

Markdown to Moodle: Converting and Importing Test Items

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Abstract: Creating your questions or test with numerous items in Moodle UI can sometimes be tedious and less intuitive compared to writing test items in a conventional format. Using an online converter, the converted DOC files to XML files have compatibility issues with Moodle. This study aims to develop a web application that allows users to type directly to the browser and generates *.doc, *.md and *.xml files. Converted files are stored directly in the local drive and that of an *.xml file can be imported to Moodle. Thus, it also aims to lessen the time allotted in creating test item one at a time in the Moodle. Teachers with varying levels of experience in using Moodle and web applications were engaged in this study. The application was developed using Python on Flask Framework. This study was tested and evaluated through observation, interview and online questionnaire. Results from the study allowed the researchers to determine the usability of the application and the users' behavioral intention. Moreover, data collected will be used to further discussions on possible implementation of the software to larger audience in private and public schools that uses Moodle.

Keywords: Markdown, XML Files, Moodle, Python, Test Items

INTRODUCTION

Learning Management System (LMS) has been utilized to deliver, monitor, document and manage learning in educational training programs or courses by industry trainers and school teachers. Blackboard Learn, D2L Brightspace, Moodle, and Instructure Canvas are some of the best known commercially available LMS systems according to PC Magazine (Fenton, 2018). Others such as such as Segue, Interact, CourseWork, Atutor and KEWL to name few are open source.

Thus, to utilize the learning management system this study investigated on converting and importing test items in Moodle.

REVIEW OF RELATED LITERATURE

Some of the commercial learning management system like Moodle can be implemented in a local premise for free but has limitations. Currently, Moodle has 130,809,018 users and has 102498 active sites that have registered from 234 countries. Moreover, there are 14,986,766 courses available, 568,978,046 enrolments, 281,983,257 forum posts, 133,175,929 resources and 852,412,023 quiz questions (Moodle Statistics, 2018).

Aside from the problem that the test construction confronts such as "what to measure?" and "how to measure?" (Lindquist, 1936), the process within these questions or activities specifically encoding and

generating of test items has been given less attention. Evaluating LMS poses some important issues to address (Hall, 2003). Part of the LMS functionality is constructing test items and importing it to the test bank in their User Interface (UI).

Usability Dimensions

Taking advantage of the usability engineering techniques assists to better productivity (Gore, 1998). There is a variability of standards vis-à-vis the quality in use or attribute usability (Bevan, 2001; Seffah, Metzker, 2004). This attribute provides a basis to determine the factors, criteria, and metrics in improving a product or a system.

The attributes vary from efficiency of use or speed of performance, learnability or time to learn, rememberability or retention over time, reliability in use or rate of errors and user satisfaction or subjective satisfaction of the system in which the user meet their goals (Constantine & Lockwood, 1999; Schneiderman, 1992; Nielsen, 1993).

Other attributes such throughput and attitude (Preece, Rogers, Sharp, Benyon, Holland, & Carey, 1994) are also identified to meet the standards on designing a computer system that assists and supports user to carry out activities safely and productively.

Models and Theories of Individual Acceptance

Several determinants are developed to investigate the user agreement that indicates the success or failure

of a system (Melone, 1990) and predict user acceptance (Venkatesh and Davis, 2000). Venkatesh et al. (2003) synthesized the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975), Technology Acceptance Model (TAM) (Davis, 1989) and Technology Acceptance Model 2 (TAM2) (Venkatesh and Davis, 2000). TRA measures performance and behavioral intention. TAM uses two specific variables to determine the technology acceptance of users. Motivation was used on Motivational Model (MM) by Davis, et al. (1992) to determine user's technology adoption and use. The Theory of Planned Behavior (TBA) is an extension of TRA which determine intention and behavior by adding one more variable (Ajzen, 1991).

This study focused on assessing the Markdown-to-Moodle web based application in constructing test items on a web browser, converting the constructed test items and up to importing the converted test files to Moodle test banks.

Specifically, the study sought to answer the following questions.

