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Assessment and learning engagement in massive open online courses

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Chapter 6

General discussion



6.1. Introduction

This dissertation primarily aimed to deepen our understanding of learning assessment in MOOCs and contribute insights into how we can make MOOC learning more effective and engaging to optimize learners' learning experience, ultimately leading to better learning outcomes. The aim is achieved by carrying out four studies to gain knowledge across four key themes: (1) the assessment of learning outcomes in MOOCs (Chapter 2), (2) how individuals' motivation drives learner-determined learning in MOOCs (Chapter 3, 4, and 5), (3) how self-regulated learning shapes personalized learning paths in MOOCs (Chapter 3), and (4) the social construction of knowledge in MOOC (Chapter 2, 3, and 5). The studies in this dissertation provide MOOC researchers and practitioners with both theoretical and practical implications on learning assessment and making learning more effective and engaging for learners, benefiting learners in achieving their educational goals.

In the final chapter of the dissertation, we first summarize the main findings of each chapter, followed by a general discussion of the main findings. Then, the reflections of this dissertation are addressed and recommendations for future research avenues are provided to further advance our understanding of teaching and learning in MOOCs. Finally, practical implications are discussed, providing evidence-based recommendations to improve teaching and learning that support MOOC learners to be motivated and engaged in MOOC learning, which can enhance learners' learning effectiveness and success throughout their MOOC journey.

6.2. Main findings per chapter

Chapter 2 Assessment of cognitive, behavioral, and affective learning outcomes in massive open online courses: A systematic literature review

In *Chapter 2*, we carried out a systematic literature review on the assessment of learning outcomes, which aimed to address the learning outcomes assessed, related instruments, and assessment characteristics of these instruments in MOOC research. Three research questions were addressed: (RQ1) What learning outcomes are assessed in MOOCs? (RQ2) What instruments are employed to measure these learning outcomes? (RQ3) What assessment characteristics do these instruments have? The PRISMA guidelines and content analysis were employed to analyze 65 eligible peer-reviewed articles published between 2017 and 2019. To synthesize findings from the selected articles, learning outcomes were categorized adopting the taxonomy of Bloom and Krathwohl (Bloom et al., 1956; Krathwohl et al., 1964), focusing on

cognitive outcomes (e.g., knowledge and skills), behavioral outcomes (e.g., actual behavior), and affective outcomes (e.g., value, attitudes, and motivation). Assessment instruments and their characteristics were examined by assessment type, discipline, purpose, assessor, frequency, feedback, mandatory (i.e., learners have to take the assessments), scoring (i.e., contribution to the percentage of the final grades), and reward (i.e., to obtain credits/certificate). Altogether, 25 types of assessment approaches were employed to examine learning outcomes in these selected articles, and the assessment characteristics were identified. Regarding cognitive outcomes, 32 studies measured learners' conceptual knowledge and academic achievement as the outcomes of MOOCs, and 8 studies estimated learners' intellectual skills, such as reasoning, comprehension, thinking abilities, problem-solving, and decision-making skills. In the knowledge test, instruments like quizzes, assignments, tests, exams, and exercises were the most common instruments, while assessments, such as assignments, surveys, assessments, discussion forums, tests, exercises, user data, essays, labs, and writing projects were employed to measure intellectual skills. In terms of behavioral outcomes, the frequency of learners' observable behavior in course content, assessment, and discussion forums (39 studies), course completion (16 studies), and course certificate earned (14 studies) was investigated. In these studies, five types of measurements, namely user data, surveys, interviews, observations, and group embedded figure tests, were implemented to assess behavioral outcomes, among which user data and surveys were the two most frequently used approaches. Furthermore, the results identified affective learning gains in aspects of learners' course satisfaction (i.e., positive evaluation of courses; 7 studies), perceptions of learning experiences (i.e., learners' perceived appreciation of course learning; 19 studies), and perceptions of learning benefits (learners' perceived learning improvement; 25 studies). Among the five approaches used to estimate affective outcomes, surveys and interviews were the two most used, followed by observations, self-assessment, and user data.

The results indicated that considering the assessment of learning outcomes at the beginning of course design could support the formulation of explicit assessment goals and, in this way, instruct learners to work towards learning outcomes. A combination of knowledge tests and skills tasks can be used to examine cognitive outcomes in a particular MOOC. Outcome-oriented feedback rubrics are beneficial to support learners' essay performance, and interpretations of the utilization of rubrics could better guide providers to give peer feedback. A variety of behavioral and affective outcomes reflect multiple aspects of participants' learning in MOOCs, which might contribute to better understanding of and support for learners' learning. Furthermore, assessment tasks throughout the course may differ in difficulty and complexity,

which could align with different levels of motivation of learners. The findings provide a holistic picture of learning outcomes and related assessment instruments in current MOOCs. Curriculum designers and teachers could benefit from this study to consider appropriate learning outcome variables and instruments to apply in their MOOC practices. Future research might investigate the motivation of learners to participate in a MOOC and how their motivation changes during a MOOC. This could help MOOC designers and teachers to align how learners are motivated, what they want to learn, and what they actually do.

Chapter 3 Do learners share the same perceived learning outcomes in MOOCs? Identifying the role of motivation, perceived learning support, learning engagement, and self-regulated learning strategies

This study aimed to examine how motivation, perceived learning support, learning engagement, and self-regulated learning strategies relate to learners' perceived learning outcomes of massive open online courses (MOOCs). We gained insights via three research questions: (RQ1) What motivates learners to participate in MOOCs? (RQ2) How is motivation related to perceived learning support, learning engagement, self-regulated learning strategies, and perceived learning outcomes in MOOCs? (RQ3) How do self-regulated learning strategies mediate the relationships between motivation, perceived learning support, and learning engagement, on the one hand, and perceived learning outcomes, on the other hand? Self-determination theory (Deci & Ryan, 1985a, 1987) and Pintrich's model of self-regulated learning (Pintrich & De Groot, 1990) were employed to establish the theoretical framework in this study. Qualitative and quantitative data were gathered via online surveys from 546 participants in four MOOCs. A series of analysis methods, such as content analysis, One-way MANOVA, multiple regression analysis, and mediation analysis, were employed to address research questions.

