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Assessment and learning engagement in massive open online courses

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Chapter 1

General introduction

1.1. Introduction

The advancement of digital technology has transformed teaching and learning in higher education into open and online learning environments, making quality higher education more accessible and affordable. Massive open online courses (MOOCs) are one of the most significant forms of educational transformation, which were first introduced in 2008 and emerged as a popular learning model in 2012 (Pappano, 2012), providing formal or non-formal education and training online. MOOCs are offered by top knowledge institutions, and supported by government initiatives across countries. The development of MOOCs has been seen as a pivotal innovation in providing quality and efficient educational resources for higher education, professional advancement, and lifelong learning and training (UNESCO & Commonwealth of Learning, 2016). As such, MOOCs are an important means to contribute to Goal 4 (Education) of the 2030 Agenda for Sustainable Development, "ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all" (UNESCO, 2016).

MOOCs are open to all. Their scalability and sustainability enable a massive number of global learners to access courses for free or at affordable costs through online platforms, such as edX, Coursera, and FutureLearn, covering courses across various disciplines. The flexibility in the learning schedule of MOOCs enables learners to engage in a series of learning activities, such as video lectures, discussion forums, assessments, and peer review, in self-paced or instructor-paced formats to fulfill their learning goals without any restrictions of time and geographical location (Baturay, 2015). Furthermore, as the ever-growing demand for inclusive and equitable quality education and lifelong learning for all learners worldwide rises, MOOCs have been regarded as innovative solutions in facilitating the internationalization of higher education (UNESCO, 2016; UNESCO & Commonwealth of Learning, 2016). Over the past years, MOOCs have contributed to globally widening participation in higher education, improving student equity and social inclusion. A wide range of underrepresented learner cohorts has been offered learning opportunities and has obtained learning benefits from MOOCs, such as learners with low skills, and/or low levels of previous education (e.g., low-performed students, low-waged workers and the unemployed, regional and remote low-socio-economic communities), bi-lingual and/or non-English learners, learners with disabilities (e.g., with special education needs), and vulnerable people and communities (e.g., refugees, ethnic relations; Lambert, 2020). In addition, MOOCs were initially oriented towards informal learning, while the integration of MOOCs as part of formal campus education has been addressed more (Hendriks et al., 2020; Pertuz et al., 2023; Williams, 2024). As campus-like

courses, MOOCs have been implemented in various practices ranging from undergraduate to graduate education (Hendriks et al., 2024; Yuan et al., 2014), as well as full online educational degree programs (OECD, 2020).

MOOCs, as a force for educational transformation in higher education, hold significant potential for both societal and educational relevance. Nevertheless, MOOCs have encountered persistent challenges regarding examining the effectiveness of teaching and learning at a large scale. In an asynchronous teaching and learning environment, MOOCs are designed to provide learners with complete course experiences that require a high degree of autonomy to shape their learning experiences and achieve educational outcomes. Yet, more learners gradually disengage as the course progresses or do not engage at all, resulting in low completion rates and academic achievement (Cagiltay et al., 2020; Galikyan et al., 2021; Poquet et al., 2020; Sunar et al., 2016). Of the published evidence to date, the portion of learners completing MOOCs typically averages below 10% of the initial enrollments, which has been often criticized in MOOC discourses (e.g., Celik & Cagiltay, 2024; Henderikx et al., 2017; Jordan, 2015; Reich & Ruipérez-Valiente, 2019). 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.

Unlike campus education, learning in MOOCs is generally more learner-determined, where learners take the primary role in their learning process, with full agency over what, how, and when they learn (Blaschke, 2012). Learner motivation in MOOCs appears to be more diverse, and pursuing full course completion or high academic achievement is not the predominant goal for all learners (e.g., Littlejohn et al., 2016). Considering the heterogeneous nature of MOOC learners, retention (e.g., completion rates, attrition, and dropout rates) and academic achievement that can only categorize learner cohorts into completers and non-completers regarding the course experience in completion, lacking nuanced information regarding the mechanism of how the learning happens and leads to outcomes throughout their MOOC journey. However, learners vary in their motivation, which then fuels them to achieve their intended outcomes through various pathways. This results in executing effort to learn differently to achieve their learning goals, as well as a diversity of degrees in learning effectiveness and success in their MOOC journey. The preprepared video lectures and learning materials create an asynchronous space, which poses challenges to offer MOOC learners direct monitoring and immediate instructions to improve learning experience and outcomes throughout the learning process (Oh et al., 2020). Learners' perceptions of teaching and learning in MOOCs can contribute to finding ways to improve instructional design. Examining how we