1. What is the experience and proficiency and the extent of elementary, secondary and tertiary teachers in using the internet?
2. How usability dimensions affect the teachers' behavioral intention to use the Markdown-to-Moodle application?
3. What are the challenges or barriers that the teachers encounter using this application?

RESEARCH DESIGN AND METHOD

In this study, an online and a paper and pencil survey was administered to private school teachers in the elementary, secondary and tertiary from April to June of 2018. The survey was conducted right after the facilitation and training on the Markdown-to-Moodle application. Teachers has prior knowledge and experience in using learning management system particularly Moodle. There were 120 valid responses. A snowball sampling was used because the training was through a referral method. The demographic data of the respondents were also collected as demonstrated in Table 1.

Table 1. Respondents Characteristics

Respondents Characteristics	Results
Age	Mean 31.66 S.D. 7.704
Gender	Male 40.8% Female 59.2%
Nationality	Filipinos 86.7% Indonesians 11.7% Cambodians 1.7%

Respondents Characteristics	Results
Highest Educational Attainment	Bachelors 39.2%
Teaching Academic Level	Masters 50.0% Doctorate 10.8% Elementary 25.0% Secondary 25.8% Tertiary 49.2%

The measurement of the usability dimensions of the application was adopted from Nielsen (1993) and the measurement of the behavioral intention were adopted from Ajzen (1991). The questionnaire was composed of 1) Demographics, (k = 5); 2) Effectiveness (k = 4); 3) Efficiency (k = 2); 4) Level of Engagement (k = 2); 5) Error Tolerance (k = 3); 6) Ease of Learning (k = 3); and 7) Behavioral Intention to Use the System (k = 2). We adopted a validated scale to develop our survey questionnaire, employing a seven-point scale (Vagias, 2006), where 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither disagree nor disagree, 5 = somewhat agree, 6 = moderately agree, and 7 = strongly agree and for the level of frequency and 1 = never, 2 = rarely, 3 = occasionally, 4 = sometimes, 5 = frequently, 6 = usually and 7 = every time for the frequency).

A t-test and ANOVA were conducted to determine the significant difference of the experience and proficiency of teachers in using the internet. A Durbin-Watson test was also performed to determine the correlations between errors. An ANOVA test was also conducted to identify whether the model is significantly better at predicting the outcome. A multiple regression analysis was conducted to examine the relationship of the predictors to the criterion.

RESULTS AND DISCUSSION

This study obtained 120 valid responses from private school teachers from the elementary, secondary and tertiary level based on the following: Filipino = 104 (Male = 42, Female = 62, mean of age = 32.02), Indonesian = 14 (Male = 7, Female = 7, mean of age = 29.07) and Cambodian = 2 (Male = 0, Female = 2, mean of age = 30.5); 48 male and 72 female respondents.

Proficiency and Internet Use of Teachers

The overall experience and proficiency of the teachers (M=6.06, SD=.863) is very proficient.

Table 2. Teachers' Internet Experience and Proficiency

Academic Level	Mean	SD	Verbal Interpretation
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Elementary(n=30)	5.77	.774	Very Proficient
Secondary(n=30)	6.10	.759	Very Proficient
Tertiary(n=60)	6.18	.930	Extremely Proficient
Total	6.06	.863	Very Proficient

Legend: 6.16-7.00 = Extremely Proficient, 5.30-6.16 = Very Proficient, 4.44-5.29 = Moderately Proficient, 3.58-4.43 = Neutral, 2.72-3.57 = Slightly Proficient, 1.86-2.71 = Low Proficient, 1.00-1.85 = Not Proficient at All

Table 2 also shows the proficiency of the teachers in using the internet at each academic level. The elementary teachers (M=5.77, SD=.774) and secondary teachers (M=6.10, SD=.759) are very proficient in using the internet while tertiary teachers (M=6.18, SD=.930) are extremely proficient.