The findings identified seven types of reasons for attending MOOCs from qualitative data, such as personal interests, to supplement knowledge, self-development, easy access to learning resources, earning credits, and teachers' requirements. These reasons range from intrinsic to extrinsic motivation. Based on the shared quality of learner motivation, three motivational profiles emerged: autonomous motivation, controlled motivation, and combined motivation. Overall, learners with autonomous motivation demonstrated higher scores than controlled and combined motivation groups on course design, interaction with instructors and peers, learner autonomy, self-regulated learning strategies, time management, and perceived learning outcomes. However, there were no significant differences found in engagement in

learning activities and course assessments among the three motivational profiles. Furthermore, the results demonstrated that factors such as course design, interaction with instructors and peers, learner autonomy, and cognitive and metacognitive learning strategies significantly explained individual differences in perceived learning outcomes. Additionally, in asynchronous learning with the absence of instructors' direct monitoring, self-regulated learning positively contributed to learners' perceived learning benefits. Specifically, cognitive and metacognitive learning strategies significantly mediated the relationships between motivation, perceived learning support, and learning engagement on the one hand and perceived learning outcomes on the other. Based on our findings, we recommended that MOOC practitioners create autonomy-supportive instruction to cater to learners' personal needs and embed self-regulated learning interventions into curriculum design and learning content to promote perceived learning outcomes.

Chapter 4 What rationale would work? Unfolding the role of learners' attitudes and motivation in predicting learning engagement and perceived learning outcomes in MOOCs

The quantitative study presented in Chapter 4 aimed to gain knowledge about the interplay between attitudes, motivation, learning engagement, and perceived learning outcomes in massive open online courses (MOOCs). Firstly, we explored the direct effects of attitudes and motivation on learning engagement and perceived learning outcomes, respectively. Four research questions were formulated: (RQ1) How are attitudes related to (a) self-efficacy, (b) task value, (c) perceived cost, (d) learning engagement, and (e) perceived learning outcomes in MOOCs? (RQ2) How is self-efficacy related to (a) task value, (b) perceived cost, (c) learning engagement, and (d) perceived learning outcomes in MOOCs? (RQ3) How is task value related to (a) learning engagement and (b) perceived learning outcomes in MOOCs? (RQ4) How is perceived cost related to (a) learning engagement and (b) perceived learning outcomes in MOOCs? Moreover, given that the indirect roles of task value and perceived cost in influencing learning were not consistently documented in previous research, both their mediating and moderating effects on learning engagement and perceived learning outcomes were examined. The following research questions were proposed: (RQ5) How does task value mediate the relationships between attitudes, self-efficacy on the one hand, and learning engagement, on the other hand? (RQ6) How does perceived cost mediate the relationships between attitudes, self-efficacy, on the one hand, and perceived learning outcomes, on the other hand? (RQ7) How does task value moderate the relationships between attitudes, self-efficacy on the one hand, and

learning engagement, on the other hand? (RQ8) How does perceived cost moderate the relationships between attitudes, self-efficacy, on the one hand, and perceived learning outcomes, on the other hand? Attitudes toward MOOC learning were integrated into the model of the expectancy-value theory of achievement motivation (Wigfield & Eccles, 2000), which provided comprehensive explanations for individual differences in learning engagement and perceived learning outcomes in MOOCs. 232 MOOC learners were involved in an online survey investigation.

The structural equation modeling revealed that attitudes served as a precursor of participation in MOOCs that significantly influenced self-efficacy, intrinsic value, and task effort cost. Self-efficacy and intrinsic value were positively associated with both learning engagement and perceived learning outcomes, while attitudes toward MOOC learning were positively related to perceived learning outcomes only. Furthermore, the mediation analyses highlighted that intrinsic value was a powerful mediator, which positively influenced the effects of attitudes and self-efficacy on learning engagement and perceived learning outcomes. The moderation analyses discovered that task effort cost moderated the effects of attitudes on learning engagement and perceived learning outcomes. Curriculum designers and instructors could benefit from this study to understand what rationales drive individuals to be engaged in MOOC learning and to reach greater perceived learning outcomes in MOOCs.

6

Chapter 5 Would you be an active learner in MOOC discussion forums? The interplay of motivation, social interaction, and cognitive engagement

This study aimed to gain insights into the cognitive engagement modes manifested in the social construction of knowledge and how motivation and social interaction influence cognitive engagement modes in MOOC discussion forums. The following research questions guided this study: (1) What modes of cognitive engagement characterize the co-construction of knowledge in MOOC discussion forums? (2) How is motivation related to different modes of cognitive engagement in MOOC discussion forums? (3) How is social interaction related to different modes of cognitive engagement in MOOC discussion forums? Self-determination theory (Deci & Ryan, 1985a, 1987) and the interactive, constructive, active, and passive theory of cognitive engagement (Chi & Wylie, 2014) were adopted to build up the theoretical framework for this study. At the beginning of the MOOC, learners were invited to express their primary reasons for attending the course via online questionnaires. During the course, learners voluntarily participated in the weekly forum discussions related to the course content. Multiple types of

data (e.g., demographic information, pre-course surveys, log events, and discussion forum logs) were collected from 5465 MOOC learners.

The content analyses were implemented to analyze content-related contributions in forum discussions and learner motivation to attend this MOOC. The results yielded that learners were mainly engaged in constructive and interactive engagement modes, followed by the active engagement mode. The reasons for learners' participation in this MOOC were categorized into personal interest, related to studies, and related to work or career, and all three categories place learners into an autonomous motivation group. The zero-inflated negative binomial regression modeling between motivation and cognitive engagement revealed that, within autonomous motivation, learners motivated by personal interest demonstrated higher scores on active and interactive engagement modes than those learners who were motivated by the MOOC because it was related to their studies. Moreover, social network modeling and zero-inflated negative binomial regression modeling were employed to examine the interplay between social interaction and cognitive engagement in MOOC forum discussions. The results indicated that the number of content-related contributions were positively correlated with active, constructive, and interactive engagement. However, social network metrics vary in their influences on cognitive engagement modes. Indegree centrality was negatively related to constructive engagement, while outdegree centrality was negatively associated with active and constructive engagement but positively related to interactive engagement. Additionally, authority scores powerfully predicted constructive engagement, showing a positive influence. This study contributes to a better understanding of learners' varying levels of cognitive engagement with content reflected learning through discussions and the influences of motivation and social interaction on cognitive engagement in MOOC forum discussions.

