

Submit- Homework Submission Platform

[Design, Development and Evaluation of the features]

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ABSTRACT

Academic technologies, especially online or web-enhanced courses play a significant role in the creation of high quality learning environment. Apart from managing the courses, the courseware should provide ease of usability. In this paper, we evaluate usability drawbacks associated with the WolfWare and Moodle system being used at NC State University from perspectives of both students and teaching staff. We specifically identify the problems associated with homework submission and grading portal of Moodle. The conventional system creates an environment for incorrect submission where students forget one of the document during a multi-file submission. Also, the existing system requires teaching staff to download each submissions, grade them and then upload again. We developed a tool which eases the cumbersome task of managing homework submissions for students and grading process for teaching staff. The instructor/TA also generally try to understand the performance of a class for which we try to provide a dashboard with the basic statistics.

Categories and Subject Descriptors

H.4 [Information Systems Applications]: Miscellaneous;
D.2.8 [Software Engineering]: Metrics—*observations, convenience measures*

General Terms

Analysis, Case Study, Assignments, Evaluation, Peer review

Keywords

Moodle, Google Calendar, Learning Management System, Homework Submission, Homework Analytics Dashboard

1. INTRODUCTION

In modern education, information technology, particularly the internet plays a very important role in imparting learnings to students. The best practices in education require the usage of courseware tools in order to support the teaching and learning processes, as well as in efficient assessment of students. In this paper, we discuss about a few features implemented on top of the basic features available in few courseware tools such as Wolfware and Moodle used at North Carolina State University for learning management platform to solve the problems and challenges faced by students, instructors, teaching assistants and graders in using them.

WolfWare is NC State's enterprise suite of academic technologies and tools that provide instructors, students, prospective students and staff with a cohesive online platform that facilitate teaching and learning in fully-online, face-to-face and blended environments [1]. Moodle is a web-based tool (often referred to as a learning management system or LMS) used for web-enhanced and online courses. NC State uses Moodle as its primary learning management software. Moodle enables instructors to communicate with students and provide a variety of activities and resources. Some of the features that Moodle provide are maintaining a website for the course, posting or linking to a variety of content such as syllabi, assignments, readings, reference materials or recorded media, e-mailing and posting messages to notify your students about important events, using forums and wikis to allow students to collaborate, posting grades securely, receiving and returning assignments from students and creating online assignments and quizzes [2].

In this paper, we discuss the features to solve the drawbacks in the existing system being used at NC State University. We conducted various surveys with target audience as students and teaching staff to understand and identify the most frustrating problems faced by them in using Moodle, WolfWare and other courseware. We also did a literature review to learn about the drawbacks in the usually used learning management systems. Our interviews with teaching staff helped us to understand their perspective of a good course management system, to learn more about how they currently use the system to manage the course and to brainstorm the problems with the current system that needs immediate attention and needs to be solved immediately to make their life easy in rightly delivering and managing the course. Our surveys with considerate amount of observations and analysis helped us identify the problems they face while interacting with the course management systems and which additional features they think that will benefit them to manage their courses, submit homework and assignments, enable collaborative learning through forums, chats, file storage areas and email notifications, and increase the ease of using course management portals. Also, we referred to the existing studies [3], [4] and [5] that investigates student's and teacher's experiences with the Moodle and analyzes their opinions.

From our study, we concluded that the most common problem faced by both students and teaching staff is related to the submissions and grading of assignments and homework through Moodle.

Based on the surveys, we implemented three features to solve various issues faced by the students, graders, teaching

assistants and instructors to ease the process of grading and analysing the submissions. The three features were then evaluated using different user groups and the feedback was obtained and the features were ranked based on them.

The rest of the paper is organized as follows. Section 2 presents a synopsis about the project, the previous study conducted related to these features and also a brief description about the features being implemented in the system. In section 3, we discuss about the architecture used for implementing the system. The experiments conducted for evaluating the three features and the results are discussed in section 4 and section 5. Section 6 discusses about the three features and their limitations.

