Comparative study of teaching assistant intervention within two courses with different subject matter

Insert Subtitle Here

FirstName Surname†  
 Department Name  
 Institution/University Name  
 City State Country  
 email@email.com

FirstName Surname  
 Department Name  
 Institution/University Name  
 City State Country  
 [email@email.com](mailto:email@email.com)

FirstName Surname  
 Department Name  
 Institution/University Name  
 City State Country  
 email@email.com

ABSTRACT

In Massive Open Online Courses (MOOCs), discussion forum is a platform that provides communication and interaction between its users, such as students, teachers and teaching assistants. In this research, we focus on the teaching assistants’ interactions with other learners within the discussion forum of two courses with different subject matter, the first is a computer science and the second a humanities course. The purpose of this study is to scaffold teaching assistants’ discussions in both courses and explore the characteristics of their intervention in them. The method we used to achieve that is a comparative qualitative analysis. We employ a coding scheme, a hybrid version of Chandrasekaran’s taxonomy, in order to categorize the messages of teaching assistants within the forum of both courses. Two coders performed the labeling on a subset of the discussion data by using the proposed coding scheme. The results reveal quite notable differences in the characteristics of teaching assistants’ messages within the two courses. We then build two predictive models one for each course’s teaching assistant messages and discuss the difficulties of such a classification task. Despite the common aspects of their behavior, which include answering to students’ questions about the course material and helping learners with their problems on assignments, differences were found on the characteristics of their interventions. In the computer science course, teaching assistants were more formal in their dialogues, with shorter messages and with a more robust way of speaking. On the other hand, in humanities course, teaching assistants’ vocabulary was more informal, their messages were bigger and dialogues were more extended.

CCS CONCEPTS

• **Education** 🡪 E-learning, Learning analytics

KEYWORDS

Learning analytics, Massive Open Online Courses, discussion forum, teaching assistant intervention

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1 INTRODUCTION

MOOCs nowadays have become a very popular tool for distance education due to the variety of the available courses found online and the flexibility they provide with the course material. Through technology-based platforms, such as discussion forums, they provide opportunity for interactions among learners inside the course’s environment. In discussion forum, learners can interact with their peers and the instructional staff and dive deeper in the course’s content, search for solutions in their problems and give help to other learners. Prior work has shown that the active participation in the discussion forum help learners improve their learning performance [1, 5, 6]. A part of this improvement is due to the intervention of instructors in learners’ discussions. Their role is to guide learners within the course’s platform, help them with their questions and generally support their learning experience.

To provide a more engaging and effective learning experience to learners, there has been a lot of research on instructor interventions within forum discussions [4]. The role of instructors and teaching assistants within the discussion forum is an important factor in the evolution of the learners’ participation and outcome. The level of instructor intervention may influence discussion and participation of learners in unexpected ways [2]. In his research, Mazzolini [3] studied the effect of instructor intervention on student participation in online discussion forums. The findings of this study showed that higher frequency of instructor posting resulted to shorter dialogues and less frequent learner posting. Another study by Balaji [7] revealed that facilitating discourse has a strong positive effect on the students’ interactions in discussion forums. The findings of this study also indicate that the instructor’s role in online discussion is essential for maintaining the interest and motivation of learners to participate and engage with the course material.

In this study, we collected data from the discussion forum of two completed courses in different subjects, one related to technology (Introduction to Programming) and the other in humanities (World History of Religion). They were collected from Mathesis, a prominent Greek MOOCs platform based on OpenEdX technology. In this platform, there is a distinction in the roles of the instructor, the forum moderator and teaching assistant of an online course. Instructor is the main teacher of the course, he performs the video lectures, provides the course’s content and rarely participates in the forum to answer to other learners’ questions. The moderator’s role is to maintain a healthy climate within the course’s discussion forum, delete improper messages and intervene if a message does not comply with the forum’s rules (e.g. posting solutions of the course’s assignments). Teaching assistant, on the other hand, is a learner, who is informally authorized by the course’s staff to help other learners within discussion forum, answer to their questions and improve their learning experience. He is usually a high-graded learner, with high-level of engagement within the course and he voluntarily accepts this role. This role is quite unusual because in most MOOC platforms the course’s personnel provides this kind of assistance to learners, within specific restrictions and rules. In this context, teaching assistants’ role is quite different because they are also learners of the course and their behavior and intervention might reveal interesting characteristics. In both courses, teaching assistants intervened in forum discussions and offered help to other learners, but the question is if the different subject matter of the courses can result in different characteristics in these types of interactions.

