Implementation intention and how it affects goal achievement in MOOCs

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Abstract. Implementation intentions are a way for MOOC learners to help acting out their goal intentions. Implementation intentions are concerned with planning where, when, and how learning will take place as well as planning how much time will be allocated to the learning and determining how potential problems will be resolved (referred to as shielding behavior). The current study investigates the relationship between the degree to which implementation intentions are formed and the degree to which goals are achieved (less than intended, all as intended, more than intended) thereby taking the time spent on learning and the number of barriers encountered into account. The results, based on the current data collection of a single MOOC, revealed that the degree of implementation intentions was completely determined by time planning. Implementation intentions did not affect the degree of achieved goals relative to intended goal achievement nor did the number of barriers encountered. Implementation intentions also did not influence the impact of the number of barriers on the degree of achieved goals relative to intended goal achievement (the finding was not significant). Finally, MOOC learners who planned time spent less time on learning than those who did not, which suggests these planning learners were more effective with their learning time. For those time-planning learners, time spent had a significant positive effect on the degree of achieved goals relative to intended goal achievement.

Keywords: MOOCs, online learning, success, intention, dropout

1 Introduction

Dropout in MOOCs is currently one of the most investigated subject in the MOOC research community because literature reports alarming high dropout rates which range from about 90% till 95% [1]. These dropout rates are based on the concept that a drop-outter is someone who did not receive a certificate after the MOOC run. MOOC providers mostly adhere to this concept and try to find ways to lower these
dropout rates. This often means changing the course design of the MOOC to increase engagement, persistence, and completion [2]. However, a growing group of researchers do not adopt this concept of dropout and argue that when the learner perspective is chosen as a point of departure the dropout rates will become much lower. The learner perspective holds that dropout occurs when the learner did not achieve her/his learning goals because there were reasons to stop premature [3]. Using the learner perspective, three basic types of MOOC learners can be distinguished, namely those MOOC learners who have achieved more goals than intended, those who achieved exactly what they intended, those who achieved less than intended. We do not consider the group who did less than intended as drop outers because their goal intentions may have changed during the MOOC run—very similar to those who did more than intended. We have earlier proposed a research agenda on MOOCs based on the reasoned-action approach and the intention-behaviour gap [4].

Gollwitzer [5, 6] proposed implementation intentions as a way to help individuals (here the MOOC learners) to act out their intentions. We interpreted his implementation intentions as being concerned with planning where, when, and how the learning will take place as well as planning how much time will be allocated to the learning and determining how potential problems will be resolved. The latter is referred to as shielding behavior. Research has shown that when implementation intentions are formed, acting out the goal intentions will be more successful [7].

The current study investigated the relationship between the degree to which implementation intentions were formed and the degree to which goals were achieved (less than intended, all as intended, more than intended) thereby taking the time spent on learning and the number of barriers encountered into account. It was expected that the more time is spent on learning the higher the probability that the intended goal achievement will be realized. It was also expected that the more barriers are encountered the less the probability that the intended goal achievement will be realized but that the impact of the barriers can be reduced if plans for shielding behavior exists. We also expected that, in general, forming implementation intentions will also reduce the impact of these barriers on goal achievement. The paper is structured as follows: we first present the research model. Then we present our research and the findings. We discuss our results and draw conclusions of the approach.

