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OPINION

Promoting educational equity and facilitating effective use of high-quality resources: An empirical study on improving massive open online courses completions

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ABSTRACT

Massive open online courses (MOOC) have witnessed a surge in popularity in recent years, affording learners the convenience and adaptability to access top-tier educational resources. Despite the myriad advantages MOOC offer, the global and Chinese completion rates linger at a modest level. Recent data reveals a worldwide average completion rate of approximately 10%, underscoring the challenge of retaining learners throughout their enrolled courses. In China, a parallel scenario unfolds, with completion rates fluctuating around 5%–10%. This study delves into the examination of social-psychological factors contributing to China's low MOOC completion rates. In study 1, we found a disparity in MOOC completion and scores between first-generation college students and non-first generation college students, and underpinned social threat as one contributing factor to this disparity. In the experiment, we nudge college students towards enhancing their participation and elevating completion rates within MOOC learning.This research conducted a comparative analysis of two cognitive nudge methodologies, revealing the superiority of the value affirmation intervention over the reappraisal intervention. Moreover, hierarchical intervention strategies were recommended to enhance students' learning experiences more efficiently.

Key words: massive open online courses, completion rates, social-psychological factors, cognitive nudge, learning enhancement.

As Internet technology matures and permeates education, Massive open online courses (MOOC) have emerged as a novel pedagogical model. In 2008, the inaugural MOOC, boasting a mere 2, 300 registered users, marked the genesis of a transformative trend. Major MOOC platforms command audiences in the tens of millions, exemplifying a developmental trajectory from subdued growth to meteoric expansion in just over a decade. Since 2012, preeminent American universities have pioneered the establishment of MOOC learning platforms, including Coursera, Udacity, and edX, proffering complimentary courses and affording a broader spectrum of students systematic learning opportunities.

From 2013 onward, MOOC proliferated across Asia,

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with esteemed institutions such as the Hong Kong University of Science and Technology, Peking University, and Tsinghua University venturing into the online course domain. Notably, XuetangX, a Chinese MOOC platform developed by Tsinghua University, curates top-tier courses from an array of distinguished universities, including Tsinghua University, Peking University, Stanford University, Massachusetts Institute of Technology, University of California, Berkeley, spanning diverse disciplines like computer science, business management, engineering, psychology, literature, history, and art. The advent of MOOC aggregates and disseminates globally sourced, high-quality teaching resources, fostering an elevation in educational standards and advocating for educational parity.[1] Official data from the Chinese University MOOC platform shows that by 2019, the platform had over 10 million registered users and more than 40 million course enrollments. However, the course completion rate was only 1.5%, and courses with a pass rate of over 10% did not exceed 10% of the total, resulting in a significant waste of educational resources. While MOOC provide a wealth of resources for the university student population with their openness and free access, the low course completion rate undermines the original intention of improving the quality of education and promoting educational equity.[2]

This study targets the low course completion rate of online learners, analyzes the psychological factors affecting learners' motivation, hopes to increase the participation and completion rate of online learners through psychological interventions, and verifies effective methods to improve course completion rates.

FACTORS AFFECTING THE COMPLETION RATE OF MOOC

An online survey, conducted by Colman,[3] delineated the foremost reasons underpinning the attrition from MOOC, encompassing factors such as excessive time demands, perceived difficulty levels (either too advanced or overly basic), suboptimal course design marked by a reliance on lecture videos, insufficient guidance on technological aspects and course structure, and the mismanagement of discussion boards. Furthermore, ancillary costs, such as the mandatory acquisition of expensive textbooks by instructors, contribute to diminished completion rates. Additionally, a subset of students enrolls with a selective focus on acquiring partial knowledge, demonstrating indifference towards obtaining a course completion certificate.[4]

In the investigation conducted by Rosé *et al.*,[5] three social factors were identified as influential in student attrition. Individuals assuming the role of opinion leaders in course discussions exhibited heightened investment and lower dropout rates. Active participation in the initial week correlated with a 35% reduction in dropout rates. Notably, the act of dropout itself may induce a ripple effect, as students perceive the learning environment as unsupportive, thereby fostering a cascading impact on peer interaction, and students with a high degree of self-regulated learning have better course completion rates and grades.