Specifically, in this work we ask the following research questions:

1. Are there any differences in teaching assistant interventions within the discussion forum of two courses with different subject matter?
2. If yes, then what differences are there observed in teaching assistants’ interaction with other learners and why they occur?

We consider that answering these research questions will give us important insights about how teaching assistants behave within courses with different subject matters discussion forum and provide us implications for designing discussion interventions in MOOCs in the future.

In this work, to answer these research questions, we perform a qualitative analysis on teaching assistants messages. We choose randomly a subset of 200 discussions teaching assistants intervened to, for each course. Next, we use a hybrid coding scheme based on Chandrasekaran’s taxonomy, which includes only the instructor intervention categories, to label teaching assistants’ messages. Two coders performed the labeling of the messages in the coding scheme categories. The results and discussion are presented below.

2 RELATED WORK

2.1 Research on instructor intervention in discussion forums

Instructor and teaching assistant intervention within the discussion forum has been a topic of interest of many studies. In his study, Tomkin [8] investigates the impact instructors and other instructional staff have on student learning outcome and participation rates within the discussion forum of a physics course. By dividing enrolled students in two control groups using an A/B test, one without and the other with instructional interaction, they tried to identify differences in students’ learning outcomes. The results showed that there was no significant difference between the two groups in terms of completion rates, but did have on forum badge completion. In a similar work of An [12], they divided students in three groups with different facilitation approaches to identify differences on students’ participation rates. In the first group instructors were responding in students’ messages directly and students should reply to at least two other student posts, in the second the same but without being necessary to answer to other peer posts and in the third group, students could only communicate with other peers and not with instructors. Results showed that in group 2, interaction of students with other peers rarely occurred because students chose to communicate more with the instructors. In groups 1 and 3, students tended to more communicate with other peers when the instructor intervention was minimal.

These studies give important insights about how the design of instructional staff intervention can alter learners’ participation rates in the discussion forum.

2.2 Research on forum classification tasks

In the field of forum classification models, Wise [10] build a predictive model in order to categorize and identify threads based on whether or not they relate to the course’s content. The results revealed some useful evidence where content-related threads contained some distinct linguistic features over the unrelated threads and the classifier accuracy was quite satisfying (>0.77).

In his work, Chandrasekaran [9] studies the problem of instructor intervention in discussion forum and builds a binary classifier in order to predict whether an instructor or not must intervene in a discussion thread. The results of this study showed that such a decision problem is quite difficult to solve and the classifier’s accuracy differs in courses with different subject matter. In another work, Chandrasekaran [11] studies ways for automatic guidance of instructors in discussion forums. He proposes a new taxonomy of transactive contributions of instructors. He uses natural language processing techniques to analyze discussion forum texts, categorize them and then conditional random fields (CRF), a supervised machine learning technique, to create a predictive model. He proposes a type of dashboard that would use this model and give feedback to instructors by mentioning them which threads are urgent to be intervened by them and discusses the difficulties of such an implementation.