can enhance learner engagement and improve perceived learning benefits is crucial to narrowing the gap between designed curriculum and experienced curriculum in MOOCs. Therefore, to gain a deeper understanding of the effectiveness and success of learner learning in MOOCs, it is essential to explore learners' motivation for taking a MOOC, how they engage with course content, and their perceptions of the learning benefits.

1.2. The aim of this dissertation

Learning assessment is the core consideration that communicates how teaching and learning are going on in MOOC learning. For example, it helps educators to appraise the effectiveness of teaching and learning approaches on learner learning and progression, and informs instruction for fostering learner learning. In the self-determined learning processes, facilitation of learning engagement is crucial as it mediates the content of subject matter taught in a MOOC to knowledge and skill construction (Fredricks et al., 2004; Reeve & Tseng, 2011), which ultimately leads to valuable learning outcomes (Wang et al., 2019). Learners' perceptions of the learning benefits, specifically perceived learning outcomes, can provide perspectives on how individuals experience and value their learning gains, helping to interpret learner-determined learning in MOOCs (Wei et al., 2021). The current dissertation aims to advance our knowledge about learning assessment in MOOCs and contribute valuable insights into how we can make MOOC learning more effective and engaging to optimize learners' learning experience, ultimately leading to better experienced learning benefits. Utilizing quantitative and qualitative approaches, this dissertation advances our theoretical and practical knowledge on the assessment of learning outcomes in MOOCs and on how aspects of teaching and learning are related to learning engagement and perceived learning outcomes in MOOCs. The remainder of the introduction first illustrates the theoretical framework for the study, followed by the relevant concepts involved and the research objective of the dissertation. Finally, an overview of the subsequent chapters is presented.

1.3. Theoretical framework

This dissertation draws on two key theoretical frameworks of motivation to understand the complex nature of learner motivation in MOOCs: self-determination theory (Deci & Ryan, 1985b) and expectancy-value theory of achievement motivation (Eccles, 1983; Wigfield & Eccles, 2000). These two theories were adopted because they provide different but complementary perspectives on motivation. Self-determination theory focuses on individuals'

internalization process and the quality of motivation to initiate a behavior, explaining how internal or external resources motivate learners to learn and grow to achieve their goals. It emphasizes that learners achieve optimal learning and growth when offering contextual support to satisfy their three innate psychological needs, namely having freedom of choices (autonomy), experiencing competence mastery (competence), and feeling connected to others (relatedness). Motivation is a complicated construct, which cannot be solely interpreted by a single motivational belief. The expectancy-value theory examines the strength of individuals' achievement motivation, suggesting that individuals' expectancies for success and subjective task values positively contribute to significant outcomes such as engagement, persistence, and academic achievement. It provides a theoretical framework to examine how multiple aspects of motivational beliefs, both positive and negative, have differentiated influences on MOOC learning. Therefore, we employed these two theories to provide a more comprehensive understanding of learner motivational processes, gaining insights into the innate psychological needs and subjective beliefs that influence learning. Moreover, the interactive, constructive, active, and passive theory of cognitive engagement (Chi & Wylie, 2014) was adopted to measure learning engagement in discussion forums.

