Comunicar, n. 75, v. XXXI, 2023 | Media Education Research Journal | ISSN: 1134-3478; e-ISSN: 1988-3478
www.comunicarjournal.com

The student self-assessment paradigm in MOOC: An example in Chinese higher education

Paradigma de autoevaluación de estudiantes en MOOC: El caso de la educación superior en China

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ABSTRACT

Although scholars have proposed many types of self-assessment methods. There are still many teachers in China who consider that student self-assessment is "difficult to implement". This paper aims to optimize the assessment of MOOC learning, and to establish an integrated student self-assessment paradigm with "student-centered, teacher, and peer auxiliary". We started by selecting nine key factors that influence the implementation of self-assessment in MOOCs. Then, we clarified the relationship between the nine factors by using the interpretative structure model (ISM) and the MICMAC analysis, and a six-level paradigm of integrated student self-assessment was established. Moreover, we put forward the following suggestions to optimize student self-assessment in MOOC learning. First, it's necessary to consider student self-assessment in MOOCs as a formative assessment method. Second, universities should enhance student awareness of self-assessment through publicity. Third, institutions of higher education could set up assessment courses to enhance the quality of assessment of students. Fourth, schools should optimize the environment of student self-assessment with the help of technology. This study is of great significance for students to make self-assessment become the basis of online learning and thus perfect the research on MOOC learning.

RESUMEN

Los estudios han propuesto varios tipos de métodos de autoevaluación, sin embargo, muchos profesores, en el país, todavía consideran que la autoevaluación de estudiantes es «difícil de implementar». El objetivo de este artículo es optimizar la evaluación del método MOOC y establecer un paradigma integrado de autoevaluación para los estudiantes, en base de «centrado en estudiantes, asistido por profesores y compañeros». Se han seleccionado nueve factores clave que influyen en la implementación de autoevaluación del MOOC, y sobre esta base, a través del modelo de estructura interpretativa ISM y el método de análisis MICMAC, se han definido las relaciones entre estos factores y se ha establecido un paradigma integrado de seis niveles de la autoevaluación de estudiantes. Además, se han dado unas proposiciones para optimizar la autoevaluación del MOOC. En primer lugar, se necesitan utilizar la autoevaluación del MOOC como un método de evaluación formativa. En segundo lugar, las universidades deberían, mediante la publicidad, aumentar la conciencia de los estudiantes sobre la autoevaluación. En tercer lugar, las universidades pueden ofrecer programas de evaluación para mejorar la calidad de la evaluación de los estudiantes. En cuarto lugar, se utilizan los medios tecnológicos para optimizar el entorno de autoevaluación de estudiantes. Este estudio es significativo para hacer la autoevaluación como una base del aprendizaje online, y así, promover los efectos del MOOC.

KEYWORDS | PALABRAS CLAVE

MOOC, MOOC learning, self-assessment, interpretative structure, lifelong learning, cognitive learning.
MOOC, aprendizaje MOOC, auto-evaluación, estructura interpretative, aprendizaje permanente, cogniciones del aprendizaje.

Received: 2022-09-01 | Reviewed: 2022-10-06 | Accepted: 2022-11-29 | OnlineFirst: 2023-01-30 | Published: 2023-04-01
DOI https://doi.org/10.3916/C75-2023-09 | Pages: 111-123

1. Introduction

In recent years, massive open online courses (MOOCs) have become quite popular. Popular does not mean regular. MOOC faces the challenge of not being recognized as "regular" courses (i.e., the ones taken at traditional learning institutions). Shrader et al. (2016) found that MOOC learners described different preferences for exploratory or instructor-directed instructional strategies. The implications for the instructional design of MOOC for attitudinal learning included recognizing that MOOC learners often view MOOC more as entertainment than formal education. MOOC is only seen as an auxiliary way to upskill. One of the major reasons for this is the assessment in an unsupervised environment, for example, the problems of test takers' online searches or interaction with others to find the answers to test questions (Beg et al., 2020). As a form of free and self-paced education, MOOC often does not count toward a formal university qualification. In addition, the low course completion rate is the most criticized problem of MOOCs, a difficult problem that online courses have always faced (Tauber, 2013). As a result, assessments valued by universities as important learning outcomes are thought to be less relevant to MOOC learners or designers (Zhao et al., 2017; Chudowsky et al., 2003; Earl & Torrance, 2000).

Assessment is a central character in the design of massive open online courses (MOOC) (Sandeen, 2021). In the past few years, a few universities started designing credit-bearing MOOCs as part of university programs, with the aim to encourage quality learning and good outcomes that satisfy formal university assessment criteria. Chunwijitra et al. (2020) suggest that the MOOC service framework consists of five layers: authentication, resources, learning, assessment, and credential layers. Assessment is one of the emerging key themes of MOOC (Bayne & Ross, 2013). Self-assessment is also very important in MOOC, especially in our case, as we received a lot of letters with questions. It has been suggested that self-assessment should be used as an assessment for learning instead of an assessment of learning (Admiraal et al., 2015). Some scholars suggest developing and embedding student self-assessment courses in subject teaching (Brown & Harris, 2014; Olivares et al., 2021). As a result, more and more universities are conducting assessment research on MOOCs. Earl (2003) divided the assessment into three categories according to the purpose of the assessment: assessment for learning, assessment of learning, and assessment as learning.