3 DATASET

3.1 Description of data

For this study, we retrieved data from two MOOCs offered in 2017 on the mathesis.cup.gr platform. The first course, ‘Introduction to Python’ (IP), was an introductive course to computer programming through Python. The second course, ‘World History: Man versus Divine‘ (WH), aimed to introduce learners to the history of Asian religions during the Second Circle of World History. The duration of the two courses were 6 and 9 weeks, respectively. Their learning design consisted of video lectures, assignments and weekly tests. The data used for this analysis contained all the discussions from both courses’ discussion forum. The usernames of all participants were anonymized. In both courses, students were encouraged to participate in the discussion forum to communicate with their peers and the instructional staff about problems they face with course-related issues. Their participation was optional. In each discussion forum, some learners that acquired high grades and had high engagement in older lessons were set as **teaching assistants** **(TAs)** by each course’s instructional staff. Their role was to watch the forum discussions regularly and help other learners with their questions and problems. These actions, though, should be done voluntarily.

3.2 Analysis of data

Each course consisted of its own number of TAs. The IP course consisted of three TAs, user u#2314, u#402 and u#1173. The WH course consisted of four TAs, user u#18, u#535, u#187 and u#4872. The discussion forums for the two courses are structured in three levels, threads, posts and replies. In Table 1 below, we present the message measures of TAs in each course.

|  |  |  |
| --- | --- | --- |
|  | IP Course | WH Course |
| Total number of messages posted | 695 | 1361 |
| Avg number of sentences per message | 3.90 | 5.48 |
| Avg number of words per message | 42.56 | 58.04 |
| Avg number of messages posted in forum | 231.68 | 340.25 |
| Avg response time (hours) in a message | 13.33 | 3.96 |

**Table 1: Message measures of TAs in both courses**

As we can see in Table 1, there are some notable differences in the message characteristics of TAs between the two courses. It is quite clear that in WH course TAs had twice posts than in IP course. The average sentences per message in IP course (3.90) is smaller than in WH course (5.48) and it may imply that TAs in WH answers to other users in a more analytical way than on IP course. The same observation can also be made by comparing the average words per message of a TA. TAs in WH course seem to have more messages within the forum in average than IP TAs. By comparing the response time of them it is obvious that in WH course TAs would respond to learners’ questions more quickly than in IP course. To explore further our data, below in Table 2 we present the measures of posting activity of TAs.

|  |  |  |
| --- | --- | --- |
|  | IP Course | WH Course |
| Avg number of posts they participated in | 143.66 | 150.50 |
| Avg length\* of the posts they participated in | 5.33 | 7.21 |
| Avg number of replies per post they made | 1.30 | 2.79 |
| Avg other users participated in their posts | 2.41 | 2.75 |

\*total number of replies a post had

**Table 2: Posting activity measures of TAs in both courses**

In Table 2, we may observe some similarities in the posting activity behavior of TAs in both courses. TAs in both discussion forums replied to almost the same average number of learners’ posts. This big number of posts they replied to implies a high engagement of TAs within the discussion forum. On the other hand, the average length of posts they replied to, seem to be quite bigger in WH course. TAs of WH course tend to participate in longer conversations that TAs of IP course. They also tend to reply more in a single post. In WH course, TAs made 2.79 replies in average in a single post, while in IP course 1.30. This may be explained due to the fact that in IP course, which is technology-based course, learners usually post the problems they face with their code. In this situation, the TA can give the solution in just one message, while in WH course, where learners’problems relate to historical events, TAs tend to seek the solution through dialogue with the learner.

4 METHODOLOGY

4.1 Unit of analysis

In this study, our unit of analysis is the message. In a MOOC context, to better understand the users’ behavior, the data we usually deal with are their log data and traces within the MOOC platform [13, 14], which depicts their participation process. However, TAs behaviors are better represented in their messages, dialogues and interactions with other learners within the discussion forum of a course. In this work, we hand-code part of each courses’ TAs messages, which may reduce the noise of this kind of analysis. By manually diving deeper in the messages’ content of TAs, we may be able to better compare their behavior between the two courses and draw our conclusions.