The secondary teachers (M=3.97, SD=1.326) and tertiary teachers (M=3.72, SD=1.462) are using the internet at home 50% of the time as indicated at Table 3. On the other hand, elementary teachers (M=3.00, SD=.947) only spend 30% of their time using the internet at home. Thus, a significant difference found between and within groups of teachers (M=3.60, SD=1.356) in using internet, $F(2,117)=4.507, p<.05$

Table 3. Teacher Internet Usage at Home

Academic Level	Mean	SD	Verbal Interpretation
Elementary(n=30)	3.00	.947	Occasionally (30%)
Secondary(n=30)	3.97	1.326	Sometimes (50%)
Tertiary(n=60)	3.72	1.462	Sometimes (50%)
Total	3.60	1.356	Sometimes (50%)

Legend: 6.16-7.00 = Every time, 5.30-6.16 = Usually, in about 90%, 4.44-5.29 = Frequently, in about 70%, 3.58-4.43 = Sometimes, in about 50%, 2.72-3.57 = Occasionally, in about 30%, 1.86-2.71 = Rarely, in less than 10%, 1.00-1.85 = Never

It clearly shows in Table 4 that teachers (M=5.56, SD=.977) use internet at school 90% of the time. Tertiary teachers (M=5.70, SD=.997) and secondary teachers (M=5.43, SD=1.07) highly utilize the internet 90% of their time at work. Likewise, elementary teachers (M=5.40, SD=.814).

Table 4. Teacher Internet Usage at Work

Academic Level	Mean	SD	Verbal Interpretation
Elementary(n=30)	5.40	.814	Frequently (70%)
Secondary(n=30)	5.43	1.07	Usually (90%)
Tertiary(n=60)	5.70	.997	Usually (90%)

Total	5.56	.977	Usually (90%)
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Legend: 6.16-7.00 = Every time, 5.30-6.16 = Usually, in about 90%, 4.44-5.29 = Frequently, in about 70%, 3.58-4.43 = Sometimes, in about 50%, 2.72-3.57 = Occasionally, in about 30%, 1.86-2.71 = Rarely, in less than 10%, 1.00-1.85 = Never

Teachers use of internet at work (M=5.56, SD=.977) was significantly different with their use at home (M=3.60, SD=1.356), $t(120)=13.404, p<.001$.

Markdown-to-Moodle Application

Markdown-to-Moodle Application is a web-based platform that allows teachers to directly encode their test items in the web browser. However, there are rules set in creating a questionnaire and constructing a test item. The user interface provides an example of test items and a brief instruction as shown in Figure 1.

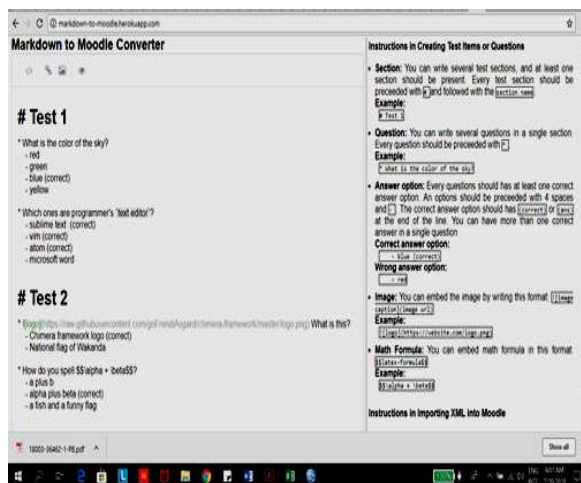


Figure 1. Markdown-to-Moodle Interface

The converter takes markdown formatted file name as command-line-interface argument. The converter then reads the file and convert it into python-dictionary format.