2 Research Model

The research model in the current study is depicted in Figure 1.
In this finite mixture model ‘implementation intention’ is a categorical latent variable with binary latent class indicators ‘time,’ ‘when,’ ‘where,’ ‘how,’ and ‘shielding.’ The arrow from implementation intention to ‘time spent’ (continuous variable) indicates that the mean of ‘time spent’ may vary across ‘implementation intention’ classes. The arrow from ‘implementation intention’ to ‘difference’ (continuous variable) indicates that the intercept of ‘difference’ varies across ‘implementation intention’ classes whereas the dotted arrow from ‘implementation intention’ indicates that the slope in the regression of ‘difference’ on ‘number of barriers’ (count variable) vary across classes of ‘implementation intention.’ As we used a finite mixture model that identifies subpopulations within the overall population we treated ‘gender’ as a known categorical latent variable, determined by the single latent class indicator sex, rather than as a covariate. The arrow from ‘gender’ to ‘implementation intentions’ represents the multinomial logistic regression of ‘implementation intention’ on ‘gender’ when comparing the latent classes of ‘implementation intention.’ The arrows from ‘time spent’ and ‘number of barriers’ to ‘difference’ represent the linear regressions of ‘difference’ on ‘time spent’ and ‘number of barriers’ respectively. Finally, the arrow from ‘time’ to ‘time spent’ indicates that the mean of ‘time spent’ varies between those of the overall population who made plans about time and those who did not. In a similar way, the slope in the regression of ‘difference’ on ‘number of barriers’ is also varying between those who made plans about shielding behavior and
those who did not. It is further to be noted that ‘implementation intention’ was measured at the beginning of the MOOC whereas ‘time spent,’ ‘number of barriers,’ and ‘difference’ were measured at the end of the MOOC.

3 Method

3.1 Participants

1436 Participants of the MOOC “The Adolescent Brain” have received an invitation to fill in the pre-questionnaire before the start of the course and the post-questionnaire after course finalization. The MOOC was offered in the Dutch language and ran from April until June 2016 covering seven modules for seven weeks. MOOC-takers who participated in all learning activities could request a certificate. The weekly study load was estimated at three to five hours per week. The pre-questionnaire was completed by 821 MOOC-takers (664 women, 157 men, M_{age}= 45.1, age range: 18-74 years). The post-questionnaire was completed by 126 MOOC-takers (no demographic information available). In total 101 MOOC-takers completed both questionnaires (90 women, 11 men, M_{age}= 37, age range: 18-54 years). However, only 40 respondents (4 men, and 36 woman) selected all items used in this study. This meant that the analyses for determining the number of latent classes for the categorical latent variable ‘implementation intention’ could only use these 40 participants.

3.2 Procedure

A pre-and post-questionnaire has been administered to participants of the MOOCs on “The Adolescent Brain” offered by the Open University of the Netherlands on the EMMA platform from April until June 2016. After matching answers between both questionnaire, 101 participants could be identified who answered questions about intended and realised behavior. A correlation analysis has been conducted between the variable measuring intention and the reported behavior. A new variable was constructed by substracting the intentions from behavior leading to a new variable determining the ‘size’ of the intention behavior gap. Only 40 respondents (4 men, and 36 woman) completely filled in all items for this study. This meant that the analyses for determining the number of latent classes for the categorical latent variable ‘implementation intention’ could only use these 40 participants.

3.3 Measures

The items to measure intention and behaviour were designed according to guidelines by Sutton [9]. Intentions were measured with a self-constructed single-choice scale with items of increasing intensity for participation ranging from “browsing the course” up to “finalising all activities and requesting a certificate”. The items to measure implementation intentions were taken from a study by Sheeran, Webb and Gollwitzer [10]. Implementation intentions were assessed by five dichotomous items (‘time,’ ‘when,’ ‘where,’ ‘how,’ and ‘shielding) with answering categories ‘yes’ an
These items function as latent class indicators in the analyses. Time spent was measured by one open entry item in the post-questionnaire.

Number of barriers was measured by an optional multiple-choice item that presented x potential barriers and the option ‘other’ to participants. A new variable has been constructed based on the barriers selected for his item.

3.4 Analysis

All latent class analyses (LCA) were performed in Mplus version 7.3 [8]. SPSS version 24 was used for some descriptive statistics. We first performed a series of LCA analyses for determining the number of classes of the categorical latent variable ‘implementation intention.’ After that the number of latent classes was determined, we performed LCA analyses on the structural model as depicted in Figure 1. That is, we actually performed the LCA analyses on a simplified version of it—depicted in Figure 3—for reasons explained in the result section.

4 Results

The 40 respondents who completely filled in the surveys turned out to encompass only four men versus thirty-six women. Therefore, it was decided to exclude the known categorical latent class ‘gender’ in our analyses. Because the latent class indicator ‘where’ was answered by the whole population positive (i.e., category 2, implicating ‘yes’), this indicator was not included in these analyses as well.