6.3. General discussion of main findings

The studies described in the chapters contribute to insights into the assessment of learning outcomes in MOOCs and how aspects of teaching and learning are related to learning engagement and perceived learning outcomes in MOOCs. Within the current section, we elaborate and discuss the main theoretical contributions of this dissertation.

6.3.1. Constructive alignment matters for effective learning in MOOCs

If students are to learn desired outcomes in a reasonably effective manner, then the teacher's fundamental task is to get students to engage in learning activities that are likely to result in their achieving those outcomes ...It is helpful to remember that what the student does is actually more important in determining what is learned than what the teacher does. (Shuell, 1986, p429)

Effective learning happens when learners are motivated and engaged in MOOCs. One of the central strands that emerges across the four studies presented in Chapters 2-5 is the critical role of constructive alignment in facilitating effective learning in MOOCs. *Constructive alignment*, as defined by Biggs (1996), focuses on aligning the intended learning outcomes, teaching and learning activities, and assessment to create a coherent and effective learning experience, ensuring that learners are motivated to learn and achieve the expected learning outcomes. This curriculum theory emphasizes that (a) intended learning outcomes should be formulated clearly and at the start of a session or course, and they should be measurable; (b) learners constructively create meaning to obtain these intended learning outcomes through relevant activities, and course components must support learners in shaping an effective learning experience for assessment; (c) the assessment is aligned with both intended learning outcomes and learning and teaching activities, estimating how well learners achieve intended learning outcomes. Based on our findings in the context of MOOCs, the importance of alignment between at least two components in the constructive alignment framework (see Figure 6.1.) is discussed below.

In Chapter 2, we distinguished learning outcomes, various related assessments, and characteristics of these assessments in MOOCs. The results showed that the frequently used approaches to assess learning outcomes vary across disciplines of STEM (e.g., quizzes, exams, tests, hands-on exercises, and labs), Humanity and Social Science (e.g., essays, peer review, peer feedback, and writing projects), and Medical Science (e.g., exams, practice-oriented assessments, case discussions, and virtual patient cases), obtaining evidence of the mastery of course content and the attainment of learning objectives. These assessment approaches we found have different functions that can be used for formative or summative assessment. These results suggest that considering the assessment of learning outcomes at the beginning of course design could support the formulation of explicit assessment goals, thereby instructing learners

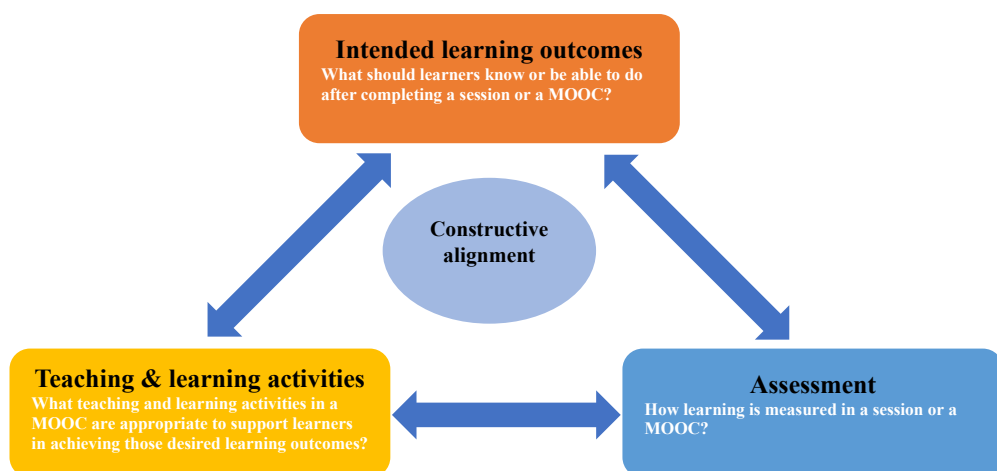


Figure 6.1. Constructive alignment model (Adapted from Biggs, 1999).

to work towards achieving these outcomes. This aligns with the claim from Sandeen (2013) that the assessment is the core consideration at the very beginning of the MOOC course design rather than a later add-on. This study adds to the growing body of literature on cognitive, behavioral, and affective learning outcomes and their related assessments in different disciplinary fields within higher education MOOCs. Based on our findings, we argue that the alignment between learning outcomes and assessment instruments in a MOOC is pivotal to ensure that learners can recognize the course's required learning outcomes and work towards what they should be learning (Bralić & Divjak, 2018; Ewais et al., 2020), which is a central concern in constructive alignment.

MOOC learners acquire knowledge and master skills via teaching and learning activities, such as engaging in pre-prepared video lectures and learning materials, interacting with instructors and peers, and learners' spontaneous activities. These activities contribute to successful online learning, but create an asynchronous space where it is challenging to offer learners adequate learning support (Oh et al., 2020). Through the lens of constructive alignment in theory, well-designed instructional activities and supportive learning activities are essential to ensure learners work along the pathway to construct meaning successfully and achieve intended learning outcomes in MOOCs (Loughlin et al., 2021). To understand the learner-

centered learning in MOOCs, the exploratory study in Chapter 3 investigated the relationships between learners' perceptions of teaching and learning activities and the perceived learning outcomes (X. Wei et al., 2023). Specifically, with respect to the perceived learning support, the strong and positive impact of course design on perceived learning outcomes suggests that well-organized course content and learning materials, as well as aligned learning objectives and required effort, contribute to learners' perceived learning gains, which is in line with the study by Joo et al. (2018). Learners perceived the learning support in interaction with instructors and peers was found to significantly explain the difference in perceived learning outcomes, which is in agreement with the results of a study conducted by Kurucay and Inan (2017). This finding indicates that interaction with instructors and peers can help learners construct knowledge and get connected with others. These two findings suggest an alignment between perceived learning support and perceived learning outcomes.