1.3.1. Self-determination theory

Motivation is defined as the impetus to activate a person toward performing a behavior or actions (Ryan & Deci, 2000a). According to the *self-determination theory* (Deci & Ryan, 1985b), different types of motivation are distinguished based on the reasons or goals for doing something, indicating that individuals are mobilized to act by distinct motivational orientations, ranging from internalization to external regulation. Firstly, *amotivation* refers to an individual experiencing the absence of motivation to initiate and regulate one's behavior for doing something. Second, *extrinsic motivation* refers to taking actions for reasons that are induced by exogenous demands or others, comprising four underlying regulations varying from a low to a high degree of autonomy. These four regulations are external regulation (e.g., rewards and punishment), introjected regulation (e.g., senses of guilt and shame), identified regulation (e.g., personal importance), and integrated regulation (e.g., personal identified values and needs; Deci et al., 1994; Ryan & Connell, 1989; Ryan & Deci, 2002). Third, *intrinsic motivation* drives one's performance to respond to the personal inherent motivational resources (e.g., interest, pleasure, and enjoyment).

Following the controlled-to-autonomous continuum, three motivational profiles emerged: *impersonal* (i.e., amotivation), *controlled* (i.e., introjected and external regulation), and *autonomous motivation* (i.e., intrinsic, integrated, and identified regulation; Deci & Ryan, 1985a, 1987). Self-determination theory assumes that an individual who initiates and regulates one's behavior based on inherent motivational resources is more likely to succeed in achieving desired outcomes. Across life domains (e.g., education, sports, work, and health care), autonomous motivation has been found to lead to more significant, or more positive outcomes (e.g., persistence, grades, engagement, and psychological well-being) than controlled motivation and amotivation (Deci & Ryan, 2008).

1.3.2. The expectancy-value theory of achievement motivation

To further examine MOOC learners' motivation multidimensionally, *the expectancy-value theory of achievement motivation* (Eccles, 1983) offers a lens to investigate how learners' motivational beliefs about the valuable and disadvantageous characteristics of courses or tasks can influence their decisions on choice, persistence, and performance in MOOC learning. The expectancy-value model comprises three major components in terms of expectancy (i.e., self-efficacy), task value, and perceived cost. All these three components are hypothesized to predict performance, choice, effort, and persistence (Wigfield & Eccles, 2000).

Self-efficacy is one way to examine individual expectancy for learning and performance, which refers to one's confidence in his or her capabilities of being well-performed and expectancy of being successful in tasks (Bandura & Wessels, 1994). *Task value* is described as the perceived valuable characteristics of the MOOC that influence learners making a choice to engage, perform, and persist in the task. It incorporates three indicators: (1) *intrinsic value*, which refers to individuals enjoying and being interested in the MOOC: (2) *attainment value*, which refers to doing well in the MOOC, which is vital to fulfilling individuals self-identity; and (3) *utility value*, which refers to achieving individuals' short-term or future goals related to the MOOC (Wigfield & Eccles, 2000). *Perceived cost* is conceptualized as the detracted characteristics of the task that affect learners' engagement in course learning. It comprises three indicators: (1) *task effort cost*, which refers to the anticipated time and effort investment required to succeed in the task or course; (2) *loss of valued alternatives*, which refers to completing the task or course keeps individuals away from other valued activities; and (3) *emotional cost*, which refers to the negative psychological states that are related to the potential failure or struggle in the task or course (Wigfield & Cambria, 2010).

1.3.3. The theory of cognitive engagement

MOOC discussion forums serve as a venue for collaborative knowledge construction through text-based and asynchronous communication. A collaborative learning community for social learning emerges when MOOC learners actively engage in discussions to demonstrate their understanding of specific topics by sharing their perspectives within discussion threads, and they interact with peers through constructive dialogues, ultimately deepening their comprehension of the subject matter (Schrire, 2006). Therefore, the present dissertation adopts Chi and Wylie (2014)'s framework to examine learners' cognitive engagement in MOOC discussion forums thoroughly. *The interactive, constructive, active, and passive theory of cognitive engagement* (ICAP) establishes a theoretical framework to distinguish cognitive behaviors observed into four cognitive engagement modes: interactive, constructive, active, or passive (Chi et al., 2018; Chi & Wylie, 2014), which follow a continuum from high to low levels of cognitive engagement.

