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Understanding Student Experiences in a Blended-Learning MOOC: A Phenomenographic Study

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1. Introduction

This work-in-progress paper investigates the qualitatively different ways in which Massive Open Online Course (MOOC) students interact with and learn from *Fundamentals of Neuroscience (MCB80x),* a neuroscience MOOC with extensive electrical engineering content. A distinguishing feature of this MOOC is that a small group of students also received an at home lab-kit on which they could perform neuroscience experiments. As part of an on-going study of MCB80x, we previously performed initial quantitative analysis to describe the general patterns of website interaction of MOOC students[1,2]. Those findings, grounded in data mining and traditional statistics, are consistent with findings from other MOOCs. However, we were not able to describe the nature of the behaviors the students exhibit and why they interact with the online learning environment the way they do. This follow-up phenomenography studies the variation in user learning experiences in MCB80x. The findings of this study may inform structural and pedagogical decisions for future MOOCs. Increased understanding of the rich experiences students have while interacting with lab-kits may also provide valuable insights to help MOOC designers develop effective at-home and remote lab activities, which could scale to virtual lab environments for engineering and other STEM classrooms in general.

This work-in-progress paper begins with a description of our research questions, followed by a detailed description of the chosen methodology – phenomenography. We then discuss our data collection methods, validity concerns, data analysis procedures, and preliminary findings. We close by discussing some implications, limitations, and plans for completing this study.

2. Research Questions

To better understand the multi-faceted MOOC student experience, we investigate the following research questions:

1. What are student intentions and perceptions of the utility of engagement with online and offline components of this class?
2. How do students describe their learning behaviors while interacting with the online environment, and what reasoning do they give for these behaviors?
3. How are the students using the physical lab-kits, and how can we characterize their experiences interacting with the kits?

3. Background on MOOCs and Methodology

Since the advent of MOOCs, instructors and researchers have grappled with a highly diverse classroom of students[3-5]. Students hail from a wide variety of countries and cultural backgrounds[6], language groups[7] , and education levels[8], all factors likely to shape their educational experiences. Further, there is evidence that MOOC users enroll in the courses with widely varying intentions, from college preparation to casual curiosity, and from refreshing one's understanding of a topic for future work goals to gathering material to use as a teacher of similar

subject matter[9]. These widely varying backgrounds and goals are likely related to the wide variety in MOOC users' behaviors and manners of engaging with the online class[5,10]. By extension, we hypothesize that MOOC users' lived experiences going through these courses also reflect the diversity of their backgrounds, intents, and observed behaviors. We therefore employ phenomenographic analysis to understand the different layers of experience for MOOC users in the course we study.

Phenomenography as a methodology for education research was developed and gained popularity over the past 25 years[11]. It grew out of the field of learning sciences in an attempt to explore how variations in student experiences lead to variation in learning outcomes[12]. A phenomenographic study begins by choosing a phenomenon to explore, which in our case is the user's learning experience in MCB80x; hence, we are interested in understanding the variation present in the learning experiences of these MOOC students. MCB80x had participation by people from all over the globe with different cultural, social, and educational backgrounds. This diversity brings with itself many challenges, which are not as frequently or as intensely present in a brick-and-mortar classroom. For instance, since everyone is not a native English speaker, understanding and interacting with a MOOC delivered in English may differentially pose challenges to students with diverse language proficiencies. We therefore employ phenomenography as a suitable method to understand such variability.