Motivation and self-regulated learning emerged as focal points in elucidating MOOC dropout rates. Carson's findings underscored the pivotal role of self-regulated learning, indicating that a high degree of self-regulation correlated with enhanced course completion rates and grades.[5] Addressing the issue of inequality in knowledge acquisition, Semenova *et al.*[6] posited that while MOOC aims to mitigate knowledge disparities, the reality belies universal equity. Disparities in education level, prior MOOC experience, and gender were identified as pivotal factors. Notably, individuals with higher education levels exhibited an 18% completion rate compared to a mere 3% for those with lower education levels. The completion rates were significantly higher for highly educated participants (84%-88%) and those with previous MOOC experience (65%-80%), while gender disparities were evident, with 6%–7% more males completing MOOC than females, reflecting societal norms that disproportionately allocate domestic responsibilities to women, thereby influencing their course participation.

In China, where university students constitute the primary demographic engaging with MOOC, the age group of 18 to 23 years accounts for 71.11% of users, with undergraduate freshmen and sophomores comprising over half of MOOC learners. A noteworthy division among university students is between first-generation and non-first-generation college students. A Research revealed that over 70% of first-generation college students in China come from rural areas, exhibiting lower socioeconomic status and diminished cultural capital than their non-first-generation counterparts.[7] Academic motivation and engagement in high-impact educational activities are notably lower among first-generation college students. Additionally, these students grapple with cognitive and psychological challenges during the transition from home to school, encountering issues such as anxiety, spatial dislocation, psychological imbalance, cultural conflict, and strained social relations. The societal stereotypes associated with first-generation college students exacerbate these challenges, leading to attributions of difficulties to threatening signals and subsequent academic performance deterioration. To ameliorate the academic performance of first-generation college students, interventions targeting psychological and cognitive

enhancements are imperative.[8–10]

Concerning academic performance, first-generation college students lack motivation for engaging in high-impact educational pursuits. This manifests in a substantial contrast in online learning compared to their non-first-generation counterparts, as highlighted by Zhang *et al.*[7] Cognitively and psychologically, the transition from home to school and middle school to university presents formidable challenges for first-generation college students. The societal stereotyping of the first-generation college student cohort further compounds their difficulties in campus life. When confronted with challenges, these students are prone to attributing them to perceived threats.[10] Faced with stereotypes, individuals' social identity and self-esteem undergo jeopardy, instigating a sense of fear that detrimentally influences their academic performance.[9] Consequently, a pivotal avenue for enhancing the academic performance of first-generation college students lies in initiating interventions directed at bolstering their psychological and cognitive faculties.

To ameliorate the challenges faced by marginalized groups, particularly in contending with stereotypes and social identity threats, Cohen's team at Stanford University conducted psychological interventions centered around self-affirmation and fostering social belonging among MOOC learners. The outcomes of these interventions yielded noteworthy advancements, particularly among learners in both underdeveloped nations.[11]

Kizilcec's study plotted data from 18 million MOOC learners engaging in 55 courses offered by Stanford University on Coursera. The United Nations' Human Development Index (HDI) exhibits a positive correlation with the completion rates of MOOC courses. A correlation coefficient of 0.78, revealed a high correlation between the completion rate of MOOCs and the HDI of the learner's country.

Analyzing the enrollment data of 891, 646 entries across 760 MOOC courses offered by XuetangX Online between 2015 and 2018 (as shown in Figure 1), the completion rates of courses across different provinces was 0.07. When aligned with HDI, we did not find the same trend as in Kizlcec *et al.*[11]

Although we did not find the same pattern of course completion in relation to HDI, we found a distinct pattern that differentiates Chinese MOOC learners and varies in self-efficacy. In China, the primary demographic engaging in MOOC comprises university students, particularly divided into first-generation and non-first-generation students based on whether both parents have received higher education. Research

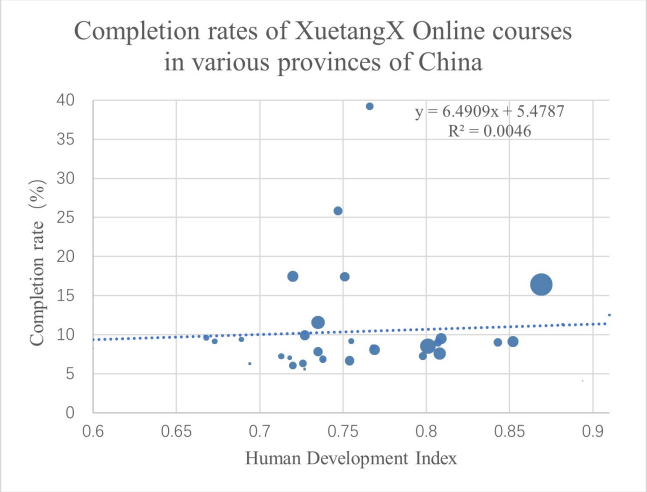

Figure 1. Completion rates of XuetangX Online courses in China.