In asynchronous MOOC learning, what learners spontaneously do influence what is learned. The finding from Chapter 3 that learners' engagement in learning activities was significantly associated with perceived learning outcomes, which corresponds with prior studies (Elizondo-Garcia & Gallardo, 2020; Wang et al., 2015). The high engagement observed in learning activities suggests a successful alignment between learner-centered activities and perceived learning outcomes. Our study in Chapter 3 emphasizes the importance of self-regulated learning, indicating that cognitive and metacognitive learning strategies facilitate the transformation of course content into deep understanding and knowledge construction, which also enhances the direct influence of perceived learning support and learning engagement on perceived learning outcomes. These outcomes corroborate the findings in previous research (Cheng & Chau, 2013; Magen-Nagar & Cohen, 2017), and also extend the literature on the mediating role of cognitive and metacognitive learning strategies in MOOC learning within the context of higher education. In the study described in Chapter 3, the high engagement observed in learning activities and the crucial mediating role of cognitive and metacognitive learning strategies suggest a successful alignment between learner-centered activities and perceived learning outcomes. The result from Chapter 3 that engagement in course assessment was not significantly related to perceived learning outcomes contradicts the results of Tseng et al. (2016), which found that participants who actively engaged in assessments reported better final grades and higher course completion rates than their counterparts. The findings of Tseng et al. (2016) and the current study suggest that the frequency of behavioral engagement in course assessments can reveal learners' varied levels of course completion and course grades, but it cannot validly explain how active learners have obtained better perceived learning outcomes.

A further exploration of the relationship between engagement in course assessment and perceived learning outcomes in MOOCs is needed.

Forum discussions are a crucial pedagogical element in MOOCs, facilitating knowledge building and sharing and helping develop cognitive skills from basic recall to higher-order thinking. The study presented in Chapter 5 examined learner learning through forum discussions. The findings of this study indicated heterogeneous levels of learner cognitive engagement, which are aligned with previous MOOC studies (Galikyan et al., 2021; Goggins et al., 2016; Tawfik et al., 2017). However, these studies reported that learners mainly engaged in discussions at a low level of knowledge construction. Regarding pedagogical instruction of the discussions in our study in Chapter 5, most discussion tasks guided learners to construct meaning and interact with peers based on course content or relate the content knowledge to cases, problems, and real-life issues, which might increase their chances of being constructive and co-creative in discussions. In Chapter 5, the dominant constructive engagement and interactive engagement observed in forum discussions were at intermediate and advanced cognitive levels, suggesting a successful alignment between student-centered discussion tasks and intended deep learning outcomes. This finding also emphasizes what constructive alignment is concerned with: teaching and learning activities in MOOCs should be organized so that learners are more likely to use the higher-order learning processes (Biggs, 1999). According to Rivera et al. (2024), the MOOCs that they investigated varied in the quality of pedagogical instruction of discussion forums regarding specifications and guidance for stimulating and guiding cognitive and socio-cognitive processes, and proper pedagogical instruction was insufficient. These findings, together with our findings in Chapter 5, suggest that instructions in forum discussions should align with learning objectives that ensure and elicit learners' higher levels of cognitive activities, shaping their learning experience to approach the intended learning outcomes.

Building constructive alignment among intended learning outcomes, teaching and learning activities, and assessment that enables instructors to develop and communicate the pathway for learners' learning progression and to involve learners in constructive learning in MOOCs. The findings from studies described in Chapters 2, 3, and 5 provide valuable evidence that supports the alignment between every two aspects of the constructive alignment framework (Figure 6.1.). However, in these studies, we are short of direct evidence on how intended learning outcomes, teaching and learning activities, and assessment are aligned in MOOC learning. Future MOOC research may provide more empirical insights into how these three components are aligned. Importantly, the findings across studies in this dissertation collectively

emphasize the vital role of self-regulated learning in MOOCs, as self-regulated learning skills are important cognitive outcomes acquired and measured from MOOC learning (Chapter 2), and with powerful mediating effects, cognitive and metacognitive learning skills transform the MOOC content into deep understanding and knowledge construction (Chapter 3 and 5). Considering that learner-centered learning in digital learning environments like MOOCs lacks instructors' direct instruction, learners' ability to self-regulate becomes significantly crucial for effective learning, with learners taking a primary role in their own learning. Therefore, we propose an extended constructive alignment model that incorporates self-regulated learning (SRL) as the fourth element, highlighting the need to design MOOCs that can support and develop learners' self-regulation for the achievement of intended learning outcomes. In the *Constructive alignment + SRL model* (Figure 6.2.; Biggs, 1999; Pintrich, 2000), it is not only to align intended learning outcomes, teaching learning outcomes, and assessment in MOOC design, but also to integrate self-regulated learning principles into these three components. Specifically, expand the intended learning outcomes in a MOOC to include self-regulation skills related to self-regulated learning processes in terms of (1) forethought, planning and activation; (2) monitoring; (3) control; and (4) reaction and reflection (Pintrich, 2000). The self-regulated learning requires MOOC learners to take responsibility and ownership of their learning process. In MOOC teaching and learning activities, instructional design should integrate activities that foster content learning and self-regulation. Aligning with the content learning, the selected self-regulated activities should target to support and facilitate learner motivation to learn, and the use of cognitive and metacognitive learning skills and resource management strategies for deep learning (Pintrich et al., 1991; Zimmerman, 2002). Assessment can measure both content-related learning outcomes and the development of MOOC learners' ability to regulate their learning processes. Designing assessments for promoting self-regulation in MOOCs that should support learners in self-regulated learning processes, which focus on learning to learn. Given that learning through MOOCs is self-regulated and lacks instructors' direct instruction, well-designed MOOCs should create a web of consistency, in which intended learning outcomes, teaching and learning activities, self-regulated learning, and assessment are well-aligned to ensure learners' constructive learning and develop their self-regulation (Biggs, 1999; Pintrich, 2000). This approach helps learners engage in MOOC learning that guide them to most likely perform toward targeted higher-level cognitive goals, deepen their understanding of the content taught, develop the complexity of their knowledge scheme, and be able to take responsibility and ownership of their learning process. Future research may examine the alignment of four elements in the *Constructive alignment + SRL model* in MOOCs.