Passive engagement mode is conceptualized as learners merely paying attention and being oriented toward the instructional materials without any visible manipulation related to learning. For example, learners are passively engaged with instructional materials, such as reading, watching, and listening, and they are more likely only to receive new information and store it in an isolated way, not integrating it with prior knowledge. *Active engagement mode* is defined as an individual's overt action or physical movement to activate prior knowledge and use new knowledge to engage with learning tasks without providing any new information from outside of instructional materials. Regarding being active, learners take overt actions such as repeating, copying, and paraphrasing to focus attention and manipulate what has been presented in instructional materials to respond to learning tasks. In this mode, newly gained knowledge is integrated into prior knowledge to strengthen the understanding of relevant topics, resulting in learners having a shallow understanding of the subject matter and being able to apply the assimilated knowledge to similar tasks in a new context. *Constructive engagement mode* is described as learners' generating of new information and constructing meaning that goes beyond what is included in instructional materials. Learners undertake constructive learning activities, such as explanation, elaboration, justification, comparison, and connection, to construct new content-related information to respond to learning tasks. In this mode, learners cognitively process the knowledge gained by creating new inferences to enrich their current knowledge structure and transfer their deep understanding to a new context. Lastly, *interactive engagement mode* means that based on others' inputs, learners constructively and

collaboratively engage with learning tasks, for instance, proposing new directions or alternative perspectives, challenging or questioning others, and defending their opinions. By undertaking interactive activities, learners are assumed to co-infer innovative perspectives to expand each other's knowledge and potentially reach the most profound understanding. In sum, the passive-to-interactive mode continuum assumes that the underlying cognitive processes corresponding to each mode develop dynamically toward higher levels, and learners have achieved better meaningful learning outcomes in the progressed mode (Chi, 2009).

1.4. Learning engagement and learning outcomes

1.4.1. Learning engagement

Learning engagement is defined as the exertion of one's physical and psychological ongoing effort during the learning process to realize academic achievement or learning goals (Oh et al., 2017). It is important to address learning engagement in online learning, as it is positively associated with academic achievement (Vayre & Vonthron, 2019). The current dissertation estimates learning engagement in MOOCs from three perspectives: cognitive, behavioral, and emotional engagement (Fredricks et al., 2004). *Cognitive engagement* refers to learners exerting mental effort in MOOCs, which concerns employing higher-order learning strategies (e.g., elaboration, critical thinking, problem solving) and metacognitive self-regulation strategies (e.g., planning, monitoring, and regulating), aiming at acquiring content knowledge and mastering skills (Kuo et al., 2021; Reeve & Tseng, 2011). *Behavioral engagement* is presented as learners' involvement in MOOC learning activities (e.g., course materials, video lectures, discussion forums, course assessments), on-task attention, and investment of effort within the learning process (Kang, 2020; Reeve & Tseng, 2011). Moreover, *emotional engagement* is regarded as learners expressing emotional feelings about their MOOC learning, such as interest, curiosity, enjoyment, and enthusiasm, which show the extent of positive evaluation on what they have learned (Skinner et al., 2008).

1.4.2. Assessment of learning outcomes

Learning assessment in MOOCs has been regarded as a challenge, and both learners and teachers are aware that assessment instruments should be related to the learning goals of a particular MOOC (Yousef et al., 2014). Various learning outcomes in MOOCs have been studied, such as knowledge, skills, academic achievement, engagement, motivation, satisfaction, and perceptions of learning (Barak et al., 2016; Deng et al., 2020b; Jung et al., 2019; Jung &

Lee, 2020; Li & Baker, 2018; Shapiro et al., 2017). Xiong and Suen (2018) have discussed different formats of assessments, such as discussion forums, Q&A sessions, quizzes, and automated grading essays. These assessment forms can be used as formative or summative assessments. In addition to automated tests, self-assessment and peer assessment (Admiraal et al., 2015; Huisman et al., 2018; Papathoma et al., 2015), as well as other methods, such as groups of experts, semantic web, portfolio, and learning analytics, are recommended to be used as alternative assessments in MOOCs (del Mar Sánchez-Vera & Prendes-Espinosa, 2015). Although there is a debate about various methods that can be used as learning assessments in MOOC in a wide range of disciplines within higher education, it lacks a focus on the connection between learning outcomes and assessment instruments.