4. Course Context

This study investigates the *"Fundamentals of Neuroscience"* (MCB80x), a MOOC offered by Harvard University via the edX platform. This MOOC provides a wide array of interactive activities to its users including interactive videos, DIY videos, and virtual labs. We are focusing on the Fall 2013 offering of MCB80x, where student interaction was recorded from the opening of the course (10/31/2013) until the end of the final exam (1/25/2014). Three different types of data were initially collected for all students via the platform: 1) student demographic information via a pre- and post-survey, 2) clickstream data, and 3) final exam grades. Over 24,000 students enrolled for the Fall 2013 offering of MCB80x, of which over 5000 volunteered to participate in a Randomized Control Trial (RCT). The treatment group of the RCT constituted 200 MOOC users, who were randomly selected to receive a lab-kit on which they could perform actual neuroscience experiments, in addition to learning from the online interactives. 185 of these users actually received the lab-kit, and this group is the focus of the current study.

5. Methods

Sampling and Participant Recruitment

Using stratified sampling (based on grades and number of page views), we recruited 12 interview participants, thus including variety in the population. All participants were recruited from the set of students who received an at-home physical lab-kit. Table 1 lists the demographic information of our participants. We were able to recruit participants from all groups except for students who passed with a high grade and had low page views (p_hi_lo) and students who passed with low grades and high page views (p_lo_hi). Although we sent a recruitment email to all the users,

these two groups did not volunteer to participate in our study. For participation in the interview, the users were compensated with a $15 Amazon gift card.

Table 1. *Participant's Demographic Information*

Student Pseudonym	*Gender*	*Age*	*Country*	*Passed Final Exam*	*Grade (%)*	*Stratum ***	*No. Page views*
Alex	*Male*	*47*	*India*	*Yes*	*81.1*	*P_hi_hi*	*341*
Alice	*Female*	*-*	*Mexico*	*Yes*	*61.2*	*P_lo_lo*	*153*
Max	*Male*	*51*	*Morocco*	*No*	*39.5*	*F_lo*	*140*
Kurisu	*Female*	*54*	*France*	*Yes*	*82.6*	*P_hi_hi*	*736*
Bob	*Male*	*42*	*USA*	*N/A**	*-*	*F_hi*	*44*
Wuki	*Male*	*35*	*China*	*N/A**	*-*	*F_hi*	*106*
Jasmine	*Female*	*34*	*Kuwait*	*Yes*	*60.5*	*P_lo_lo*	*175*
Andrew	*Male*	*51*	*Brazil*	*Yes*	*79.7*	*P_hi_hi*	*283*
Emily	*Female*	*30*	*India*	*Yes*	*68.1*	*P_lo_lo*	*151*
Steve	*Male*	*31*	*Ghana*	*Yes*	*60.8*	*P_lo_lo*	*34*
Ana	*Female*	*28*	*Poland*	*Yes*	*84.4*	*P_hi_hi*	*517*
Carl	*Male*	*35*	*Kyrgyzstan*	*N/A**	*-*	*F_lo*	*6*

** N/A = Not Attempted*

*** P_hi_hi is passed (> 60%) with high grade and high number of page views, P_lo_lo is passed with low grade and low page views, F_hi is failed with high page views, F_lo is failed with low page views.*

Data Collection Methods

Interviews are the primary method for data collection for a phenomenographic study, as the interviewer and interviewee jointly construct understanding from their conversation[13]. We utilize a semi-structured protocol, which not only has some standard organization, but also allows the researcher to have a conversation with the participant, prompting the participant for additional information, as and when necessary[14].

The interview protocol was developed by brainstorming with the Principal Investigator and research team. Recognizing that a pilot test could help us uncover flaws and limitations of the interview design[15], we conducted a pilot of the protocol and made necessary revisions. However, questions did not include overly specific details, as we wanted to give participants freedom to choose the dimension of the question they felt was important to answer. This dimension becomes an important source of data, as it reveals aspects of individual relevance structure[13].

Since these MOOC students are distributed across different parts of the world, we conducted the interviews via an online video conferencing system (either Skype or Google Hangout). However, only the text or audio of the interview was recorded, depending on the preference of the participant. To ensure anonymity, participants were assigned pseudonyms.