Peer and self-assessment offer an opportunity to scale both assessments and learning in global classrooms (Kulkarni et al., 2013). Gradually, more and more scholars are beginning to study the effectiveness of the assessment. Among them, many scholars place more emphasis on peer assessment. Stan i (2020) showed that despite being stressful and uncomfortable for many students, peer assessment was more beneficial for the student's learning than self-assessment. Peer assessment is becoming an increasingly popular tool to assess complex assignments in MOOCs (Capuano & Caballé, 2018; Reinholz, 2016). But some learners do not have the necessary knowledge and experience to assess their peer's work. Hence, there are some problems with the quality of the peers' respective feedback (Hew & Cheung, 2014). One of the major challenges facing Massive Open Online Courses (MOOC) is assessing learner performances beyond traditional automated assessment methods (Cho & Cho, 2011; Watson et al., 2017). However, there is no in-depth and systematic study on student self-assessment of MOOC (Liyanagunawardena et al., 2013). Today, students who self-assess effectively often learn better, and creating effective, comprehensive methods to help them do so is still a critical challenge. Although self-assessment appears to be a skill that can be improved, both students and professionals continue to have difficulty with accurate self-assessment (Motycka et al., 2010). For example, Ivaniushin et al. (2016) proposed the approach of assessment learning outcomes in collaborative project-based learning. Ashton and Davis (2015) identified that training students to assess will improve their ability to provide quality feedback. Different researchers have different priorities in defining self-assessment. Andrade and Du (2007) believed that self-assessment belongs to formative assessment. The concept emphasizes that the purpose of students' self-assessment is not only to make a self-judgment to identify what's lacking, but also to adjust their learning on this basis. Some researchers have expanded the concept of self-assessment to self-judgment based on assessment criteria, emphasizing the use of assessment criteria. As Rolheiser and Ross (2000) put it, "Self-assessment is 'Students judging the quality of their work based on quality criteria and assessment of good performance"'. Some researchers directly define self-assessment as student self-

assessment. There is no special emphasis on the use of assessment criteria in judging learning. For example, Brown and Harris (2014) defined student self-assessment as the description and assessment of students on their performance and academic ability. There are different types of assessment used by different MOOCs (Papathoma-Köhle et al., 2015; Zeng, 2017; Wong, 2016), for example, automated assessment (Pieterse, 2013; Ashton & Davis, 2015), peer assessment (Kulkarni et al., 2013; Sadler & Good, 2006; Stan i , 2020), and self-assessment (Wilkowski et al., 2014).

Reviewing the existing research, there are three popular directions for student self-assessment in the academic world. First, Boud and Brew (1995) proposed that different learning and assessment tasks serve different cognitive interests, and then proposed three types of student self-assessment: student self-assessment in technical interest, practical interest, and emancipatory interest. Student self-assessment in technical interest means that we check whether knowledge and skills have been acquired and understood against established standards and the level achieved. Second, Panadero et al. (2013) identified three strategies for teachers to help students develop self-assessment skills, namely self-assessment, self-assessment gauge, and self-assessment script. A script is an ordered set of structured statements built from task execution steps (Alonso-Tapia & Panadero, 2010). The self-assessment script indicates that students conduct learning activities according to the questions in the self-assessment script, then reflect on and evaluate the learning results. Self-assessment scripts are ordered reflective questions based on evaluation criteria constructed according to task execution steps (Alonso-Tapia & Panadero, 2010). For example, Lepp et al. (2017) showed that the two tools of self-assessment (self-assessment questions and troubleshooters) complement each other and can be suitable for different participants.

In a survey of 15 MOOC pilot schools in China, the reason lies in the lack of clear criteria, which makes it difficult for teachers and students to control this form of assessment. For this situation, some scholars' research provides some help. For example, Panadero et al. (2013) discussed the question of "whether, and in what form, assessment standards exist" in student self-assessment activities. According to power sharing between teachers and students, Taras (2016) rates student self-assessment as low, medium, and high, including a standard model, learning contract design, self-marking, sound standard, and self-assessment with an integrated tutor and peer feedback. One of the power prerequisites is resources (Burns, 1996). In self-assessment, reflective learning can help learners speed up knowledge updating, make students become learning subjects, promote online collaboration and communication of learners, effectively improve their information literacy, and complete the transition from superficial learning to deep learning (Wang et al., 2018). Some researchers (Wang & Sun, 2002) point out that student self-assessment mainly takes place in learning. Student self-assessment should include three stages: the beginning of learning activities, the middle of learning activities, and the end of learning activities. In terms of the results of learning, it should include a self-assessment of knowledge, skills, habits, attitudes, and personality (Wang & Sun, 2002; Eschenbrenner & Nah, 2007). Scholars also focus on the technical aspects of how to apply it, and there is no in-depth research on how to assess it. Valdivia-Vázquez et al. (2021) indicate that the EIIMC-MOOC is a valid, reliable, and stable tool to evaluate initial motivation and prior knowledge of participants regarding energy-related topics. Student self-assessment in MOOC is not only lacking in China but has also received little attention in other countries. Therefore, this study hopes to establish an integrated student self-assessment paradigm for MOOC learning, especially for university students in China.