As Sandeen (2013) claims, the assessment is the core consideration at the very beginning of the MOOC course design rather than a later add-on. The match between learning goal, learning outcomes and assessment instruments is important to guarantee learners to realize the course required achievement (Bralić & Divjak, 2018; Ewais et al., 2020). Assessment of learning outcomes is key to measuring the actual achievements of the student, which is also critical for examining the effectiveness of instructional practices and students' learning progression (Alexandron et al., 2020; Anne Clark, 2002). In order to provide a holistic picture of the assessment of learning outcomes in recent MOOC studies, we investigate the dimensions of learning outcomes and related instruments, and the assessment characteristics of these instruments in higher education MOOCs across different disciplinary fields.

1.4.3. Perceived learning outcomes

This dissertation examines MOOC learners' perceptions of learning benefits, specifically *perceived learning outcomes*, investigating how individuals value their learning gains to interpret learner-determined learning in MOOCs. We distinguish and estimate three domains of learners' perceived learning outcomes, including cognitive, behavioral, and affective outcomes (Wei et al., 2021; Yu et al., 2010). *Cognitive outcomes* are defined as the acquisition of content knowledge and intellectual skills from MOOCs (Lan & Hew, 2020). *Behavioral outcomes* refer to the capabilities of applying knowledge and skills in MOOC learning, such as study skills, and self-regulated learning skills (Min & Foon, 2019). Furthermore, *affective outcomes* refer to learners' satisfaction with the learning gains and appreciation of the interaction with instructors and peers (Hew et al., 2020; Li, 2019). Learners report their perceptions regarding these three aspects of learning outcomes gained from MOOC learning.

1.5. Factors that affect learner learning in MOOCs

1.5.1. Attitudes

Attitudes refer to learners' general beliefs of favorability and benefits of learning in MOOCs. Prior research highlights that attitude is one of the powerful determinants of continuance intentions to MOOC participation and actual behavior to course completion (Al-Rahmi et al., 2019; Altalhi, 2021; Joo et al., 2018; Wu & Chen, 2017). This suggests that attitudes serve as the evaluative predisposition to planned behavior (Ajzen, 1985). In this regard, attitudes toward MOOC learning might have effects on motivation and participation, because continuance intentions are consistent with personal motivation for MOOC participation and indicate individual willingness to continued participation. To our knowledge, in online learning context only a few studies examined how attitudes influence learners' motivation, learning engagement, and perceived learning outcomes. For example, in online distance education, Prior et al. (2016) conducted an investigation of postgraduate students to identify to what extent attitudes, digital literacy and self-efficacy impact their online learning behavior. The findings showed that positive attitudes had a significant influence on self-efficacy. Ma and Lee (2019) discovered some learner-related barriers, in which lack of positive attitudes toward learning in MOOCs hindered learning engagement. Moreover, regarding perceived learning outcomes, it was found that positive attitudes toward learning in MOOCs contributed to satisfaction (Albelbisi, 2020), as well as the improvement in self-regulated learning skills (Albelbisi & Yusop, 2019). According to Prior et al. (2016), positive attitudes contributed to self-efficacy in online learning. To further build the knowledge of the role of attitudes in MOOC learning, in the current dissertation attitudes toward MOOC learning is regarded as the antecedent of learner motivation, learning engagement, and perceived learning outcomes.

1.5.2. Motivation

Learners are driven by diverse types of motivation to attend MOOCs, such as personal enjoyment, satisfying curiosity, the acquisition of knowledge and skills gains, educational achievement, professional advancement, personal development, relevance to career, and social connection (Littlejohn et al., 2016; Luik et al., 2019; Milligan & Littlejohn, 2017; Watted & Barak, 2018). These prior studies further suggested that motivation for participation in MOOCs is more personalized and goes beyond just succeeding in course completion and academic grades. Several studies showed that autonomous motivation (e.g., initial interest, curiosity, development of knowledge and expertise) positively predicted satisfaction, the intention to use