2. SYNOPSIS

In this section, we discuss about the work done previously in homework submission platforms, the common problems users face in the systems and three solutions for improving the platform for students, graders, teaching assistants and instructors.

2.1 Previous work

There have been various web and desktop applications that implement the homework management systems in different ways with different features. One such tool which is widely used is Moodle. This application has a lot of features like a discussion forum, a portal for assignments submission and a deadline tracker. But the problem with Moodle alone is that it isn't sufficient to cover all the required elements.

Some of the issues with Moodle are discussed here. The discussion forum available in Moodle isn't the most user friendly tool and the deadline tracker doesn't have an option for reminders. The homework submission portal isn't the most user-friendly one. Many professors use multiple platforms like Moodle, piazza, Top Hat and many more for a single course. This highlights the problem with the existing system. Our aim is to provide a solution to these problems and come up with a single platform that will make the both the instructors and students job easier.

2.2 Features

For the purpose of this project, we built a new platform called Submit for testing the various features proposed below. The features are separated by access controls. There are 4 groups of users - students, graders, teaching assistants and instructors. Submit enables students to submit homeworks as file attachments, view deadlines for various courses, enables sharing of submission within the team for group submissions and also view inline feedback for the submissions. For graders and teaching assistants, it enables them to view, grade and provide feedback for the submissions by the students. For instructors and teaching assistants, it provides options for creating new assignments, as well as viewing the statistics like the mean, median and the distribution of the scores for the assignment.

2.2.1 Slotted submissions

One of the most important problems for any assignment is to figure out how many files need to be submitted and their file types. Submitting the wrong files in unexpected formats cause a lot of problems for the graders when the grading is automatic. This ensures that the grading process will be faster and efficient for the graders and teaching as-

sistants. Another effect of this submission system is that once a member of the group submits the assignment, it will be available to all the members of the group ensuring that all the members of the group have access to the submission files.

2.2.2 Inline feedback for submissions

The traditional system of downloading assignments and saving feedback in the pdf files or as a separate document and then uploading them to the portal for students to view the feedback is a cumbersome process. The solution provides an inline viewer/editor where the graders and teaching assistants can view the files submitted if it is a PDF and save the comments/feedback as annotations inside the PDF itself. Saving the comments as annotations ensures that the users can view the feedback comments easily. The students can view the comments in the viewer available to them to check the feedback provided by the graders. The solution ensures that the graders and teaching assistants need not download and maintain the files separately. The whole process is done online if the file type is supported by the viewer to add annotations and save them.

2.2.3 Statistics dashboard

In many cases, the teaching assistants and instructors need to get an overall performance of the class based on assignments. This enables the instructor to change the course structure, modify the difficulty of the assignments, etc. based on the performance. Also, they can view the progress of the class based on the performance in the individual assignments. The stats board comprises of various features like the mean, median and mode. Various visual representations of the data is employed to provide an easy understanding for the TA/instructor to understand where the performance of the class stands.

3. ARCHITECTURE

We designed the application to be web application following a MVC architecture in the front end and a RESTful backend. In the front end, we used HTML5, CSS and javascript. We took advantage of the bootstrap framework to get a better user experience. The front end was designed in a proper model-view-controller format. All the communications with the server takes place using AJAX calls to the servers. The server is RESTful and always responds with a JSON. The client then parses the JSON response and performs the required actions with the data.

The backend consists of a cyclone server which is a python based server built on top of tornado web server. This server acts as the REST server. All the data is stored in a SQL based database. The database schema is designed in such a way that it will be efficient and consistent to store the data. The server communicates with this database and responds to the requests it get from the client side.

Another important front end feature that we have is the document viewer. Though the document viewer is built using pdfjs, it is a custom implementation that allows the user to annotate inline on the pdf documents. So, the user can directly open the file in their browser itself and comment or annotate on the file itself.