The analyses on the measurement LCA model of ‘implementation intention’ revealed three classes of the categorical latent variable ‘implementation intention;’ more classes yielded values > .05 for the Vuong-Lo-Mendell-Ruben likelihood ratio test (LRT), the Lo-Mendel-Rubin adjusted LRT test, and the Parametric bootstrapped LRT (see Table 1).

<table>
<thead>
<tr>
<th>number of classes</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akaike (AIC)</td>
<td>145.398</td>
<td>153.495</td>
<td>163.447</td>
</tr>
<tr>
<td>Bayesian (BIC)</td>
<td>160.598</td>
<td>177.139</td>
<td>195.536</td>
</tr>
<tr>
<td>Sample-Size Adjusted BIC</td>
<td>132.435</td>
<td>133.330</td>
<td>136.080</td>
</tr>
<tr>
<td>entropy</td>
<td>1.000</td>
<td>1.000</td>
<td>0.573</td>
</tr>
<tr>
<td>Vuong-Lo-Mendell-Ruben LRT test</td>
<td>0.0238</td>
<td>0.0306</td>
<td>0.8163</td>
</tr>
<tr>
<td>Lo-Mendel-Rubin adjusted LRT test</td>
<td>0.0278</td>
<td>0.0345</td>
<td>0.8190</td>
</tr>
<tr>
<td>Parametric bootstrapped LRT</td>
<td>0.3333</td>
<td>0.6667</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Table 1. Fit indices for each solution of number of classes.
However, the three classes solution had one class (latent class 3) which has zero man and only one woman as class members. Therefore, it was decided to adopt the two classes solution. This choice also corresponds with the lowest values for AIC, BIC and adjusted BIC as well as for the Vuong-Lo-Mendell-Rubin likelihood ratio test (LRT), the Lo-Mendel-Rubin adjusted LRT test, and the Parametric bootstrapped LRT. The two latent classes differentiated between those who are strong on making implementations intention (15 respondents, 1 man and 14 woman) and those who are weak (25 respondents, 3 men and 22 women). For each latent class the probabilities of answering positive on the latent class indicators were calculated, see the chart in Figure 2. For example, those who belong to the class of weak implementation intention have an 86.7% probability of answering positive (i.e., a ‘yes’) on the latent class indicator ‘where’ whereas those who belong to the class of strong implementation intention have a 100% probability of answering positive on this indicator.

![Fig. 2. The two latent classes of ‘implementation intention.’](image)

Fig. 2. The two latent classes of ‘implementation intention.’

Note that although the latent class indicator ‘when’ was not included in the analyses for the determination of the number of latent classes, it is included in this chart in Figure 2 for completion reasons. Regardless to which latent class respondents belonged to, they would have a 100% probability of answering positive on this indicator; that is, the answer would always be ‘yes.’ As there were only 40 men and woman in the population, we must interpret the chart in Figure 2 with care. Therefore, the extreme conditional probabilities (i.e., 100% or 0% conditional probability) should be interpreted with some relaxation.

Interestingly, the most important finding from these analyses was that the latent class indicator ‘time’ appeared to be completely responsible for the determination of who of the respondents belongs to the weak- or to the strong class of ‘implementation intention.’ By this finding, the categorical latent variable ‘implementation intention’
could be regarded as a known categorical latent variable with ‘time’ as it’s only latent class indicator. As a result, the research model depicted in Figure 1 was simplified to the model depicted in Figure 3. Another advantage of the finding was that a much larger group of respondents could be used for the analysis of simplified model as more respondents filled in answers for latent class indicators for ‘implementation intention.’ It turned out that actually all 101 respondents could be included in the analyses. In Figure 3, the known categorical latent variable gender was here also excluded from the analyses for the same reasons we had when performing the above analyses, but this time the population encompassed 13 men and 88 women.

Fig. 3. The simplified research model of the current study. The figure also depicts the results of the analyses encompassing all respondents: the unstandardized slopes (i.e., the path coefficients), the intercepts and the explained variances (R2) for each of the two latent classes.