MOOCs, and the use of self-regulated learning skills (Littlejohn et al., 2016; Maya-Jariego et al., 2020; Pozón-López et al., 2021). The above-mentioned studies suggest that learners' motivation for attending a MOOC can be diverse ranging from extrinsic motivation to intrinsic motivation. The underlying regulations of extrinsic and intrinsic motivation vary from a low to high degree of autonomy, which generates learner profiles of motivation namely impersonal, controlled, and autonomous motivation (Deci & Ryan, 1985a, 1987). Based on prior findings, a further focus on the shared quality of learner motivation is needed, which can characterize motivational profiles and how these motivational profiles correlate to individual learning in MOOCs.

Furthermore, motivation is significantly associated with learners' participation in forum discussions. Barak et al. (2016) showed a positive relationship between MOOC learners' motivation and their engagement in social interaction, such as posting messages for sharing knowledge, asking questions, and receiving answers from others. Similarly, Yang (2014) has witnessed learners' motivation differences in MOOC learning throughout the semester. Initially, no relationship was found between intrinsic motivation and participation in discussion forums, but later the relationship became significant and strengthened as the course progressed. Moreover, researchers have also examined the influence of different types of motivation on MOOC learners' forum participation. For example, MOOC learners with intrinsic motivation performed better than their counterparts with extrinsic motivation in longitudinally forum engagement (Tang et al., 2018). This suggests that intrinsic motivation better keeps MOOC learners actively and continually engaged in forum discussions than extrinsic motivation. Nevertheless, previous studies have examined how motivation influences MOOC learners' forum participation concerning social or behavioral engagement, it is still unclear how motivation is related to various levels of learners' cognitive engagement with discussions.

1.5.3. Expectancy-value beliefs

While existing MOOC studies have primarily focused on positive motivational values, less attention has been paid to negative motivational values, such as perceived cost. Part et al. (2020) and Flake et al. (2015) have argued that, for a multidimensional presentation of individuals' motivational process, examining the benefits of robust predictors (i.e., self-efficacy, and task value) to educational outcomes is not enough, being aware of the negative effects of perceived cost is also essential. The weighting and role of the components of task value and perceived cost to influence academic outcomes vary in individuals and contexts (Eccles & Wigfield, 2020;

Perez et al., 2019). However, considering both positive and negative motivational beliefs in MOOC learning, it is unclear whether the direct and indirect effects of task value and perceived cost have on learner learning. Given the context of teaching-learning asynchronously and learner-determined learning in MOOCs, there is a need to identify the roles of self-efficacy, task value, and perceived cost in learning.

1.5.3.1. Self-efficacy

Within the online learning environment, it has been confirmed that self-efficacy has a significant influence on learning (e.g., Tseng et al., 2020; Vayre & Vonthron, 2017). In a MOOC study by Kuo et al. (2021), it was found that general internet-based learning self-efficacy (i.e., general belief of one's ability can master Internet-related activities) had a significant influence on behavioral and emotional engagement. Moreover, they discovered that functional Internet-based learning self-efficacy (i.e., specific belief of one's internet skills can complete online tasks) was significantly associated with cognitive and emotional engagement. Min and Foon (2019) discovered that these MOOC learners who expressed low self-efficacy reported their worries on cognitive (i.e., comprehension monitoring), behavioral (i.e., effort expended), emotional (i.e., anxiety, boredom) engagement. In addition, Jung and Lee (2018) found that academic self-efficacy was significantly linked with learning engagement (i.e., cognitive, behavioral, and emotional engagement) in MOOCs.

Researchers have pointed out that self-efficacy is a vital predictor of perceived learning outcomes in MOOCs. For example, in the study of Rabin et al. (2020), the less self-efficacious MOOC learners were, the more likely they were to perceive barriers to satisfaction while taking the MOOC. Lee et al. (2020b) found that learners with higher self-efficacy were more likely to use self-regulated learning strategies, suggesting that self-efficacy played a crucial role in facilitating the use of self-regulated learning strategies in MOOCs. Furthermore, Ghazali et al. (2020) had set up a four-dimension of MOOC-efficacy (i.e., information searching, making queries, MOOC learning, MOOC usability). They identified that MOOC-efficacy had a positive influence on perceived learning outcomes, such as learners' willingness to peer interaction and collaboration, knowledge and skills construction, self-regulated learning skills, etc.