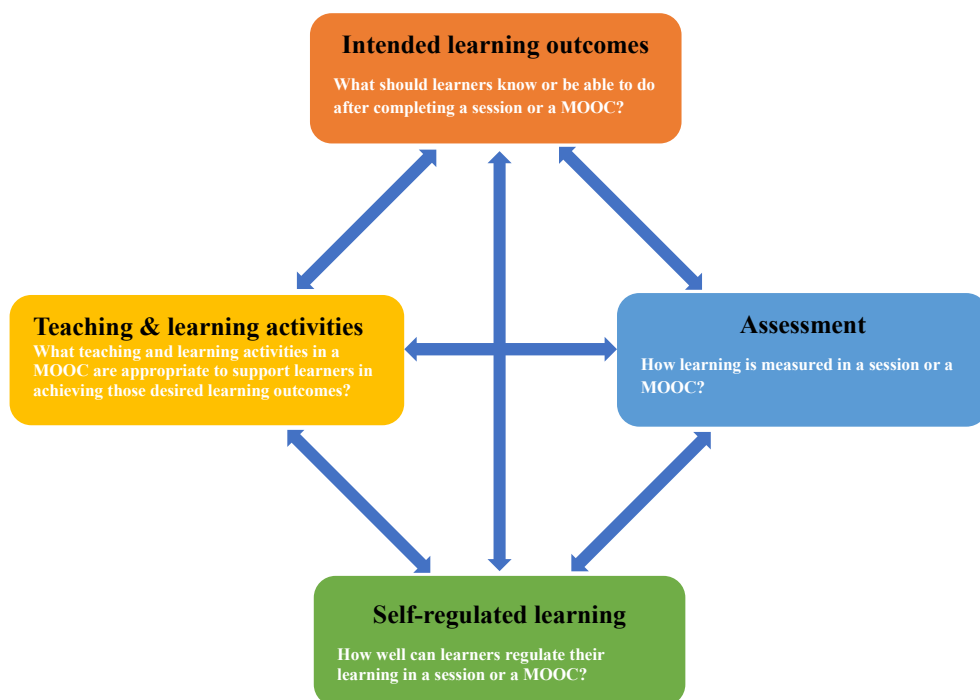


Figure 6.2. Constructive alignment + SRL model (Biggs, 1999; Pintrich, 2000).

6.3.2. *The role of motivation in driving learner-determined learning in MOOCs*

In an open and asynchronous teaching and learning environment, MOOCs are designed to provide learners with a complete course experience, resulting in the acquisition of knowledge and mastery of skills. However, the low completion rates and academic achievement are long-standing unresolved issues in MOOCs (Celik & Cagiltay, 2024; Galikyan et al., 2021; Poquet et al., 2020; Sunar et al., 2016), which have raised questions concerning the effectiveness of teaching and learning at a large scale. This has drawn attention to how we can support MOOC learners to stay motivated and engaged in their studies and encourage them to invest effort in achieving academic success. Learning in MOOCs places learners at the center, it requires learners to have a high degree of autonomy to shape their learning experience and achieve intended learning outcomes throughout the course. Thus, to gain a more comprehensive understanding of the effectiveness of large-scale teaching and learning in MOOCs, this dissertation has employed both qualitative and quantitative methods to examine the role of

learner motivation in driving learner-determined learning in MOOCs. Firstly, we adopted self-determination theory as the theoretical framework to estimate the extent to which individuals' internalization process and the quality of motivation (Deci & Ryan, 1985b), explaining individual differences in learning experience and results in learners' perceived learning outcomes (Chapters 3 and 5). Second, with utilizing the expectancy-value theory (Eccles, 1983; Wigfield & Eccles, 2000) to measure the strength of individuals' achievement motivation, the study presented in Chapter 4 investigated how multiple aspects of motivational beliefs, both positive and negative, have differentiated influences on MOOC learning (Wei et al., 2024). Therefore, we provided evidence rooted in different but complementary theoretical perspectives to shed light on how individuals' innate psychological needs and subjective beliefs influence MOOC learning.

Studies presented in Chapters 3 and 5 showed that learners were driven by diverse reasons to attend a MOOC, such as personal interests, to supplement knowledge, self-development, easy access to learning resources, earning credits, teachers' requirement, and relationship to studies and work. These reasons range from intrinsic to extrinsic motivation, revealing that the motivation of MOOC learners was more open and diverse than predominantly pursuing full course completion or high academic achievement, which is consistent with prior research (Milligan & Littlejohn, 2017; Semenova, 2022; Watted & Barak, 2018). Based on shared characteristics of learner motivation, we further explored how the quality of learner motivation influenced MOOC learning, and identified autonomous, controlled, and combined motivation profiles among learners. Across the studies described in Chapters 3 and 5, a consistent pattern emerged: autonomous motivation played a critical role in shaping learning experience and perceived learning outcomes. For example, learners with autonomous motivation scored high in perceived learning support, cognitive and meta-cognitive learning strategies and perceived learning outcomes (Chapter 3), and cognitive engagement in forum discussions (Chapter 5). These findings illustrate that when the impetus of motivation is from inherent and essential valued motivational resources, learners are more likely to engage with course content, implement high-order thinking skills to learn, and perceive the learning benefits from MOOC learning. According to the findings of two empirical studies, we highlight the importance of supporting autonomous motivation in MOOCs, as it positively contributes to learner learning and growth (Littlejohn et al., 2016; Pozón-López et al., 2021; Zhou, 2016).