The results were a bit surprising. Though the latent class representing the group of weak implementation intention (53 respondents, 7 men, 45 women, and one unknown) as well as the latent class representing the strong implementation class (48 respondents, 6 men and 42 women) had impact on the slopes in the regression of ‘difference’ on ‘number of barriers,’ the slopes themselves, however, were not significant meaning that ‘number of barriers’ did not affect ‘difference. Nevertheless, their impact was negative as expected. In contrast, the slope in the regression of ‘difference’ on ‘time spent’ was significant meaning that the more time spent on studying the MOOC the more positive the difference between intended and actual behavior will
be; that is, more goals were achieved than intended. This was true for both latent classes but for only the latent class representing the group of strong implementation intentions the explained variance was significant.

MPlus provided as part of the LCA analyses estimated sample statistics for ‘time spent,’ ‘number of barriers,’ and ‘difference’ for each latent class. These statistics are shown in Table 2 for the LCA analyses encompassing the 40 respondents and for the LCA analyses encompassing all 101 respondents.

<table>
<thead>
<tr>
<th></th>
<th>estimated sample statistics for the 40 respondents in the first LCA analyses</th>
<th>estimated sample statistics for all 101 respondents in the second LCA analyses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>weak (N = 15)</td>
<td>strong (N = 25)</td>
</tr>
<tr>
<td></td>
<td>M                  SD</td>
<td>M                  SD</td>
</tr>
<tr>
<td>‘time spent’</td>
<td>38.80              26.46</td>
<td>28.48              14.32</td>
</tr>
<tr>
<td>‘number of barriers’</td>
<td>1.47               1.96</td>
<td>1.36               1.44</td>
</tr>
<tr>
<td>‘difference’</td>
<td>-.67               1.68</td>
<td>-.40               1.16</td>
</tr>
</tbody>
</table>

Table 2. Estimated sample statistics

Table 2 shows that the latent class representing the group with weak implementation intention seemed to spent more time on studying MOOCs when compared to the latent class representing the group with strong implementation intention. This was true for the two LCA analyses (see Figure 2). However, a series of t-tests with Bonferroni adjustments proved none of the differences in means of ‘time spent,’ ‘number of barriers,’ and ‘difference’ between the weak and strong implementation intention classes in the two LCA analyses to be significant. The Bonferroni adjustment means that the normal alpha values of .05 and .01 are divided by three as there are three related variables (‘time spent,’ ‘number of barriers,’ and ‘difference’) which equals .017 and .0034 after rounding respectively.

5 Conclusion

The results, based on the current data collection of a single MOOC, revealed that the degree of implementation intentions was mainly determined by time planning. Implementation intentions did not affect the degree of achieved goals relative to intended goal achievement nor did the number of barriers encountered. Implementation intentions also did not influence the impact of the number of barriers on the degree of achieved goals relative to intended goal achievement (the finding was not significant). Finally, MOOC learners who planned time spent less time on learning than those who did not which suggests these planning learners were more effective with their learning
time. For those time-planning leaners, time spent had a positive effect on the degree of achieved goals relative to intended goal achievement.

6 Discussion

First of all, we have to stress that because of the low number of participants completely filling in the survey both at the begin and at the end of the MOOC, all findings have to be taken with extremely care. In fact, the MPlus analyses may suffer from this low number. An extra drawback was that all latent class indicators but one were dominantly answered positive, meaning that these indicators did not really contribute to the determination of the number of latent classes. The only exception was the latent class indicator ‘time’ and, therefore, ‘time’ was used as a proxy for ‘implementation intention.’ Perhaps answering the latent class indicators suffered from response bias and unwillingness to answer them. Therefore, the results of our study may not reflect the actual situation. Our future studies will take care that a much larger sample of MOOC takers will be addressed and that all latent class indicators will be answered unbiased.

Nevertheless, our findings may give a first insight in the effects of implementations intentions on the difference between intended and actual behavior in terms of goal achievement that MOOC takers had when they enrolled in the MOOC. This line of research can potentially inform an alternative approach for analysing and measuring what counts as success in the MOOC context.

References