4.2 Coding scheme

In our study, we perform a qualitative analysis on a subset of the TAs messages within each course’s discussion forum. We choose randomly 200 discussions of each course’s TAs and use a coding scheme based on a hybrid model of Chandrasekaran’s taxonomy [11] to categorize the TAs messages in them. Our coding scheme, which is presented in Figure 1, contains the ‘Instructor Interventions’ categories of Chandrasekaran’s taxonomy. We do not include the peer interventions because we want to focus only on the TA interventions to learner conversation. The coding scheme that we use is presented below.

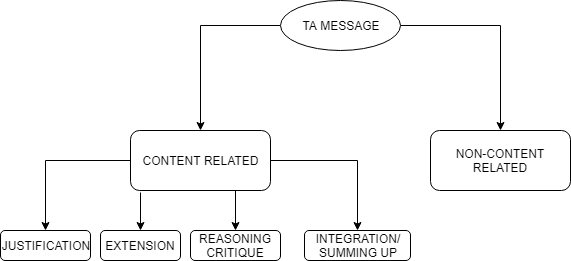


Figure 1: Coding scheme used for categorizing TAs' messages

As we can see, the coding scheme contains two levels of message categorization. In the first level, the general content of the message is checked. If the message is related to the course’s content it is labeled as ‘Content related’, if not as ‘Non content related’. To label a message as ‘Content related’, the TA’s message should relate with the video lectures’ content, the course’s assignments or weekly tests and problems or questions that learners have within the course’s material. If the message is irrelevant with the course then it is labeled as ‘Non Content related’.

In the second level, if the message is related to the content of the course, then it must be specifically labeled to one of the following categories.

1. **Justification**: Analytical explanation of a theory or a solution that was proposed. The TA provides evidence and explains in detail the solution of a problem a learner faces.
2. **Extension**: The problem that was discussed is solved but the TA proposes alternative solutions and explains the pros and cons of each one to the learner.
3. **Reasoning Critique**: TA makes his own statement on a problem. He makes criticism on an issue and by referring to his own experience he proposes the solution.
4. **Integration/Summing up**: TA gives directly the solution without being analytical to it. His message implies that the current conversation should end with his statement.

4.3 Hand-coding of the transcripts

Two coders were selected for this coding task. The principal investigator discussed the coding scheme with the coders, who then coded all the TA messages from the randomly selected discussions. The coders were encouraged to refine the protocol as they coded. Their results were evaluated for interrater reliability using Cohen’s kappa (k). Cohen’s kappa is a chance-corrected measure of interrater reliability. In calculating Cohen’s kappa, reliability is reported after accounting for the possibility of chance agreement between coders [15]. In our five-category coding scheme the results showed a kappa coefficient 0.90. This interrater reliability is quite acceptable and through it, a high consensus was achieved to continue our analysis.

5 RESULTS AND DISCUSSION

In response to the first research question, we hand-coded a random subset of discussions from the two courses’ forum data. The results of the coding are presented in this section. In Figure 2, we see the results of the coding in the first level of categorization.