The backend also acts a file storage system for all the homework file submissions which is then available for access through the server. This is very similar to a content delivery

network which gives as more advantages like control and security on the file also. This also gives an extra advantage of letting the users take a look at the files they submitted at anytime and also let them view the reviewed documents also.

4. EXPERIMENTS

In this section, we discuss about the task methodology and the various participants involved in testing the effectiveness of the three features developed.

4.1 Task Methodology

We deployed the application in four different machines. We used these installations to test the usability of all the three different features. The test format was almost constant for all the three different features. First step was to get the participant to log in and get used to the application. We let them log in and play around the application and get a feel of the various features in the application. Second step was to ask them to perform an action relevant to the test. The third and final step was the after usage feedback we got from them. Now, let us get into more details on the test for each of these features.

For the first feature which is slotted submissions, we has created two different assignments to be submitted and asked the participants to submit each of these two assignments. After they finish submitting these assignments, we got a general feedback from the participants on ease of using the application and the usefulness of the application. For the second feature which is online grading, we asked the participants to grade two different assignments and then asked them to give feedback. For the third feature which is a statistics dashboard, we ask the participants to go through the dashboard, play with it and give us feedback on the usefulness of the dashboard. We also had a custom built timer in the application which records the time taken for each of the participant's actions and we used this timing as a metric to see how easy it was for the participants to perform the given tasks.

4.2 Participants

For conducting the tests on three different user groups, we needed three different set of participants namely, student, graders and teaching assistants or instructors. So, we divided the task and made each of our team member talk with three students, two graders and a teaching assistant. This gave us a participant group of twelve people for the first feature, eight for the second feature and four participants for the third feature. Next, we asked these participants to perform the steps that we discussed earlier and got the results.

All participants were graduate students from North Carolina State University. So, all the three groups namely, the students, graders and teaching assistants belonged to this category. Also, we made sure that the participants have used a similar homework submission software like moodle earlier because the participants were expected to know how a typical homework submission system works, so that they can quickly identify and recognize the various advantages and disadvantages of our implementation compared to the various other implementations that they have used already.

5. DESCRIPTION OF THE GRAPHS

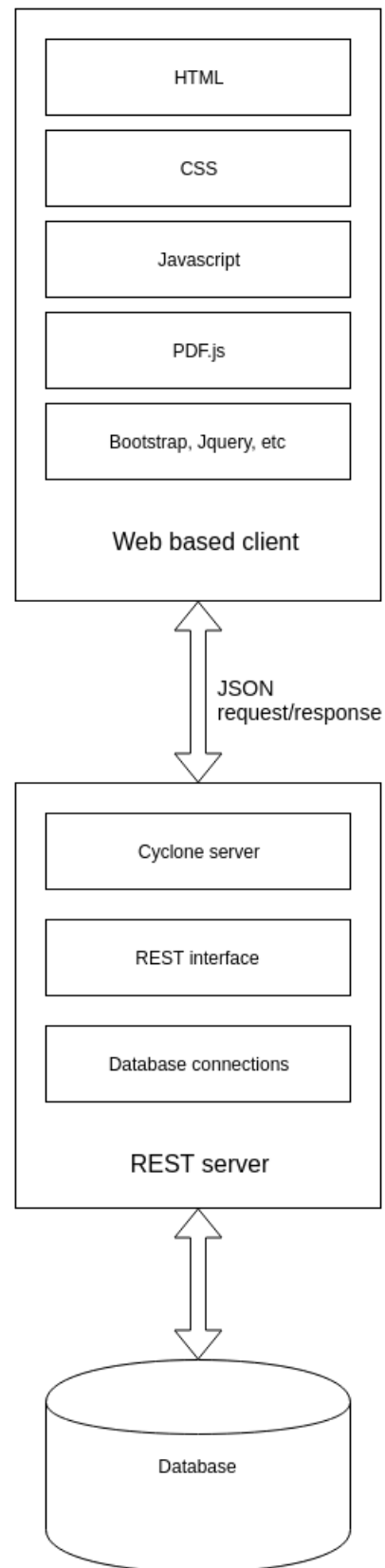
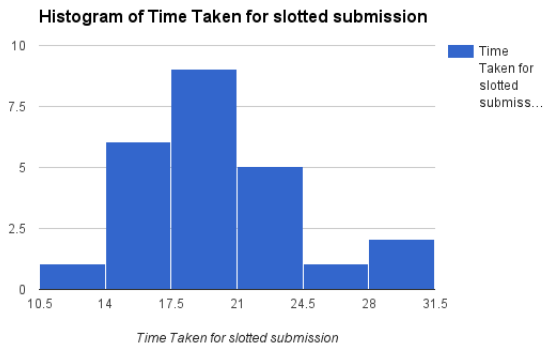
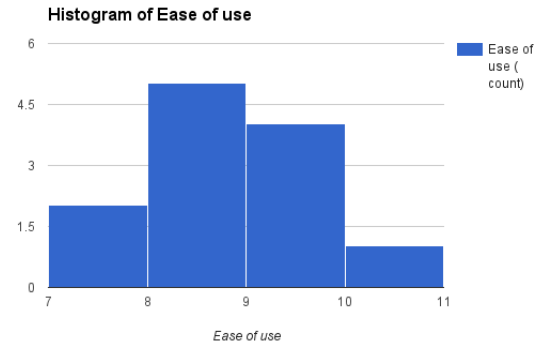