2. Material and methods

2.1. Theoretical framework

To optimize the assessment of MOOC learning, this research has three major objectives. First, we will sort out influencing factors that affect Chinese student self-assessment in MOOC. Second, we will use an analytics tool to analyze student self-assessments in MOOC. Third, we will construct an integrated student self-assessment paradigm. For this reason, the following research question was proposed: What factors influence student self-assessment in MOOC? Student self-assessment is a comprehensive assessment in which students try to find the changes in their deep and implicit learning. We need supportable theories to classify and simplify the process of student self-assessment. To answer the question, a theory called "the Seven Pillars of Assessment" can help. The main contents of this theory are as follows: Falchikov (2004)

described seven basic questions in the assessment area: "Why to Assess", "How to Assess", "What to Assess", "When to Assess", "Who Assesses", "How Well" and "Whither". It will be more concise and logical to select the factors that affect student self-assessment from these seven basic questions. According to the characteristics of MOOC learning, the author consulted fifteen experts, including educational technology experts from Chinese universities, principals and backbone teachers from pilot schools of MOOC classrooms, and finally determined nine factors that affect student self-assessment in MOOC. The nine factors are shown in Table 1.

Table 1. The principal factors

Dimension	Factor	Code	Meaning
Why Assess	Motivation for assessment	S1	To optimize student MOOC-based learning continuously.
	Assessment objective	S2	Effective MOOC learning.
How to Assess	Assessment method	S3	Qualitative methods and quantitative methods. For example, self-assessment rubrics, self-assessment scripts, reflective logging, and so on.
	Assessment technology	S4	Network evaluation techniques like computer adaptive testing and E-assessment.
What to Assess	The gaining of knowledge and skills	S5	Knowledge, skills, and cognitive processes.
When to Assess	Continuity of self-assessment process	S6	Student self-assessment runs through the whole process of learning.
Who Assess	Assessor	S7	The students themselves are given priority, and teachers and peers are supplemented.
How Well	Reliability of assessment	S8	To ensure the accuracy and realism of student self-assessment.
Whither	Appreciation of self-assessment	S9	Student self-assessment becomes the basis of MOOC evaluation.

2.2. The interpretative structure model

We need to clarify the relationship between these important factors above to provide a basis for the establishment of an integrated self-assessment paradigm. For this purpose, the interpretative structure model (ISM) was selected as the analytical tool in this study. The ISM is a structural model put forward by Professor John Warfield in 1973, which aims at analyzing complex social structure problems. The basic idea is to make use of people's practical experience, professional knowledge, and computer assistance. By structuring and layering the complex and disorderly relationships among system elements, a multi-level and hierarchical explanatory structure model is constructed. The characteristic of this model is that many fuzzy factors of the system are decomposed into a visual, organized, and hierarchical internal structure so that people can clearly understand the relationship among the factors, grasp the essence of the problem and find solutions. It is especially suitable for system analysis with many variables, complicated relations, and unclear structure. The ISM plays a very important role in revealing the system structure, especially in analyzing the content and structure of teaching resources, designing and developing learning resources, and exploring the mode of the teaching process. It is a unique research method in educational technology research. The ISM is a valuable management tool and a qualitative and interpretative method used to generate solutions for complex problems and identify the relevant importance of each variable (Shen et al., 2016; Pfohl et al., 2011). The interpretative structural model (ISM) is to create a structural model made up of nodes and directed edges by calculating the logical relationship among the elements. The model is to describe the hierarchy and causality within the complex system through mathematical methods. Given the wide applicability and the effectiveness of the model in analyzing internal factors, this paper used the ISM to analyze the influence factors of student self-assessment so that we can understand the internal structure of the process of student self-assessment in MOOC. The various steps involved in the ISM are extracted from (Abbas et al., 2022; Ravi & Shankar, 2005; Shahabadkar, 2012). The analysis process is as follows:

- Step 1. E is the set of all the elements in system S, and R is the set of all the relations in system S. There are n elements in system S.