In addition to understanding how learners were motivated to learn in MOOCs, we were also interested in the strength of learners' achievement motivation in influencing MOOC learning. The study described in Chapter 4, which adopted the expectancy-value perspective,

deepened the understanding of what rationales contributed to engaging or disengaging with learning and perceiving learning gains in MOOCs. The findings revealed that motivational incentives (i.e., self-efficacy, and task value) and disincentives (i.e., perceived cost) differentiated their roles in influencing learning engagement and perceived learning outcomes. The importance of self-efficacy in facilitating learning engagement and perceived learning outcomes is aligned with what was established in previous studies (Jung & Lee, 2018; Lee et al., 2020b; Min & Foon, 2019; Rabin et al., 2020). What our finding adds to the literature is the strong positive relationship between self-efficacy and intrinsic value, demonstrating that self-efficacious learners are more motivated to engage in MOOC learning. The strong effects of intrinsic value on learning engagement and perceived learning engagement align with the findings of prior work (Artino, 2008, 2009; Y. Liu et al., 2022; Sun et al., 2019), suggesting that the more learners perceived the intrinsic value from a MOOC, the greater their learning engagement and perceived learning outcomes. Furthermore, the substantial mediating effects of intrinsic value on learning engagement and perceived learning outcomes emphasize that learners who are with positive attitudes and are self-efficacious show relatively greater learning engagement and perceived learning outcomes because they are more internally interested in the MOOC. Together with findings from Chapters 3, 4 and 5, we argue that intrinsic interest acts as an internal driver to shape motivation with the highest quality, helping learners become autonomous and engaged in learning deeply to achieve meaningful outcomes. Previous studies mainly focused on positive motivational beliefs, but less attention has been paid to negative motivational belief in terms of perceived cost (Eccles & Wigfield, 2020). Being aware of the effects of perceived cost is essential to understanding what rationales disengage learners in MOOC learning. The non-significant correlation between task effort cost and learning engagement found in Chapter 4 contradicts the results of a laboratory experiment by Santosa (2015), which discovered that students who perceived a relatively high level of effort cost to be paid were less likely to be engaged with online tutorial activity. Non-association between task effort cost and perceived learning outcomes was found in our study in Chapter 4, but Perez et al. (2019) indicated that task effort cost was a negative contributor to final biology grades. That may imply that task effort cannot validly and solely explain individual subjective perceptions of learning outcomes. One possible explanation for these non-significant relationships could be that, in our model, the substantial direct and mediating effects of intrinsic value on learning engagement and perceived learning outcomes might take away the direct effect of task effort cost, affecting learners' perceptions of whether the MOOC is too effortful and learning benefits. The direct effect of task effort cost on learner learning still needs further exploration. The

moderating role of task effort cost found in Chapter 4 reveals that at a low task effort cost, MOOC learners with positive attitudes are more likely to have greater learning engagement and perceived learning outcomes, while a perceived high task effort cost can destroy these positive correlations. This finding emphasizes that task effort cost is a critical aspect of motivational beliefs to account for learner learning. What adds to the literature is that the effects of attitudes on learning engagement and perceived learning outcomes vary with task effort cost in MOOC learning.

6.3.3. The social construction of knowledge in MOOCs

With the emphasis on scalability and accessibility, MOOCs provide learners opportunities to build knowledge and construct meaning through interaction and collaboration with others in large online communities. In the systematic review described in Chapter 2, it was found that MOOCs commonly provide interactive learning through peer review, peer feedback, and forum discussions. For example, peer review and peer feedback are used in essay-type assessments such as essays, writing assignments, and writing projects, enabling learners to engage with others' ideas and perspectives to develop deep understandings (Comer, 2017). We argue that outcome-oriented rubrics with explicit interpretations can play a scaffolding role in supporting and facilitating learner performance, as they can guide feedback providers to review and construct the road map for learners towards desired learning outcomes. Meanwhile, being aware that feedback providers' ability to peer review can generally play a role in affecting learners' performance on essay assignments (Huisman et al., 2018). In forum discussions, there is a need to facilitate learners' deep learning and develop understanding collectively through sharing ideas, constructing meaning, and co-creating knowledge with peers. Interacting with peers, learners who engage in forum discussions involving high-order thinking are more likely to achieve better academic performance (Chiu & Hew, 2018). In Chapter 3, the outcome that interaction with instructors and peers significantly explained differences in perceived learning outcomes is in agreement with the results of study conducted by Kurucay and Inan (2017).

The interplay between social interaction and cognitive engagement was chosen as the focus of the study presented in Chapter 5 to understand the effects of social interaction on varied levels of cognitive engagement in forum discussions. Previous MOOC research highlights that active social interaction in forum discussions (e.g., based on the number of posts, and the number of threads contributed) positively predicts learning success with such as course grades, certification, and course completion (e.g., Gillani & Eynon, 2014; Z. Liu et al., 2022; Wise &

Cui, 2018). The findings from the study presented in Chapter 5 indicate that the quantity of social interaction does not necessarily guarantee the substantive depth of cognitive engagement, while the quality of social interactions is more crucial to demonstrating learners' knowledge construction in MOOC forum discussions. Regarding the direct content-related social interaction through forum discussions, the more content-related messages learners contribute, the higher the probability that learners are cognitively engaged in discussions. This finding corroborates the claim from Wise and Cui (2018) that focusing on the content of social interaction is more important to understand learners' differentiated cognitive engagement in MOOC content, rather than merely understanding the number of contributions. Researchers have adopted social network measures (e.g., degree centralities, authority score) to identify the underlying social structure and interaction patterns in the networked community, and their effects on learning outcomes in MOOCs. The inconsistent findings from previous studies demonstrate that these quantified social interaction patterns in the networked community do not always predict learning outcomes such as certification and course grades (Joksimović et al., 2016; Wise & Cui, 2018). Taking into account that the content knowledge carried by social behavior may play an important role, it is crucial to take a closer look at whether social network measures can predict learner cognitive learning through forum discussions. The findings from Chapter 5 suggest that learners' indegree and outdegree centralities do not necessarily predict their active and constructive engagement, which are manifested in stand-alone messages that respond to discussion tasks. One possible explanation could be that learners actively interacting with peers can inflate their social visibility in the network, but they may act as connectors or facilitators in social connections rather than being initial contributors to answer discussion tasks (Haythornthwaite, 1996). Our finding that the positive correlation between outdegree centrality and interactive engagement indicates that learners who actively communicate with others are more likely to constructively create meaning through discussions, which echoes the results from W. Wei et al. (2023). Moreover, the finding in Chapter 5 emphasizes the powerful positive association between authority score and constructive engagement, suggesting that learners with high authority scores show a greater potential to invest higher-order cognitive effort in knowledge construction in discussions. With the evidence from the systematic literature review in Chapter 2 and the empirical study in Chapter 5, we argue that it is necessary to support and elicit learners to create meaning with higher-order thinking skills in forum discussions, developing their knowledge scheme individually and collectively. Together with the findings in our study in Chapter 5 and previous studies (Jiang et al., 2014; Z. Liu et al., 2022), implying that in the social network, the quantity of indegree and outdegree centralities do not necessarily