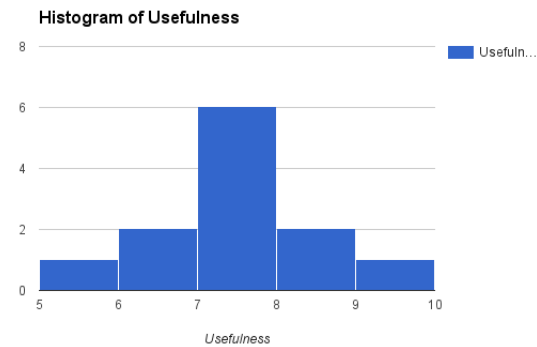
Figure 1: Architecture



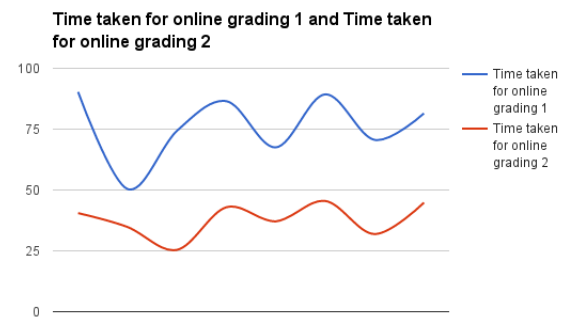
The histogram shows the time taken for submissions using the slotted submission feature. The time taken is calculated using the timestamps recorded when the user loads the various pages. This shows that the task was easy for almost all the users and that all the users could finish the task in almost the same amount of time.



The histogram shows the ease of use of the slotted submission feature. The average rating for the feature is 8.08.



The histogram shows the usefulness of the slotted submission feature. Around 50% of the users gave a rating of 7 for the feature.

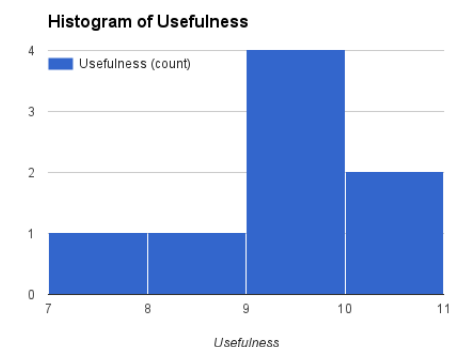


The time taken for evaluation of the submissions for two different submissions. The 8 graders were asked to evaluate 2 different assignments and the time taken to complete the evaluation was recorded by the system. This was compared with the average value expected when using some other evaluation systems.