$$S = <E, R> \quad (1)$$

$$S = \{e_i \mid i = 1, 2, 3, 4, \cdots\cdots, n\} \quad (2)$$

Adjacency matrix A is used to represent the influence relationship between two elements of the system, where,

$$a_{ij} = \begin{cases} 1, e_i \text{ has a direct impact on } e_j \\ 0, ei \text{ has an indirect impact on ej} \end{cases} \quad (i = 1, 2, \cdots\cdots, n) \quad (3)$$

$$A = \begin{pmatrix} a_{11} \cdots a_{1j} \\ \vdots \ddots \vdots \\ a_{i1} \cdots a_{ij} \end{pmatrix} \quad (4)$$

- Step 2. Solve the reachable matrix M. There is a transitive relationship between e_i and e_j. If there is a directed path from node i to node j on a directed graph, e_i to e_j is considered to be reachable, where

$$m_{ij} = \begin{cases} 1, j \text{ is reachable by i} \\ 0, j \text{ is unreachable for i} \end{cases} \quad (5)$$

The reachable matrix B can be obtained by logical operation of the adjacency matrix and the identity matrix, and the formula is:

$$B = (A + I) \cup (A + I)^2 \cup \cdots \cup (A + I)^n, \text{ and } M = A^{2r} = A^{2(r+1)} \neq A^{2(r-1)}, r \leq n$$

$$B = \begin{pmatrix} m_{11} \cdots m_{1n} \\ \vdots \ddots \vdots \\ m_{n1} \cdots m_{nn} \end{pmatrix} \quad (6)$$

- Step 3. According to the reachable matrix, the antecedent set and reachable set are given:

$$A(e_i) = \{ e_j \mid e_i \in S, m_{ji} = 1 \} \quad (7)$$

$$R(e_i) = \{ e_j \mid e_j \in S, m_{ij} = 1 \} \quad (8)$$

Further, the underlying elements are given:

$$B = \{ e_i \mid e_i \in S \text{ and } R(e_i) \cap A(e_i) = A(e_i) \} \quad (9)$$

If e_i is the underlying element, then the antecedent set A (e_i) contains e_i itself and strongly connected elements. The reachable set R (e_i) contains itself, elements strongly connected to e_i and elements reachable from e_i. If there is an element e_j at the lower level of e_i, e_j can only be contained in A (e_i) but not in A (e_i) ∩ R (e_i), that is, A (e_i) ≠ A (e_i) ∩ R (e_i).

2.2.1. Constructing the ISM of student self-assessment in MOOC

Based on Table 1, this study takes MOOC teaching in Chinese universities as an example to establish an integrated student self-assessment paradigm. According to the definition of the interpretative structure model, we use MATLAB software to get the reachability matrix B. First, this study consulted 15 experts with rich experience in MOOC teaching in Chinese pilot universities. Based on the literature review and expert discussions, the relationships among the nine factors were determined. Then the adjacency matrix A was created.

$$A = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \quad (10)$$

Next, the reachable matrix can be calculated:

$$B = \begin{bmatrix} 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 \end{bmatrix} \quad (11)$$

2.2.2. The model results

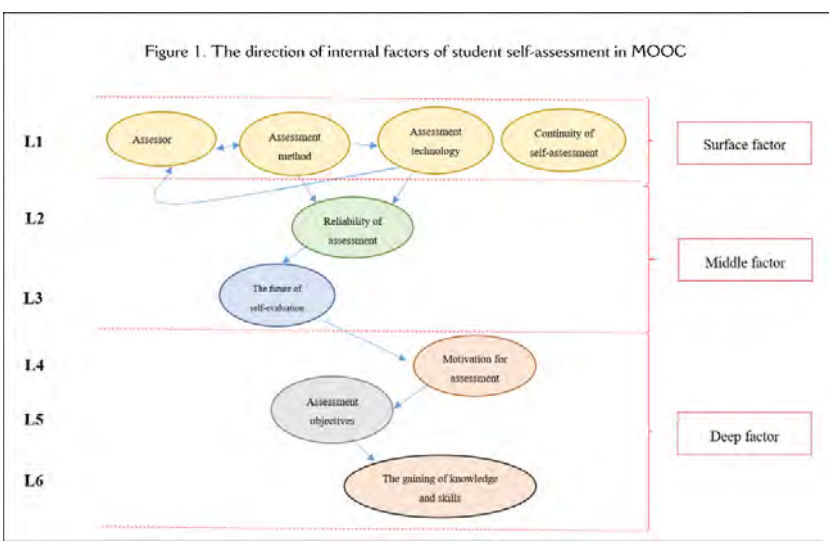
According to the solution formula of ISM, the level of division of the reachable matrix can divide the influence factors into six levels. The first level: L1={S3, S4, S6, S7}. The second level: L2={S8}. The third level: L3={S9}. The fourth level: L4={S1}. The fifth level: L5={S2}. The sixth level: L6={S5}. As shown in Table 2.