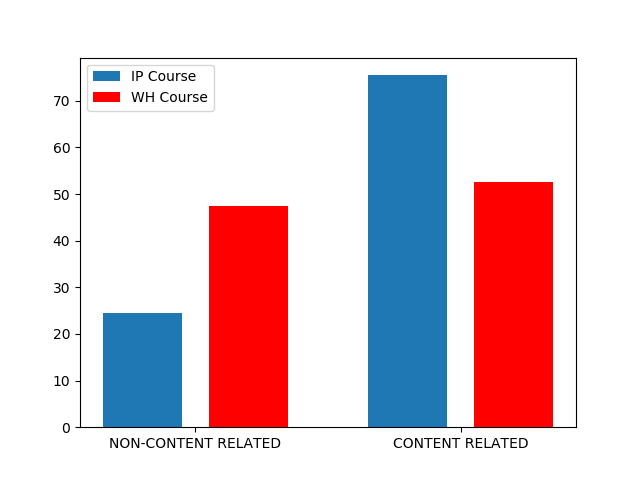


Figure 2: First level of categorization of the two courses messages

We see that in IP course almost 75% of the messages that were coded were content related, while almost half of the messages of WH were not. In IP course, most posts related with problems learners faced with Python code. TAs intervened to these conversations and tried to give solutions to them by giving coding examples or guiding learners to them. The conversations that did not relate with the course content were mostly problems learners faced with the Mathesis platform, assignment deadlines and installation problems of Python environment. On the other hand in WH, the fact that half of the interventions were coded as ‘Non-Content related’ can give some insights about the behavior of TAs in this course. They had the tendency to act more socially and intervene to conversations that were completely irrelevant with the course’s content. There were conversations where users were introducing themselves to each other or generally with more social content and TAs became initiative and intervened without offering some kind of help to learners. To further analyze the TAs behavior, below in Figure 3 we present the results from the second level categorization.

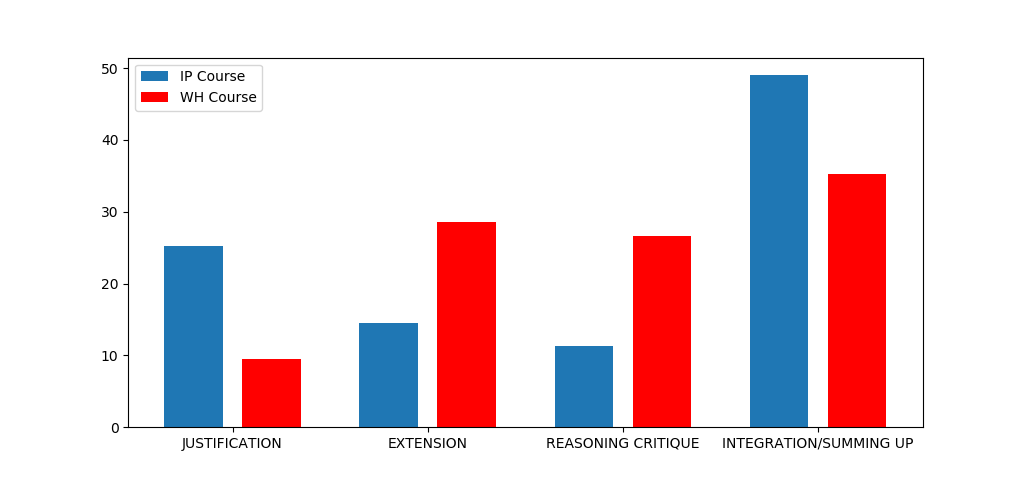


Figure 3: Second level of categorization of the two courses messages

In Figure 2, from the ‘Contented related’ messages of the TAs in both courses, we notice some insightful differences.

In IP course, almost half of the TAs’ interventions belong to an integration of a problem. In our data, most of TAs messages (49.1%) were direct answers to learners’ questions about Python code problems. Such messages mostly contained a short explanation of the solution and the rest of the message contained the correct code that responds to the question. After such interventions, the conversations were closed or sometimes a thankful message followed by the learner. The second category in percentage was the ‘Justification’ interventions (25.4%). In such interventions, TAs tend to answer to theoretical questions of learners. These questions related to the uses of Python libraries, methods of Python classes, functionality of Python interpreter and other theory-based questions about Python environment. These messages were quite long in length, containing a lot of computer programming terminology and sometimes examples of code that learners could run to understand better the corresponding theory. The last two categories that were quite rare in our data sample were the ‘Extension’ (15.9%) and the ‘Reasoning Critique’ (9.6%) interventions. The only occasions that did ‘Extension’ intervention occur were conversations where learners were discussing the performance of different solutions to a problem. In these conversations, the TA intervention just added some more information to the learners’ discussion and did not, basically, solve any problem. The TA just proposed another correct solution and the conversation would continue after that. The last category, ‘Reasoning Critique’, rarely occurred. In these interventions the TA intervened to discussions where he proposed a solution as the correct one by refering to his own experience as a programmer and speaking in a more absolute way to the learners.

In WP course, on the other hand, a very different phenomenon occurred.

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