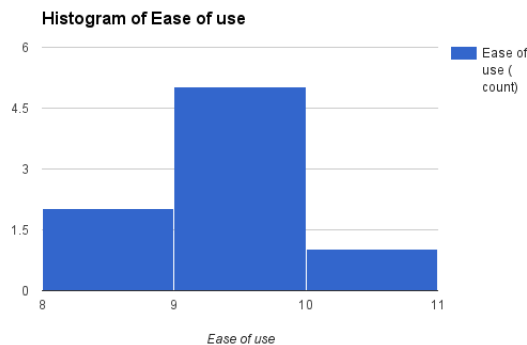
After conducting the tests with the various user groups, we obtained a whole set of data that has to be visualized to get better insights and ideas of the features. The kind of data we obtained were of two types. The first type was time taken for performing a given task and the second type was a evaluation metric ranging from one to ten for each of the feature's usefulness and ease of use. Both of these metrics can be visualized best with histograms which gives us a better idea on how the data is distributed and what is the most common response for these features.

6. DISCUSSION

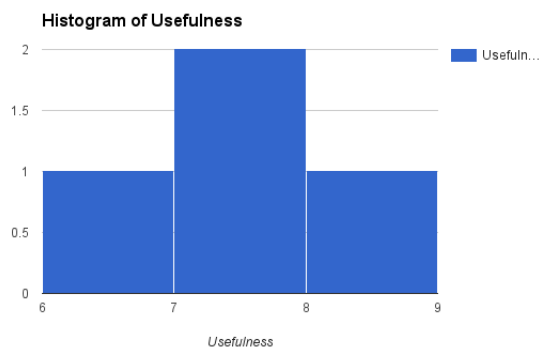
After conducting various experiments and analyzing the results, we were able to come up with a number of conclusions. Few of the results were not foreseen by us when we started working on the solutions. This can be attributed to various reasons. The main reason can be explained by the fact that during the testing phase, we encountered numerous issues which led to numerous changes to the features. This happened mainly due to the fact that while developing the solutions, we had a narrow view, which led to the



The histogram shows the usefulness of feature 2. 50% of the graders gave a rating of 9 while 25% gave a rating of 10 suggesting that the feature is useful.



The histogram shows the ease of use of the system. 5 graders gave a rating of 9 for the feature.



The histogram shows the usefulness rating of the third feature - stats dashboard. A rating of 7 by 2 out of the 4 teaching assistants suggest that the feature is not of much significance compared to the others.

assumption that the solutions were complete and error free. Only after finishing the test cycle, we saw the flaws that we couldn't notice during the development process.

This section of the report focuses on the feedback obtained from the experiments. We also discuss about which feature is the best, while also focusing on the strengths and limitations of each feature. The evaluation and the decisions were taken based on the pre-survey taken to identify the potential sources of problems and also the post-development feedback obtained during the testing phase. Finally, we discuss about the future work for all the features.

6.1 Observation

The experiments were developed to ensure that the features developed have the benefits we had foreseen while starting the project. After the experimentation, we found out that the features had the benefits we expected as well as a few limitations we didn't expect.

6.1.1 Slotted submission

This was expected to be one of the demanding features in the module. This feature enabled users to view the files required easily and submit them accordingly. Also, the teaching assistants/instructors were able to add slots for the files required easily. This ensured that the users will be submitting the files accordingly. One of the important observation while users were using this feature was that they expected a "save/submit" button to submit the assignment instead of auto submit when all the files were uploaded. Another important observation was that the users usually downloaded the uploaded files to confirm whether the file uploaded was the correct file.