equate to the substantive depth of cognitive engagement in forum discussions, while authority score has the potential to predict constructive social interactions. More importantly, we believe that facilitating the social construction of knowledge in MOOCs concerns enhancing the quality of learners' content learning through discussions, rather than simply increasing the quantity of social interaction.

6.4. Reflections and future research avenues

Across four studies in this dissertation, utilizing both quantitative and qualitative approaches, we made contributions to advance our theoretical and practical knowledge on the assessment of learning outcomes, as well as the mechanism of how learners' motivation, self-regulated learning, and social construction of knowledge can shape their learning engagement and perceived learning outcomes in MOOCs. However, the research in this dissertation has some limitations that need to be acknowledged, which provide suggestions for future research avenues.

Firstly, we collected quantitative and qualitative data primarily from sources such as structured questionnaires, open questions, log files, and forum data, which limits the qualitative resources that can reveal in-depth learners' perceptions. To understand the individual differences in learning engagement and perceived learning outcomes more thoroughly, future research could consider gathering additional qualitative data from focus groups or in-depth interviews. Interviews enable participants to express more details of their thoughts, feelings, and experiences in their own ways, which can offer rich perceptions to interpret how they are motivated, how they engage in the learning process, and perceive the learning benefits in MOOCs. For example, in Chapters 3 and 5, we identified the individual differences between autonomous and controlled motivation profiles; however, the small number of learners in the combined motivation profile did not provide sufficient empirical evidence. Aiming to get details of the picture, interviews might be used to explore the MOOC learning journey of learners motivated by both internal and external reasons. In Chapter 4, the subfactors of task value (i.e., attainment value, and utility value) and perceived cost (i.e., loss of valued alternatives, and emotional cost) dropped from our original research model, which resulted in not being able to capture evidence on their effects on learning engagement and perceived learning outcomes. Interviews could be an approach to gain more qualitative insights into how these unexamined motivational beliefs in Chapter 4 can shape learner learning in MOOCs.

Second, although this dissertation examined the correlations between influential factors and learning engagement and perceived learning outcomes, it cannot reveal the causal relationships between independent and dependent variables. The empirical studies in Chapters 3, 4, and 5 mainly investigated correlational relationships between factors and learning engagement as well as perceived learning outcomes in MOOC learning, which cannot further reveal the potential causal relationships between independent and dependent variables. Future research may adopt an experimental design to focus on specific influential variables to provide strong evidence for cause-and-effect relationships, which are more targeted for decision-making to improve teaching and learning in MOOCs.

Third, the variables involved in this dissertation were measured once with retrospective approaches, which limits the possibility of revealing the dynamic of learning engagement and perceived learning outcomes in MOOCs over time. In Chapters 3, 4, and 5, we investigated factors related to motivation, self-regulated learning, and social construction of learning, but did not account for the temporal dimension of these factors influencing the development of learner learning. One meaningful direction for future research could be conducting longitudinal research to capture the dynamic interaction between teaching and learning elements on a weekly or periodic basis. That could provide more targeted perspectives on how factors dynamically influence learner learning from weekly units and the overall period in MOOCs.

6.5. Implications for practice

Based on the main findings across four studies in this dissertation, we have formulated several implications for practice.

6.5.1. Implementing constructive alignment in MOOCs to promote effective learning

An important message from the findings in this dissertation is the need to implement constructive alignment in MOOCs to promote effective teaching and learning. MOOC learners across the studies in this dissertation have pursued their learning goals for higher education and lifelong learning, which address the broad educational and societal impact that MOOCs have brought. Chapter 2 underscores the importance of considering the assessment of learning outcomes at the beginning of the course design, utilizing appropriate measurements that can support the formulation and fulfillment of explicit assessment goals and instruct learners to work towards intended learning outcomes. The findings from Chapters 3 to 5 suggest that the more learners positively perceive teaching and learning in a MOOC, the better they are engaged

in learning, and the more positive their perceived learning benefits are. In learner-centered MOOC learning, we argue that offering a complete course experience is not enough, but designing and supporting learners to have an effective learning experience for outcome-oriented learning is far more important. To enhance effective learning of MOOC learners for higher education and lifelong learning, course design can be guided by constructive alignment (Biggs, 1999), ensuring that intended learning outcomes, teaching and learning activities, and assessments are coherently aligned to support learners to construct meaning from what learning is going on.