Table 2. Reachable set, antecedence set, intersection, dividing of the hierarchy

Number	A (e_i)	R (e_i)	A (e_i)∩R (e_i)	Level
S1	S1, S2, S5	S1, S3, S4, S7, S8, S9	S1	L4
S2	S2, S5	S1, S2, S3, S4, S7, S8, S9	S2	L5
S3	S1, S2, S3, S4, S5, S7, S8, S9	S3, S4, S7	S3, S4, S7	L1
S4	S1, S2, S3, S4, S5, S7, S8, S9	S3, S4, S7	S3, S4, S7	L1
S5	S5	S1, S2, S3, S4, S5, S7, S8, S9	S5	L6
S6	S6	S6	S6	L1
S7	S1, S2, S3, S4, S5, S7, S8, S9	S3, S4, S7	S3, S4, S7	L1
S8	S1, S2, S5, S8, S9	S3, S4, S7, S8	S8	L2
S9	S1, S2, S5, S9	S3, S4, S7, S8, S9	S9	L3

According to the hierarchy above, matrix A is presented as a directed graph as shown in Figure 1, and ellipses of different colors represent elements at different levels. According to the horizontal and vertical relationship of the factors, this paper divides the six levels into surface factors, middle factors, and deep factors. Surface factors refer to L1 {S3, S4, S6, S7}. Middle factors include L2 {S8}, L3 {S9}. Deep factors refer to L4 {S1}, L5 {S2}, L6{S5}.

Figure 1. The direction of internal factors of student self-assessment in MOOC



2.3. The MICMAC analysis

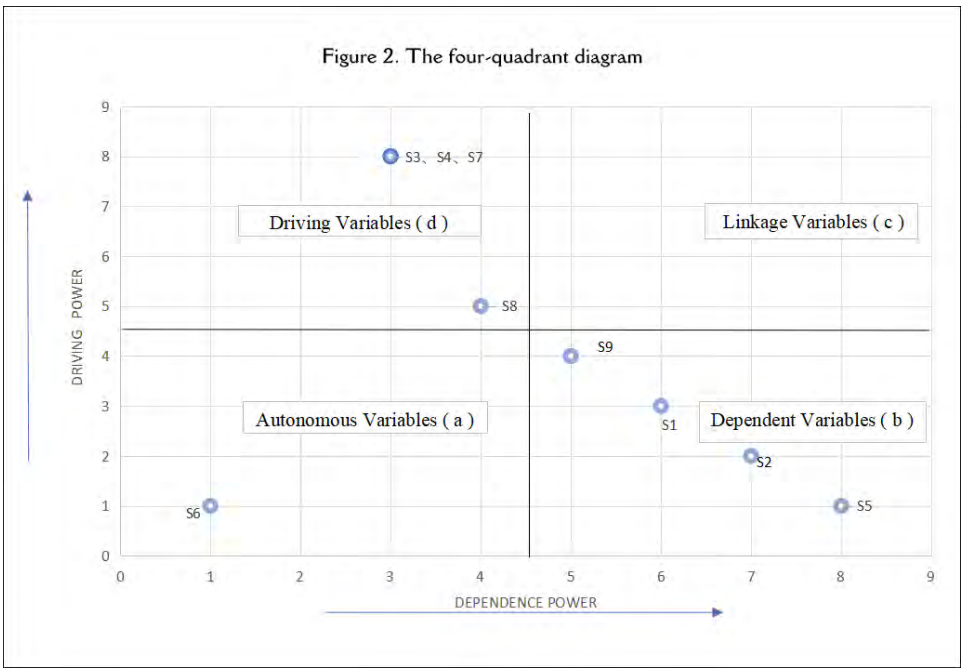
The MICMAC analysis is carried out based on the principle of matrix multiplication. The model is a method proposed by Duperrin and Godet to analyze the relationship and interaction between factors in the system and is commonly used to identify factors with high driving and high dependence in the system.

System elements can be divided into the following four quadrants: autonomous variables (a), dependent variables (b), linkage variables (c), and driving variables (d). As shown in Figure 2, the driving power and dependence power of autonomous variables are weak.

The dependence power of dependent variables is strong, but the driving power is weak. The driving power and dependence power of linkage variables are both strong. The driving power of driving variables is strong, but the dependence power is weak.

Calculate the sum of the rows and columns of the reachable matrix B, denoted as the driving force P, and the dependence J. P indicates the degree of influence of this factor on other factors. J indicates the extent to which this factor is affected by other factors. By calculating P and J values for each system element, the system element is divided into four different quadrants, as shown in Figure 2.

