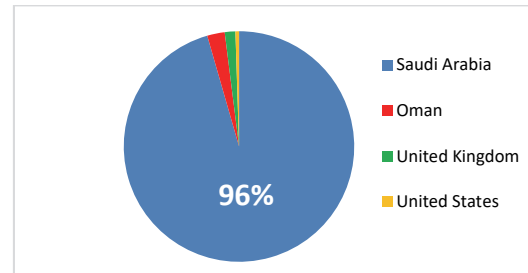

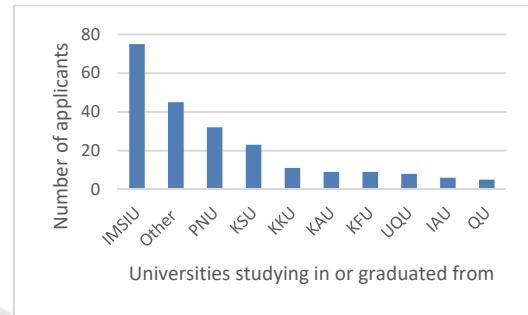Figure 1: Participants' countries.
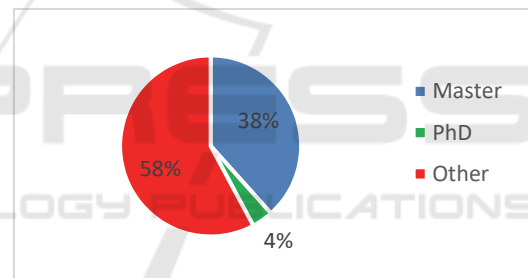

Figure 2: Participants' affiliations.
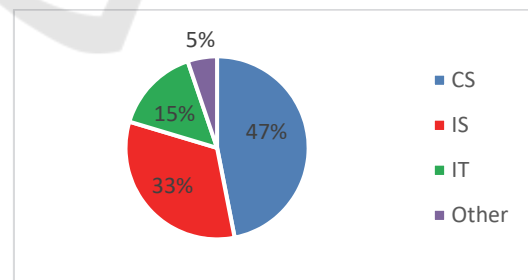

Figure 3: Current level of education.

Figure 4: Academic Majors of participants.

for it to succeed. Second, the success of online meetings depends on the quality of the Internet connection of the attendees.

Third, although the screening of campers who joined the paper writing groups went through different filtering and scrutiny phases, there were still some essential qualities that could not be discovered

solely by the registration forms. This includes, English language competency, scientific background, motivation, and commitment. As a result, some group members were not active in reaching the goal as other members. Thus, having some rigorous English proficiency measures such as IELTS or TOEFL will aid in setting the expectations early before the writing levels.

Fourth, keeping the campers learning and motivated to finish writing the paper with high commitment in attending the meetings and doing the writing assignments required a strong effort in follow-up and coaching, while that happened, we still lost 3 group members from reaching the final goal. This is attributed to either inability to continue.

5 CONCLUSIONS

The ASA research camp provided a learning experience exercising several pedagogical and educational traits that are required for good learning such as socially situated learning and experiential learning. In this course WebEx was used for teaching scientific research methods to computer science students. Although the mentors and participants faced different challenges, they were able to elicit three academically sound papers in a learning journey that positively affected campers. The listeners on the first two levels were also positively affected and learned with minimal cost. This fulfils the two research questions we asked on proposing the research camp. However, to minimise challenges and aid future success, we suggest having more mentors per campers' group with at least two mentors per group. Also, for guided paper writing starting in level 3, a group of two mentors and five students at maximum is suggested. Lastly, as the survey show, only 5 courses among 35 majors in 10 different colleges in Saudi Arabia are on scientific research. Also, 6 out of 10 colleges do not offer any course on scientific research. This is a huge gap in teaching scientific research methods in computer science colleges in Saudi Arabia that needs to be improved.

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