indicates that over 70% of Chinese university students fall into the category of first-generation.[7] First-generation students exhibit significant disparities in academic performance and psychological well-being compared to their non-first-generation counterparts. The academic gaps are attributed to cognitive states induced by social identity threats.[9] To promote the motivation of MOOC learners and enhance course completion rates, it is crucial to focus on supporting first-generation college students. The key lies in guiding them to adjust their cognitive perspectives, employing strategies that leverage the principle of "attitude influencing behavior," ultimately prompting them to achieve improved academic outcomes.

EFFECTIVE PSYCHOLOGICAL INTERVENTIONS TO PROMOTE MOOC COMPLETION RATES

Due to societal stereotypes surrounding first-generation college students, when they encounter challenges in studying and life, they are prone to categorize difficulties as signals of threat.[10] These stereotypes jeopardize individuals' social identity and self-esteem, giving rise to a sense of fear. This fear, in turn, adversely impacts their academic performance.[12]

In the face of threats, people will adopt defensive strategies to make strong self-justifications or avoid facing threats directly.[13] Self-affirmation theory believes that people want a "comprehensive sense of efficacy" to control important life events and achieve self-integrity.[14] In order to eliminate the impact of a threat that can cause dissonance on the self-concept, people can focus their attention on their abilities in an unrelated field.[15] This type of intervention expands people's perspectives by emphasizing different areas of their lives, and even if

they are threatened in one or two areas, they can still maintain self-integrity and achieve self-reinforcement in their narratives.

Self-affirmation intervention (value-affirmation intervention, VA) is designed to help students reduce the threat brought by stereotypes and narrow their academic gap with others.[16] A typical self-affirmation intervention lets participants choose what they think is most important from a series of self-related value qualities and write a paragraph to describe it.[17–14] By describing important value qualities, people's self-integrity is restored, and when they face threats, they can cope more healthily.

Re-evaluation uses expressive writing, which can help people manage negative emotions and make people systematically re-evaluate their stress, thereby reducing the burden of worry on working memory.[18] This method of reevaluation can reduce personal anxiety,[19] increase happiness,[20] and improve relationship satisfaction.[21] Kizilcec and others' research shows that self-affirmation interventions can help students reduce the threat brought by stereotypes and narrow their academic gap with others.[11]

STUDY 1

The aim of Study 1 is to confirm whether there is a difference in academic performance between first-generation college students and non-first-generation college students among MOOC online learners, and to investigate the relationship between their academic performance and social identity threats.

First, an online questionnaire was used, and it was divided into two parts: academic performance and the degree of social identity threat. The participants in Study 1 were university student users of XuetangX Online. In the first part, a total of 571 valid questionnaires were collected (358 males and 213 females), and the age was mainly distributed between 18–25 years old (82.1%); in the second part, a total of 670 valid questionnaires were collected (404 males and 266 females), and the age was mainly distributed between 18–25 years old (83.6%). The questionnaire was distributed by email, and the main content of the questionnaire included the following three aspects: demographic information, identity of first-generation college students, and the measurement of a threat scale adapted from Kizilcec *et al.*[11]

At the same time, the participants' academic performance, *i.e.*, their course grades (percentage system), was collected through the XuetangX Online platform, and the average grade of the participants was calculated as their academic performance score. Through the XuetangX Online platform, the course grades of 571 participants (345 first-generation college students and 226 non-first-generation college students) were collected. The independent t-test showed a significant difference in academic scores between first-generation college students and non-first-generation college students (t = 3.992, P < 0.001), and the course scores of non-first-generation college students were significantly higher than those of first-generation college students. The mean scores for first-generation and non-first-generation college students on XuetangX are shown in Table 1. Independent t-test analysis showed a significant difference in academic scores between male and female students (t = 2.803, P = 0.005), and female students performed better.