Figure 2. The four-quadrant diagram

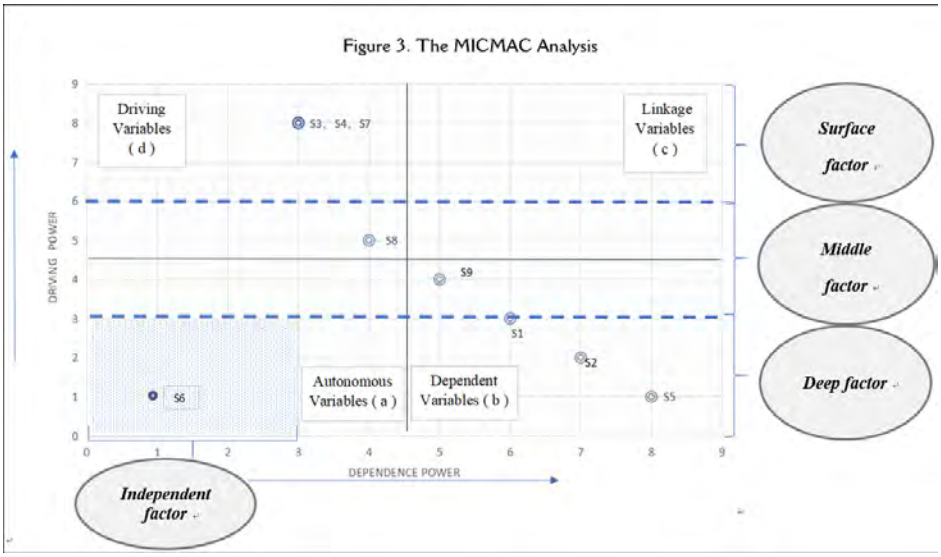


Based on the four-quadrant diagram, we further classify these nine factors. In Figure 3, the four-quadrant diagram is divided into three parts by two dashed lines. The three parts are called the surface factor, middle factor, and deep factor respectively.

As shown in Figure 3, assessment method (S3), assessment technology (S4), and assessor (S7) are in the first part, and they are the surface factors. Reliability of assessment (S8) and appreciation of self-assessment (S9) belong to the middle factors. Except for the continuity of the self-assessment process (S6), motivation for assessment (S1), assessment objective (S2), and the gaining of knowledge and skills (S5) are classified as deep factors.

We believe that the shaded region where S6 is located belongs to the region with weak dependence and power, so factors in this region cannot be considered deep factors. Combined with the classification results of the ISM before, the S6 is in the first level but it doesn't have any arrows associated to other factors in Figure 1. So, we consider that the continuity of the self-assessment process (S6) should be an independent factor for the student self-assessment in MOOC.

Figure 3. The MICMAC Analysis



3. Discussion

Based on the ISM and MICMAC analysis, we obtained a hierarchical structure (Figure 1) of students' self-assessments and the classification of influencing factors (Figure 3). In the following part, we will discuss the details of the analysis above.

3.1. Surface factor analysis

Surface factors include assessor (S7), assessment method (S3), and assessment technology (S4). The assessor, assessment method, and assessment technology form a closed loop in the MOOC learning process, and student self-assessment runs through the entire process.

Assessors can choose the method according to their judgment and the assessment method will affect and limit the assessor's choice. So, there is a two-way relationship between the assessor and the assessment method. First, the assessor's competence determines the choice of method. Given that the role of students as the main body of assessment has been neglected for a long time in MOOC, the students now are encouraged to take part in the formulation of assessment standards and determine assessment methods. Research has shown that some kind of agreement (i.e. agreed assessment criteria) is needed between students and teachers for self-assessment to play a role in promoting learning. Students set learning goals and plan their learning process according to the agreed standards before learning, and self-assess the learning outcomes according to the standards at the end of the learning process.

Second, different methods also influence the assessor's performance and decision. On the one hand, teachers give students appropriate and timely feedback (rather than grades), which can reduce students' mistakes in self-assessment and encourage students to make more intelligent assessments. On the other hand, peers can provide students with different perspectives, for example, to see the strengths or weaknesses that students cannot identify by themselves, and give workable suggestions to help students make a more comprehensive assessment.

3.2. Middle factor analysis

Middle factors include the reliability of assessment (S8) and the future of self-assessment (S9). As shown in Figure 1, the assessment methods and techniques affect the authenticity of the assessment. These two factors belong to external causes. There has been a series of research about student self-assessment that has emphasized the importance of realistic or verifiably accurate self-assessment for achievement (Boud & Falchikov, 1989; Sánchez-Vera & Prendes-Espinosa, 2015). Studies have shown that the accuracy of student self-assessment depends on students' professional knowledge and ability in the assessment area (Dunning et al., 2004; Kitsantas et al., 2004). These belong to an internal cause. Therefore, the key to

ensuring accuracy is to improve student self-assessment skills and professional knowledge, and their ability to analyze the assessment content.

The reliability of the assessment means the accuracy and realism of the assessment results. The reliability of self-assessment results will directly affect the future development trend of student self-assessment. An inauthentic or inaccurate student self-assessment is an invalid assessment. Therefore, the better development of student self-assessment must be based on reliability. In China, MOOC classroom assessment mainly happens in three ways: teacher assessment, peer assessment, and student self-assessment. In current MOOC teaching practice, teacher assessment is the foundation and dominant position, while student self-assessment is the least used. In the future, with the rise of learning-oriented assessment, and the establishment of a lifelong learning system, students must grow into excellent self-assessors. Therefore, the change in the future development of student self-assessment will inevitably affect the motivation for student self-assessment. Moreover, the objective of student self-assessment can only be determined after the new motivation for student self-assessment is established. The above discussion is about the relationship between the elements of the middle level.