The rule for conversion is as follow:

1. Any line preceded by “#” will be treated as new test session. A single file can contain some different tests.
2. Any line preceded by “*” will be treated as question. A test can contain several questions.
3. Any line preceded by “-” will be treated as multiple-choice option. A question may have several choices. The correct answer should have extra space at the end of the line. Every question may have more than one correct answers.
4. Answer option: Every question has at least one correct answer option. An options should be preceded with 4 spaces and - . The correct answer option has the “(correct)” or “(ans)” at the end of the line. You can have more than one correct answer in a single question

5. Image: You can embed the image by writing this format: `![image caption](image url)`
6. Math Formula: You can embed math formula in this format: `$$latex-formula$$`

The converted file is processed in `md_script_to_dictionary` procedure. After the conversion has been done, the weight of every option in a question will also be automatically calculated. For example, if a question has two correct answers, the weight of every correct option is $100/2$. Because of Moodle rule, the weight should be written with 7 digits behind the dot. This process is done inside `completing_dictionary` procedure.

After the dictionary has been completed, the program will generate XML representation for every test session defined. This is done inside `section_to_xml` procedure. The process from the local computer to Moodle site is shown in Figure 2.

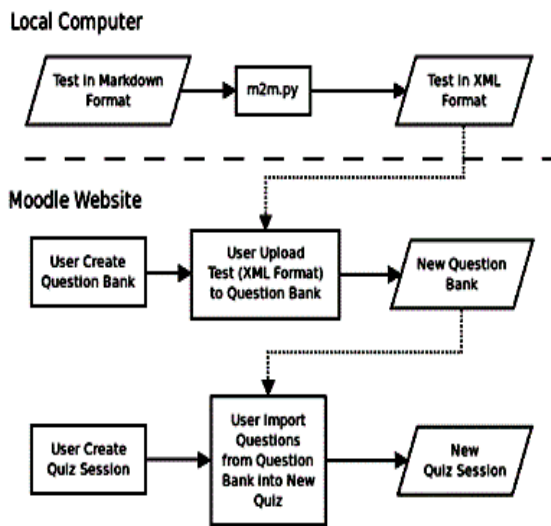
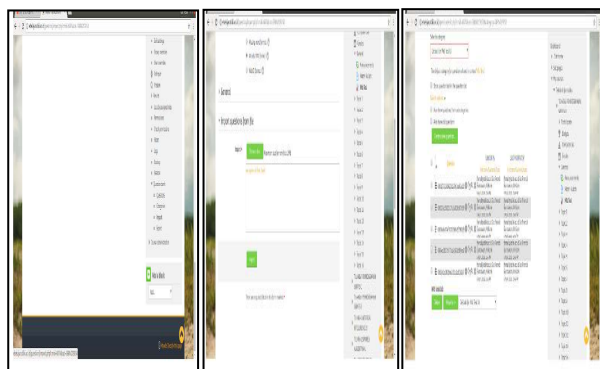


Figure 2. Online Test Item Construction Framework

And finally, for every test session, an XML file is written to the local drive, which will be eventually used to import to the Moodle system.

Importing the converted files into the Moodle system is another process. This is briefly shown on Figure 3.



- (a)
- (b)
- (c)

Figure 3. Importing XML File to Moodle Data Bank (a) Import Test Items (b) Select XML Format (c) Test Bank Item List

The XML file stored on the local drive may then be imported to the Moodle question bank. In the import questions page, select the XML format and upload your XML file. Once it is uploaded, the system shows each test items listed in the Moodle Test Bank.

Experiment Results

There are two sets of test items or questions ($n=10$) that was provided to the teachers. The questions were item-response multiple choice type. Each set are similar in form and questions. Set 1 or test items 1 consists of 10 questions the same as set 2 or test items 2. Each question and choices can be constructed by following the set of rules in creating text, formulas and images link.

In set 1, the teachers directly encoded each question from set 1 or test item 1 in the Markdown-to-Moodle web browser application. There are instructions written in the Markdown-to-Moodle application where the teachers can refer to. They received assistance from the facilitator or administrator while constructing the test items until converting it to XML file.

In set 2, the teachers were given the same number items to construct. But in case, they were not given assistance in constructing the test items up until importing the converted XML files to the Moodle test bank.

The interaction of the teachers with the Markdown-to-Moodle Application was recorded and the time stamps were collected.