Table 1: Academic performance (course scores) for first-generation and non-first-generation college students on XuetangX

	Number	Mean	Variance
First-generation college student	345	6.86	313.64
Male	232	5.70	247.75
Female	113	9.24	443.94
Non-first-generation college student	226	14.74	674.44
Male	126	11.75	423.54
Female	100	18.50	972.19

The questionnaire survey collected 670 participants' identity threat scores (397 first-generation college students and 273 non-first-generation college students). Independent t-test analysis showed a significant difference in the degree of social identity threat between first-generation and non-first-generation college students (t = -2.237, P = 0.026), and first-generation college students were subject to stronger social identity threats. The details of identity threat scores are shown in Table 2. Independent t-test analysis showed a significant difference in the degree of social identity threat between male and female students (t =-3.279, P = 0.001), and male students had a higher level of social identity threat. It may be related to men's higher expectations in Chinese society, so male students were more concerned about how other people evaluated them and their groups.

Based on the above results, in the subsequent formal experimental design, two self-affirmation and social belonging interventions will be used to improve the social identity and self-integrity of the university student group, especially the first-generation college students. It is hypothesized that the intervention implemented will reduce the pressure and threat brought by group identity. After the brief intervention, students will face academic challenges more positively and healthily,

Table 2: Identity threat scores for first-generation and non-first generation college students

	Number	Mean	Variance
First-generation college student	397	3.50	2.46
Male	262	3.70	2.50
Female	135	3.12	2.25
Non-first-generation college student	273	3.23	2.40
Male	142	3.27	2.43
Female	131	3.17	2.37

participate more in MOOC courses, and achieve better results.

EXPERIMENT

Method

The formal experiment recruited participants by disseminating through announcements and emails in four XuetangX courses: "Introduction to Modern Biology (Spring 2019)," "Introduction to Psychology (Spring 2019)," "Exploring Psychology (Spring 2019)," and "Advanced C++ Programming (Spring 2019)." A total of 190 participants were recruited and randomly divided into three groups.

Questionnaires were administered to both the experimental and control groups. After excluding 23 participants (whose questionnaire responses could not be matched with XuetangX grades), there were 167 valid participants. The distribution across the four courses was 84, 49, 20, and 14 participants, respectively.

In the formal experiment, participants were randomly assigned to three groups: Experimental Group 1, Experimental Group 2, and Control Group. Experimental Group 1, the value affirmation group, required participants to engage in a psychological intervention in the second week of the course. The intervention took the form of an online questionnaire, where participants selected 2–3 essential life values from a range, including artistic proficiency, positive relationships with family and friends, physical activity, wealth, musical skills, creativity, business/management skills, aesthetic appearance, and social service abilities. Participants were then instructed to write a detailed 150–200-word description highlighting their qualities in the chosen areas and explaining how learning the MOOC reinforced and reflected these crucial values.

Experimental Group 2, the reassessment group, assigned participants to write a 150–200-word narrative in the second week, describing themselves as first-generation and non-first-generation university student community members and expressing their thoughts and feelings about the ongoing MOOC learning experience. Participants were encouraged to explore their inner emotions, linking current sentiments to similar past experiences.

Participants in the control group read four passages discussing techniques and methods for online course learning. After reading, they were required to write a 150–200-word description of their learning strategies and compare them with the materials they had read. No gender-specific interventions exist in this study, so gender differences were not involved in the experimental design.

The experimental and control groups received a single intervention at the beginning of the semester (week 2), with the effectiveness measured by participants' quiz score percentages collected at the end of the term (as shown in Table 3).

Using analysis of variance (ANOVA) to explore the impact of group, gender, and university student identity on quiz scores, it was discovered that the main effect of university student identity was significant ($F = 5.766$, $P = 0.018$). Non-first-generation university students exhibited significantly higher quiz scores compared to first-generation students.

Within the control group, there was a notable disparity in quiz score percentages between first-generation and non-first-generation university students ($t = 2.082$, $P = 0.042$). However, in the experimental groups, this difference disappeared post-intervention (value affirmation group: $t = 1.089$, $P = 0.282$; reassessment group: $t = 1.598$, $P = 0.116$). The results of the intervention are shown in Figure 2.

Compared to the control group, positive values intervention led to a 6.15 percentage point increase in quiz scores for first-generation university students and a 5.24 percentage point increase for non-first-generation university students. Similarly, reassessment intervention resulted in a 1.90 percentage point increase for first-generation university students and a 1.67 percentage point increase for non-first-generation university students.

Conclusion

The results indicate that a single psychological intervention can enhance the academic performance of university students in MOOC. Both positive values and reassessment interventions were effective in increasing learners' quiz scores, demonstrating the effectiveness of interventions in improving MOOC completion rates.