3.3. Deep factor analysis

The motivation for assessment (S1), assessment objective (S2), and the gaining of knowledge and skills (S5) is the deep factor. Motivation is the starting point of student self-assessment, and it should be clear that the motivation of student self-evaluation in MOOC is to continuously optimize student learning. Specifically, student self-assessment not only optimizes students' current learning but also fosters students' lifelong learning. In the process of self-assessment, if students have greater assessment power and a sense of control over their learning, which is conducive to breaking the misunderstanding that students "learn for teachers or parents", making students feel that "learning is their thing", enhancing their sense of responsibility for learning, and then planning, monitoring and regulating their learning stably.

The assessment objective is like the bull's eye, and its position determines the learner's direction. Therefore, it is crucial to grasp the assessment objective. If the motivation of assessment is the starting point, then the objective is the foothold. For self-assessment in MOOC, the assessment objective is effective MOOC learning (Deng et al., 2020). This is the overall objective of MOOC learning. In MOOC, there will be many sub-goals due to the learning progress. In a word, the objectives are not set in stone, they need to be adjusted.

It should be clear that what we are assessing for student self-assessment in MOOC learning is the acquisition of knowledge and skills. This is determined by the assessment objective of student self-assessment. Compared to external assessment where students can only judge what they have learned, self-assessment can also reveal how they have learned. In the process of MOOC learning, on the one hand, students should know what they have learned and evaluate whether their knowledge and skills in a certain aspect meet the standards and to what extent they have achieved them, by referring to the established assessment standards. In this way, students clearly understand what they know, what they have mastered, what they don't know, and what they haven't mastered. On the other hand, to further understand how they are gaining knowledge and skills, students can understand their thinking mode, learning attitude, and learning strategy by reflecting on and recording the learning process. Thus, students adjust their learning in a timely and targeted way and develop their metacognitive awareness. Just as the assessment type – "self-assessment in the emancipatory interest" proposed by Boud and Brew (1995), the emancipatory interest refers to the basic interest of humans in "liberation" and "empowerment".

4. Constructing integrated student self-assessment paradigm in MOOC

Through the analysis of different levels of factors, this study established an integrated student self-assessment paradigm in MOOC, as shown in Figure 4. In the figure, the element node (○), with different colors and heights, represents different levels. The next section will expand on Figure 6, starting with L1 (the surface factor).

First, for MOOC learning in China, student self-assessment should be run through the entire process of MOOC learning. Students should carry out a self-assessment of their learning progress and achievements

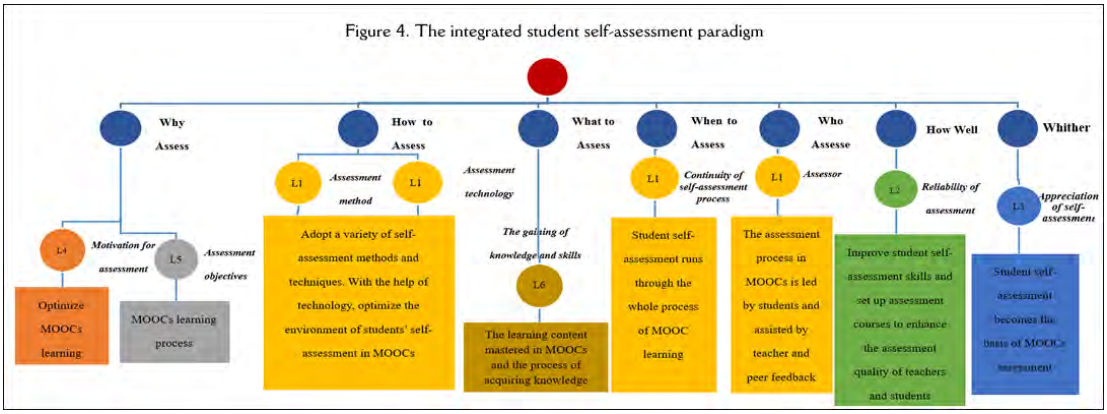
before, during, and after MOOCs. Meanwhile, it is best to adopt different assessment methods in different learning periods.

Second, students should be the primary executors of the assessment. However, being an excellent self-assessor is not something that can be accomplished by accepting a large number of assessment activities given by teachers. Instead, students need to carry out a large number of self-assessment practices and learn through doing. Therefore, teacher assessment will gradually give way to self-assessor and peer mutual assessment, and the situation dominated by teacher assessment will be transformed into students' self-assessment as the basis and leading. Universities should change the assessment trend from the traditional terrace model to the supporting lifelong learning model. This, to awaken students' self-awareness and initiative so that they can be transformed from passive assessment objects into conscious and active assessment subjects. Teachers should make students aware of their responsibility to monitor, assess, and regulate their learning.