6. Validity and Reliability Issues

Two commonly used forms of validity checks used in phenomenographic studies are: *communicative validity* and *pragmatic validity*. *Communicative validity* is concerned with measuring the quality of the research by make sure that the interpretations and claims are regarded as relevant and appropriate within the context of the study and within the broader research community[12,16,17]. This study has been designed in consultation with our colleagues who

have experience conducting phenomenographic studies. The semi-structured nature of the interview protocol also ensured communicative validity, as the interviewer and interviewee co-constructed knowledge within the context of the study. We also intend to present our findings at conferences to get constructive feedback from the broader research community. *Pragmatic validity* refers to the extent to which the results of the research are seen as useful and meaningful to the intended audience[16]. To ensure pragmatic validity, we will provide recommendations to the instructional design team of MCB80x, which may help improve the future offerings of MCB80x. Findings from this study could also scale to virtual lab environments for engineering and other STEM classrooms.

In qualitative research, reliability can be seen as the usage of appropriate methods in order to ensure consistency in data collection and interpretation[16]. Interview-based research involves two forms of reliability checks, both involving several researchers: *inter-coder reliability* and *dialogic reliability*. Since this is a work-in-progress, two researchers are independently analyzing our data to ensure *inter-coder reliability*. Moreover, we have already employed *dialogic reliability* checks (e.g., during the development and pilot testing of the interview protocol).

7. Data Analysis and Preliminary Findings

The audio interviews were transcribed verbatim and analyzed using phenomenographic data analysis procedures. The transcriptions include filler words (e.g., "ok", "um", "ah") and non-verbal communication (e.g., laughs, hesitations) to capture the full essence of the communication between the interviewer and participant. The product of phenomenography is called the outcome space[12,13]. An outcome space consists of different categories of description and their relationship with each other. This is an iterative process in which the researcher(s) revisits the interview transcripts over and over again to help with the emergence of categories. This iterative process stops when the researcher is content that the outcome space contains all the categories and all the relationships have been defined.

In this work-in-progress paper, we are still analyzing the qualitative data to derive the outcome space that answers each of our research questions. Table 2, 3, and 4 reiterate the research questions listed above and initial themes that emerged after the first iteration of data analysis. These initial themes will eventually be categorized as the data analysis matures. Once the data analysis is complete, the categories will be assigned meaningful labels, and relationships will be established between categories.

Table 2. *RQ 1 - What are student intentions and perceptions of the utility of engagement with online and offline components of this class?*

Intentions	1. Take as much from the course as possible
	2. Refresh neuroscience concepts
	3. To see how online courses worked
	4. Wanted to study a certain disease at a molecular level
	5. Expecting more advanced concepts from an introductory course
	6. Interested in neuroscience
	7. Gain in-depth information about neuroscience
	8. Testing their own ability to follow through on a goal
	9. Motivate others to learn about neuroscience

	10. Catch up with the latest developments in the field 11. To gain more command over technical nomenclature
Perceptions	1. Was expecting a traditional course but it turned out to be very interesting and interactive 2. A lot of lab experiments could be done at home

Table 3. *RQ 2 - How do students describe their learning behaviors while interacting with the online environment, and what reasoning do they give for these behaviors?*

	Learning Behaviors	**Reasoning**
1.	Taking notes while watching videos or during an exam	• To study for an exam • Teachers use the notes as learning material to prepare for their own courses
2.	Discuss difficult concepts with other people (in person or on the discussion forum)	• To better understand the concepts
3.	Irregular learning schedule	• Other commitments • Change of priorities
4.	Downloading the course material	• To be able to access the course in locations with no internet access • Teachers learning to present the material for their own course
5.	Watching and re-watching video lectures after attempting questions incorrectly	• To ensure that they learn the concept
6.	To keep up with the pace of the course and not leave anything behind	• To prevent work from piling up
7.	Taking notes even if they know the material	• There is always something new to learn
8.	Pausing and re-watching videos to take notes	• Take advantage of video lectures in order to take notes
9.	Looking up supplementary material (online or other books)	• To clarify doubts