Comparatively, the positive values intervention outperformed the reassessment intervention. Positive values

Table 3: The quiz scores of students measured at the end of the term of the three groups after a single intervention in week 2

	Number	Mean	Variance
Control group	64	0.06	269.94
First-generation college student	33	0.02	110.25
Non-first-generation college student	31	0.11	412.09
Value affirmation group	46	0.11	510.31
First-generation college student	28	0.09	335.26
Non-first-generation college student	18	0.16	782.88
Reassessment group	57	0.09	375.97
First-generation college student	27	0.04	239.32
Non-first-generation college student	30	0.12	479.17

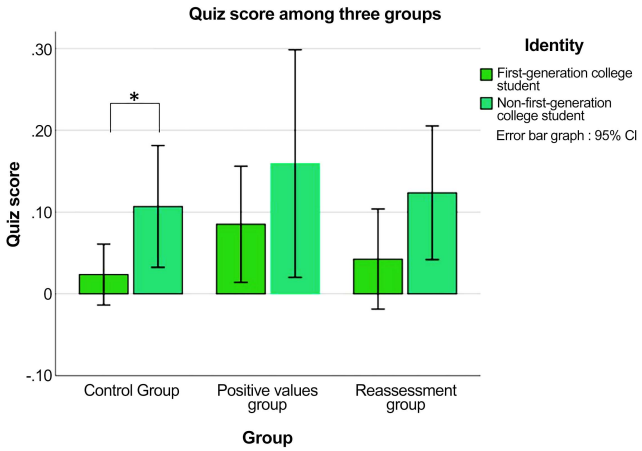

Figure 2. Completion rates of first generation and non-first generation students in three groups. $^{*}P < 0.05$.

intervention involves linking course learning with one's significant life values, which possess enduring qualities that guide future directions. This connection naturally transforms into a driving force, motivating learners to be more actively engaged in subsequent learning processes and excel.

In contrast to the findings of Kizilcec *et al.*,[11] our intervention results suggest not only an improvement in the self-efficacy of marginalized groups but an overall enhancement in performance. This not only validates the effectiveness of the intervention method but also points to the fact that the stressors for online learners stem not only from their native families but also from a more pervasive academic competition. The "positive values" boosting method effectively reduces this negative pressure.

One limitation of this study is the low questionnaire response rate. This can be attributed, on one hand, to the limited enrollment in courses, with the enrollment ranging between 2800 and 5000 for the four courses, resulting in a relatively low response rate of 1.5%. On the other hand, the low number of respondents also reflects a general lack of enthusiasm for learning. The overall course completion rate on the Chinese university MOOC platform is 1.5%, which also constrained the implementation of interventions.

MOOC's free and open characteristics allow educational resources to flow to regions and individuals in need. However, the free nature also implies no obligation, allowing individuals to join courses without any commitment to learning. This zero-threshold activity leads learners to not fully appreciate the superior learning environment and fail to invest time and effort in utilizing it.

Upon further reflection, learning is inherently an individual endeavor, and boosting aims to help individuals perform better rather than starting from scratch. In future research, considering a targeted intervention approach may be valuable. Some courses have participation and completion rates exceeding 60%, indicating intrinsic solid motivation and execution skills; they may not require intervention. For learners who sporadically engage in learning, participating when convenient and neglecting it when lazy, they become the primary targets for intervention. Students showing no learning behavior may need motivation-focused intervention, possibly requiring more frequent interventions.

This study analyzes the psychological factors that prevent online learners from completing learning tasks. From the perspective of enhancing "self-efficacy," improving students' psychological and cognitive states, boosting their learning behavior, and achieving more profound impacts, the study aims to help students carry this high self-efficacy into other aspects of the learning process.

Boosting is not about forced intervention; its characteristics lie in the effectiveness of infrequent interventions with significant results. "Four ounces move a thousand pounds" refers to the low frequency of interventions but high effectiveness. "Silent nurturing" refers to the indirect nature of interventions, positively enhancing self-efficacy without threatening students' confidence and allowing its influence to act subtly in daily learning.

DECLARATION

Author contributions

Qian J: Conceptualization, Writing—Original draft preparation, Writing—Reviewing and Editing. Du MY:

Original draft preparation, Reviewing and Editing. Yang Y and Qiu Y: Project administration.

Ethics approval
Not applicable.

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Conflict of interest
The authors declare no competing interest.

Data availability statement
Not applicable.

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