Third, the validity of an assessment depends on its reliability. To ensure the reliability of student self-assessment in MOOC, it is necessary to improve students' self-assessment skills and set up assessment courses to enhance the quality of assessment. On the premise of ensuring the effectiveness of self-assessment, universities should make student self-assessment become the basis of MOOC assessment. According to the current situation of MOOC assessment in China, teachers should be diligent in "making concessions", transferring the assessment rights to students, and turning the assessment activities into a process of students' active participation, self-reflection, self-education, and self-development. After clarifying the importance of student self-assessment in MOOC, the motivation of student self-assessment is further determined to optimize the learning of MOOC. Then, the self-assessment object (MOOC learning process) in MOOC is determined.

Finally, we should focus on the deep factors (the gaining of knowledge and skills) of student self-assessment. First, the content of student self-assessment can be divided into "knowledge and skills", and "cognitive process". So, the gaining of knowledge and skills mastered in MOOC is what the assessor needs to assess first. This assessment process is cognitive and we need to use different assessment methods. Based on the characteristics of MOOC, it is more suitable for the assessment method with the characteristics of constructive assessment criteria and dynamic assessment process. Specifically, if the content of the assessment is the knowledge and skills, self-assessment methods with a middle of power-sharing, clear assessment criteria, and emphasis on grades or scores can be adopted, like the following types, self-marking, sound standard, and self-assessment rubrics. If the content of the assessment is a cognitive process, self-assessment in the practical interest, self-assessment in the emancipatory interest, and self-assessment with the integrated tutor and peer feedback are more suitable. Through communication and discussion with teachers or peers, students form their personalized understanding of the assessment tasks and construct their assessment criteria. Students not only construct individualized understanding and individual assessment criteria but also reflect on the construction process itself and carry out self-assessment activities independently.

Figure 4. The integrated student self-assessment paradigm



5. Conclusion

Given the above discussion, we propose several suggestions for student self-assessment of MOOC learning. First, consider student self-assessment in MOOC as a formative assessment method. Student self-assessment is not only an assessment activity after a learning stage. It is a kind of formative assessment, running through the entire process of student learning. Therefore, student self-assessment is a form of "formative assessment". Second, universities should enhance student awareness of self-assessment through publicity. Make students aware of their responsibility to monitor, evaluate and regulate their learning. Third, we could set up assessment courses to enhance the quality of student assessment. For example, video micro-lectures can be created so that students can acquire assessment knowledge and skills in class. Then, choose assessment methods to increase the reliability of the results. Finally, schools should optimize the environment of student self-assessment with the help of technology. With the deep integration of information technology and education and teaching, the networked nature of assessment activities is becoming increasingly apparent. All kinds of network assessment systems provide students with personalized learning data, diversified assessment tools, and communication platforms, which break through the limitations and difficulties of traditional assessment in data collection and can optimize the environment of student self-assessment.

To sum up, a good lifelong learner must be a good self-assessment. Teachers can still assume the responsibility of assessing students' learning, but in the long run, students would rely on teachers' evaluation and feedback, and would find it difficult to form self-assessment quality. Thus, students would find it hard to judge their growth after leaving school and even miss learning opportunities. Therefore, cultivating student "assessment quality" through the process of self-assessment not only helps to optimize students' current learning but also lays a good foundation for students' lifelong learning and development. In addition, student self-assessment should integrate qualitative methods and quantitative methods. For example, for the assessment of knowledge and skills, quantitative methods, such as self-assessment rubrics can be used. For the assessment of the cognitive process, qualitative methods, such as self-assessment script, self-assessment report, and reflective logging can be used. Among them, reflective learning not only develops students' learning behavior but also enables students to have more comprehensive abilities in the learning process, making them more complete people (Cristianti et al., 2020).

In the current case of MOOC in China, the focus on student self-assessment is not enough (Li, 2017). It is necessary to break the one-sided tendency of "student self-assessment just means students grade themselves". We need to form a holistic and comprehensive understanding of self-assessment. Besides China, according to the review of existing literature, there is little research focusing on student self-assessment in MOOCs in other countries. For online learning, such as MOOC, self-assessment should be the main assessment method because of the characteristics of self-study in online teaching. Therefore, the first thing is to change the attitude of teachers and students towards self-assessment and form a comprehensive self-assessment understanding. Then, sort out the logical path of student self-assessment and construct an integrated student self-assessment paradigm in MOOC. This is the contribution of this study. In the future, we will focus on how to optimize the learning effect of MOOCs through student self-assessment.

Authors' Contribution

Idea, D.T., W.B.; Literature review (state of the art), D.T.; Methodology, D.T., W.B.; Data analysis, D.T., W.B.; Results, D.T.; Discussion and conclusions, D.T.; Writing (original draft), D.T., W.B.; Final revisions, D.T.; Project design and sponsorship, W.B.

Funding Agency

This research was funded by the Program of Social Science Foundation in Shaanxi Province of China (Grant No. 2020D048).

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