6.1.2 Inline feedback for submissions

One of the most important observation while users were using this feature was that they were looking for an option to download the files which is not currently supported by the feature. The data recorded showed results which were expected ie, a reduction in the time taken to evaluate assignments. The feedback from the users also suggested that the feature is helpful in evaluation of assignments if they are available as PDF files.

Another major observation while users were using the feature is that adding annotations were not visible to them easily. Also, saving the annotations was required to be done explicitly. This was expected to be auto-saved by the users.

6.1.3 Stats dashboard

The dashboard present is not interactive and provides limited information to be viewed by the teaching assistants/instructors.

6.2 Limitations

The various limitations in the features developed are discussed in the following section.

6.2.1 Feature 1: Slotted Submissions

This is a great feature in cases where multiple types of files are to be submitted. But in some cases, instructors might request to submit a single zip/rar file which consist of all the files. This feature isn't very useful in such cases, but we can still restrict the file types to zip/rar format.

6.2.2 Feature 2: Inline Feedback for Submissions

Using inline feedback, the graders can provide comments by typing into the PDF itself. But the limitation of such a feature is that, for courses which include a lot of formulae and computation, typing in the feedback could become harder. This solution can be optimized by providing a rich text editor for each place an annotation is added so that complex structured comments can be added instead of plain text.

Another limitation of this feature is that it supports only PDF and text files currently. It can be expanded to support multiple file types so that the complete evaluation can be done online.

6.2.3 Feature 3: Stats Dashboard

Although the dashboard is a great tool to look at the performance of the class, it currently has restricted access. Only the instructors can look at the stats right now. The students are not given access because it is not really important for them to view the progress of the whole class.

7. CONCLUSION

The three features implemented as solutions in this project were for different user groups with different scopes for each feature. The features solve different purposes with the homework submission process for the users. We had an assumption about the best feature during our initial proposal stage and during the development. The final evaluation revealed that each feature has its own merits and demerits and taking into consideration of all the factors, the inline feedback system was rated the best out of the three which is the same as the expectation of the team. The slotted submission solution had its merit of restricting the files to be submitted and performing the necessary checks while submitting. The stats dashboard had merits of its own. This enabled instructors to concentrate on difficult topics and provided analytics about the performance which is vital information for the course. It had an indirect effect on the homework submission process for the users.

We conclude that if we were to pick one feature and develop it further, it would be the inline submission feedback feature. It has a lot of scope for improvement as discussed in section 8. It also makes the evaluation process easier for the users.

8. FUTURE WORK

A lot of work still exists to be done in this project. We found a lot of improvements that can be made to all the three features. Some of the improvements are small which makes it easier to use.

For the slotted submissions, once the file is uploaded the user should be able to preview the file. Also, an online editor to support editing text files and doc files is an ideal feature to support in the future. Also, we can send email alerts when there are deadlines and make sure the student can give their submissions on time. We can add a quiz interface where instructors can set up online quizzes for the students to take. These are some of the many features that can be implemented to make sure that the student makes their submissions in the most efficient way possible.

The inline evaluation feature has a lot of scope for improvement. Currently, it supports only PDF and text file

rendering. It should support inline viewer for other formats of files too. Also, downloading of the files should be enabled. The graders can also be given options to mark something or write directly on the file. They can also be allowed to give voice comments or have a chat interface right in the context of the document with the students so that the connection between the student, grader and the assignment submission is maintained.

The statistics dashboard can be made more interactive and provide deeper insights about the performance. The dashboard also can accommodate more visualizations and we can also let the user personalize their dashboard based on the kind of data and graphs they are interested in.

Another important advantage and future enhancement of the project is that since the whole project is implemented as a rest server and a client architecture, we can extend this to any type of a client. For example, this can be extended to a mobile application or a browser or a desktop application just by extending the existing code base. The code also tries to be scalable and so, this project can be deployed and can be used in production anytime. All these can be done as future work.

9. REFERENCES

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