Table 4. *RQ 3 - How are the students using the physical lab-kits, and what is their experience interacting with the kits?*

	How are they using the kits	**What is their experience**
1.	Using their own muscles to perform experiments	• Trying to learn a specific concept.
2.	Showing the at-home lab-kit to their students, friends or colleagues	• Not only to learn themselves but also to motivate a colleague to enroll for the future offering of MCB80x • Helping others learn by performing experiments • Introducing neuroscience to the broader audience
3.	To play with or explore the kit	• Learning the concepts by performing hands on activities • Had fun • Gave a feeling of being a scientist in their own home

Although the data analysis is not complete, we have started to see identify some emergent initial tendencies. The majority of these users have prior knowledge of neuroscience concepts. They are either pursuing tertiary degrees or preparing for professional certifications, and they wanted to refresh their concepts and therefore registered for this course. On the other hand, some other students had no prior background in neuroscience, but were interested to learn about it. Carl from Kyrgystan is an example of a user who did not have any prior background in neuroscience. He is a medical doctor who is doing research to understand sleep apnea. He took MCB80x so that he could understand the relationship between the human brain and sleep apnea. We have also observed variation in how users interact with the website and the learning behaviors they adopted

while studying for this course. Different users demonstrate different study strategies. While some users take notes in their notebook, some prefer to download just the transcripts of the videos. Some users follow a regular study schedule, and some are irregular. It has also been noted that most of the students who had an irregular schedule either did not complete the course or were using this course to study for some professional certification.

The most interesting insights we have noted are user interactions with the at-home lab-kit. There is a wide variation in how students used the lab-kits. Since half of users who received the lab-kit were teachers, they used the lab-kit not only for their own learning but also used the lab-kit to demonstrate experiments to their students. Users who were not teachers also interacted with the lab-kit in interesting ways. Max from Morocco used the lab-kits to explain neuroscience concepts to his children. Kurisu from France is another interesting subject in our study. She took this course along with her daughter. They not only watched the videos together but they also used the lab-kit to perform experiments. They commented that using the lab-kit gave them the feeling of acting like scientists in their own homes.

These are just a few of the insights and observations from the data that we have collected and analyzed. By going through multiple iterations of phenomenographic data analysis, we hope to obtain an outcome space that will be representative of the variation of user experience in MCB80x.

8. Limitations

As with all research studies, our study also has some limitations. This set of participants was interviewed almost two years after they took the course. A few of the participants had difficulty recalling some events specifically about the time when they received the at-home-lab-kit. We did not have any participants from two strata: students who passed with high grades and low page views (p_hi_lo) and students who passed with low grades and high page views (p_lo_hi). The reason we did not interview these students is because no one volunteered to participate for our study. This limits the generalizations we can make about these groups of students, who are notable in the MOOC context and who may represent a very particular set of experiences, for example, students who might have a high amount of expertise or prior experience and interact little with the course but still score well on the assessments (p_hi_lo). Moreover, most of the participants were non-native English speakers, understanding their accents was difficult at times, which resulted in difficulty in transcribing the interviews. This difficulty was compounded by considerable noise in the audio.

9. Future Directions and Conclusion

As a next step, we will focus on completing the data analysis. Since themes emerge as a result of data analysis in a phenomenographic study, we do not have a pre-selected theory informing our study. However, when we have the final outcome space, we will select a suitable theory and use it as a lens to analyze our findings. We are also in the process of refining our interview protocol and planning to recruit students who registered for MCB80x but did not receive the at-home lab-kit. We will then perform a comparative analysis of the findings from the two groups in order to understand the similarities and differences in the range of student experiences between them.

Additionally, we will also focus on understanding the effectiveness of the use of the at-home lab-kits and provide recommendations to instructional designers for developing effective lab experiences for engineering and other STEM courses.

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