To be specific, firstly, the intended learning outcomes of a MOOC should be formulated clearly and be measurable, indicating what learners should know and be able to do (i.e., knowledge and skills) by the end of a session or MOOC. This aims to ensure learners are involved in goal-oriented learning at the start of a session or MOOC (Loughlin et al., 2021). Second, the formative and summative assessments adopted should inform learners how their learning is assessed, providing evidence of their development and whether they have achieved intended learning outcomes. The findings of learning outcomes and related measurements from Chapter 2 can inform MOOC instructors and designers to consider appropriate learning outcomes and relevant assessments to achieve their assessment goals (Wei et al., 2021). Third, teaching and learning activities in a MOOC should be designed to directly and specifically address intended learning outcomes and help learners achieve them. Learners in a more constructively aligned course are more likely to be engaged in deep learning (Stamov Roßnagel et al., 2021; X. Wang et al., 2013). The insights related to learner motivation, self-regulated learning, and the social construction of knowledge, as evidenced in Chapters 3 to 5, may help MOOC instructors and designers design engaging and effective teaching and learning activities with two principles: (a) align with intended learning outcomes and assessments, and (b) elicit desired higher-order cognitive skills of learners for constructive learning. With intentional design to align intended learning outcomes, teaching and learning activities, and assessments, as well as placing constructive learning at the center, this approach can make MOOCs of robust quality for effective learning across diverse learner cohorts.

6.5.2. Stimulating autonomous motivation by need-supportive teaching in MOOCs

The findings from this dissertation suggest that MOOC learners who are autonomously motivated are more likely to engage in learning and perceive learning benefits more positively. According to self-determination theory (Deci & Ryan, 2008), an individual who initiates and

regulates one's behavior based on inherent motivational resources is more likely to sustain engagement and succeed in achieving desired outcomes. It also emphasizes that learners achieve optimal learning and growth when offering contextual support to satisfy their three basic needs, namely having freedom of choices (autonomy), experiencing competence mastery (competence), and feeling connected to others (relatedness). Based on empirical evidence in our studies, autonomous motivation is an effective inherent resource for facilitating learners to invest higher-order cognitive effort in MOOC learning and perceive learning benefits positively. Therefore, we stress the importance and necessity of stimulating learners' autonomous motivation for engagement and succeeding in MOOC learning. To achieve this, we recommend MOOC instructors and designers to implement need supportive teaching (Leenknecht et al., 2017; Stroet et al., 2013), rooted in self-determination theory. Offering contextual support to satisfy individual internal psychological needs for autonomy, competence, and relatedness can promote motivation to be internalized, as these needs necessitate personal growth and development (Ryan, 1995; Ryan & Deci, 2000b).

To support learner autonomy in MOOCs, learners can be allowed to freely choose learning content and activities, and initiate personal learning paths and learning strategies. Learners become more autonomously motivated when they perceive the volition and flexibility in their learning, they are more likely to engage and have better achievement (Haw & King, 2023; Leenknecht et al., 2017). To foster learners' perceived competence in MOOCs, course elements such as clear learning objectives, scaffolded tasks, self-assessments, and competence-supportive peer feedback with structured rubrics, can be considered and well-integrated to help learners build up competence. For example, Mendoza et al. (2023) provided evidence that need-supportive task instructions were positively associated with learners' intrinsic motivation for online learning tasks. Specifically, when learners perceive their growth and adaptation in competence through self-assessment practice, their intrinsic motivation becomes greater, which can indirectly enhance online task performance. Furthermore, creating opportunities for learner-learner interaction, learner-instructor interaction, real-world problem solving and application, and discussion forums for constructive learning can promote a sense of relatedness for MOOC learners. For example, when online learners perceived social presence through connection with others, they were more likely to perceive satisfaction of relatedness (Turk et al., 2022). MOOC instructors and designers must be aware of implementing need supportive teaching, which involves support for learners' psychological need satisfaction for competence, and relatedness, as it is associated with better autonomous motivation, engagement, and achievement (Coudeville et al., 2020; Reeve et al., 2020; Stroet et al., 2013).

6.5.3. Enhancing the quality of social construction of knowledge in MOOCs

MOOCs offer various types of social interaction activities, primarily such as peer feedback and review assignments, collaborative group work, and discussion forums, to allow learners to develop knowledge and skills together with peers and instructors. As reflected in Chapters 2, 3 and 5, interaction with peers and instructors as well as social networked learning in forum discussions were associated with better engagement and more positive perceived learning outcomes. Particularly, we are concerned about the creation of meaning through social interaction with others, as the content of social interaction matters to manifest varied levels of cognitive engagement (Galikyan et al., 2021; Wise & Cui, 2018). Therefore, to enhance the quality of social construction of knowledge in MOOCs, we recommend that MOOC instructors and designers should prioritize interactive and collaborative learning that supports learners' constructive engagement.

In peer feedback and review assignments, using the feedback training module and outcome-oriented feedback rubrics is essential to engage MOOC learners in deep learning by both providing and receiving constructive feedback (Camarata & Slieman, 2020; Comer, 2017). A tutorial video for feedback training may guide learners on how to use outcome-oriented feedback rubrics to provide constructive and in-depth feedback on peers' assignments, such as giving learners examples on feedback differing in quality and the feedback's potential ability to trigger higher-order cognitive thinking. The outcome-oriented feedback rubrics can help learners to recognize clear goals and work toward the expected learning outcomes. Regarding collaborative group work, such as group-based capstone projects, sufficient investment in technical and social design may make it possible to support MOOC learners in completing a collaborative project remotely. To support learners in applying knowledge and skills through team project-based learning, MOOC instructors and designers can be inspired by the designs from Cheng et al. (2019): (a) managing dropout by providing exit points to allow learners to rejoin new team, (b) preventing free-riding by using intra-group peer evaluation weekly with transparent grading schemes to value member contribution, (c) providing appropriate scaffolding to support learner autonomy in choosing a project topic and the best project examples to guide and inspire learners, (d) team formation involves cultural and time zone differences, and (e) establishing common ground for knowledge and skills obtained before joining the capstone project. Furthermore, in MOOC discussion forums, we suggest that discussion tasks should be designed to explicitly require higher-order cognitive processes to deepen communication. The discussion tasks in a MOOC should define learning outcomes at a

high cognitive level for constructive interaction, with instructions provoking learners to employ higher-order thinking skills such as explaining or elaborating, justifying or comparing, reasoning or augmenting, asking questions, defending or challenging peers' ideas, and offering alternative solutions. By doing so, learners are more likely to be engaged in constructive discussions to develop a deep understanding of the course content through interaction (Chen et al., 2020; Raković et al., 2020).