The average time stamp of set 1 ($M=22.86$, $SD=5.20$) and set 2 ($M=15.15$, $SD=4.18$) as shown in Table 5. There is a decrease of time ($M=7.71$, $SD=4.61$) between set 1 and set 2. The decrease of time is associated to the teachers learning gain ($M=0.24$, $SD=0.33$) of 24% following the set of rules provided in lesser time than the previous task set. The teachers can complete constructing and converting the test items up until importing it to the Moodle test bank in lesser time. It also shows that the teachers adopt well in the rules in constructing the test items. This is also evident in the t-test result ($M=6.30$, $SD=6.30$), $t(120)=15.42$, $p<.001$ as shown in Table 6.

Table 5. Time Stamp Descriptive Statistics on Constructing and Converting Test Items in Markdown to Moodle Application

Time Stamp: Test Items Construction to File Conversion	Mean	SD

Set 1 Test Items (n=10)	22.86	5.20
Set 2 Test Items (n=10)	15.15	4.18
Set 1 and Set 2 Time stamp Difference	7.71	4.61
Timestamp Learning Gain	0.24	0.33

Table 6. Time Stamp T-Test Result on Constructing and Converting Test Items in Markdown to Moodle Application

Time Stamp: Test Items Construction to File Conversion	Mean	SD	t value	Sig
Set 1 and Set 2 Timestamp Difference	6.30	4.472	15.42	.000

* $p < .05$, ** $p < .01$, *** $p < .001$

Assessment Results

For the 6 items or constructs, the Cronbach Alpha is $\alpha = 0.75$ following George and Mallery (2003) guidelines: $\alpha > .9$ – Excellent, $\alpha > .8$ – Good, $\alpha > .7$ – Acceptable, $\alpha > .6$ – Questionable, $\alpha > .5$ – Poor, and $\alpha < .5$ – Unacceptable. Thus, the constructs or items are correlated.

The mean of the items effectiveness and level of engagement is relatively high at $M=6.26$, $SD=0.47$ and $M=6.24$, $SD=0.54$ respectively as shown in Table 7. This means that the teachers strongly agree that task given to them to construct and convert test items in the Markdown-to-Moodle application and import the test items to Moodle were fully completed and have met the expected results.

In addition, teachers had a pleasant experience in using the web application and were satisfied on how the web application supported their task in constructing the test items. The teachers agree that the Markdown-to-Moodle Web Application is efficient ($M=5.96$, $SD=.68$), error tolerant ($M=5.93$, $SD=.51$) and easy to learn ($M=5.91$, $SD=.56$). Thus, the teachers completed the task quickly with less effort after explaining the rules and assisting them in doing the task which is evident to the decrease of time stamp. After accomplishing set 1, the teachers had minor errors and can recover with their mistakes due to the interface ability to store previous work and the guidelines indicated in the interface. It is also easy for the teachers to learn the interface because there is not much of task and actions that must be done in using the application.

Table 7. Behavioral Intention to Use and Usability Dimensions

Constructs	Mean	SD	Verbal Interpretation
Behavioral	6.03	.68	Agree

Intention to Use			
Effectiveness	6.26	.47	Strongly Agree
Efficiency	5.96	.68	Agree
Level of Engagement	6.24	.44	Strongly Agree
Error Tolerance	5.93	.51	Agree
Ease of Learn	5.91	.56	Agree

Legend: 6.16-7.00 = Strongly Agree, 5.30-6.16 = Agree, 4.44-5.29 = Somewhat Agree, 3.58-4.43 = Neither Agree or Disagree, 2.72-3.57 = Somewhat disagree, 1.86-2.71 = Disagree, 1.00-1.85 = Strongly Disagree

A multiple linear regression was conducted using the stepwise method as shown on Table 5. It has generated two models. The first model has a value of $R^2 = .137$ which means the error tolerance accounts 13.7% of the variation in behavioral intention of the use of Markdown-to-Moodle Application.

While the second model increases to 18.2% or a value of $R^2 = .182$, a variance that can be attributed to the behavioral intention of using the Markdown-to-Moodle Application. In addition, the Dublin-Watson value is 1.903 which indicates a positive correlation between adjacent residuals.

An ANOVA test determined the initial model is highly significant at $F(1,118)=18.77$, $p < .001$ as well as the second model is $F(2,117)=12.99$, $p < .001$ in the regression line. Thus, the items or predictors in the model has a significance influence on the behavioral intention of using the application and that the assumption has been met.

Table 8. Stepwise Regression of the behavioral intention of use of the Markdown-to-Moodle Application on the usability dimensions.

Predictors	b	SE b	β
Step 1			
Constant	3.124	.672	
Error Tolerance	.490	.113	.370***
Step 2			
Constant	2.389	.719	
Error Tolerance	.387	.118	.293**
Efficiency	.225	.089	.225*

Note. $R^2 = .14$ for Step 1: $\Delta R^2 = .05$ for Step 2 ($ps < 0.05$) * $p < .05$, ** $p < .01$, *** $p < .001$

For the step 1, the Error Tolerance, $\beta = .370$, $t(120)=3.28$, $p < 0.001$ is the predictor that is making the most significant contribution to the behavioral intention of using the Markdown-to-Moodle Application as shown in Table 8. Moreover, step 2 still includes predictor Error Tolerance, $\beta = .293$, $t(120)=2.53$, $p < 0.01$ and adds Efficiency, $\beta = .225$,

$t(120)=2.53, p<0.05$ in the predictors that contributes to the behavioral intention of using the application. Thus, the regression equation for predicting the behavioral intention in using the Markdown-to-Moodle web application is:

$$BI=.387*Error\ Tolerance+.225*Efficiency-2.389$$

Where BI is the behavioral intention to use the application.

In general, the teachers' experience and challenges related to the use of the Markdown-to-Moodle web-based application are most likely similar.

According to an elementary teacher, taking into account the application's effectiveness and efficiency:

...I was happy when I completed the task. I struggled a bit at first because I am not familiar with the rules in constructing the test items specifically in linking the images in the question. But with the second task, I did it with minimal error and effort and finished the task quick.

Another elementary teacher shared how engaging it was creating test items in Markdown-to-Moodle web-based application.

...although I had difficulty of linking a picture to a test item at first, I am glad about the outcome when the test was imported to the test bank. You can clearly see the pictures. It is great to incorporate images in test items.

From the tertiary level, a business management teacher shared her experience in using the application:

...there is only one page to navigate. I don't need to go to other pages. And when I accidentally closed the browser, I thought I lost all the questions. When I opened it again, I was directed to the same page which contains the last activity, up to the last item that I encoded on the workspace. It was really a big relief.

A secondary teacher pointed out his level of engagement and ease of learning:

...I was satisfied with the outcome of the converted file. It generates an answer key and a questionnaire aside from the file I am going to import in Moodle test bank. Although, the workspace should have been a little bigger, but I understand because the instructions in constructing and creating a question is written on the same page which guides me throughout the activity.

CONCLUSION

The purpose of this study is to assess the Markdown-to-Moodle web-based application in constructing test items on a web browser, converting the constructed test items to DOC and XML file up until importing the converted test files to Moodle test banks.

This study clearly reveals that the teachers highly utilize the internet at work than at home. Moreover,

the teachers who used the Markdown-to-Moodle Web Application is very proficient in using the internet.

Using the specified rules in constructing a test item in the Markdown-to-Moodle web application, the teachers can generate a .doc file which consists of a questionnaire and an answer key and an xml file that is compatible to import to a premised-based and a cloud-based Moodle test bank. It also shows that the time of current task from the previous task in constructing, converting and importing the test items is lesser.

In the model generated in the analysis, it shows that efficiency and error tolerance significantly contribute to the teachers' utilization of the Markdown-to-Moodle web application. This can be attributed to the less effort and quick accomplishment in constructing and converting test items using the Markdown-to-Moodle Application which has interface where teachers can easily recover when committing error.

Moreover, the limitation of our study is the number of foreign respondents in Indonesia due to Ramadan long week holidays which greatly affects the schedule of teacher in classroom instruction.

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