1.5.3.2. Task value

Concerning the role of task value in online learning, several studies have pictured that task value is an effective predictor associated with learning engagement. For example, when learners

perceived that the learning activities were valuable for their teaching practice and professional development, they were more likely behaviorally engaged in the online professional learning communities (Zhang & Liu, 2019). In MOOC settings, there is evidence that task value effectively facilitates learning engagement. Findings in studies by Y. Liu et al. (2022) and Tang and Chaw (2019) showed that intrinsic interest, attainment, and utility value positively predict behavioral engagement in MOOC learning. MOOC learners with positive perceptions of the task in the course they attend were actively engaged in learning. Perceived usefulness (i.e., utility value) robustly predicted learning engagement (i.e., cognitive, behavioral, and emotional engagement) in MOOCs (Jung & Lee, 2018). In the discussion forums, Tang et al. (2018) indicated that intrinsically motivated learners who perceive the MOOC as interesting and enjoyable were more willing to longitudinally persist in behavioral engagement in forum activities than their counterparts. Moreover, intrinsic interest toward a MOOC was found to positively impact psychological engagement (i.e., cognitive, and emotional engagement; Sun et al., 2019). These studies suggest that the more learners are intrinsically motivated, the greater their cognitive, behavioral, and emotional engagement in MOOC learning.

In online learning, previous studies (Artino, 2008, 2009) discovered that task value (i.e., intrinsic, attainment, and utility value) positively influenced university students' perceived learning outcomes in terms of course satisfaction, continuing motivation, and the use of self-regulated learning strategies. Similarly, in the online university environment in South Korea, self-efficacy and task value significantly predicted both learner satisfaction and achievement scores (Joo et al., 2013). Moreover, Lee et al. (2020a) examined perceived effectiveness as learners' perceived learning outcomes of a MOOC, which was an indicator to measure satisfaction with online learning. Influential factors, such as self-efficacy, and task value, affected successful MOOC learners' perceived effectiveness. Particularly, the task value had a statistically significant effect on perceived effectiveness of learners who have fully completed the MOOC. With asynchronous instruction in MOOCs, how task value directly and indirectly impacts the perception of learners who have learned something needs further exploration.

1.5.3.3. Perceived cost

In the emerging research, researchers suggested that perceived cost was negatively linked with learning engagement in online learning (e.g., Santosa, 2015) and academic outcomes in offline learning (e.g., Perez et al., 2019). For example, Santosa (2015) examined how perceived cost influenced learning engagement with online tutorial activities. In that case, students perceived

a high level of cost (e.g., reading materials make students feel like wasting time), which resulted in disengagement with online tutorial activities. Prior studies demonstrated that perceived cost was negatively associated with perceived learning outcomes in online settings. For example, researchers reported that perceived cost was a significant predictor of Chinese college student's perception of adopting online learning (Chen et al., 2021) and the adoption of e-training in the Nigerian civil service (Zainab et al., 2017). Researchers have investigated the role of perceived cost in online learning, however, the knowledge of how perceived cost directly and indirectly shapes learning engagement and perceived learning outcomes in MOOCs is still unclear.

1.5.4. Perceived learning support

Perceived learning support refers to learners' perceptions of receiving learning support from course instruction, instructors, and peers when learning in a MOOC. Pre-prepared video lectures and learning materials create an asynchronous space where it is challenging to offer learners adequate learning support by providing access to synchronous instructions and interaction with instructors and peers (Oh et al., 2020). Yet whatever the learners' motivation is, perceived learning support, such as structured course design and effective interactions with instructors and peer learners, contributes to successful online learning (Albelbisi et al., 2018; Brophy, 2000; Narciss et al., 2007). Perceived learning support can be structured by four components (Paechter et al., 2010): (1) course design, (2) interaction with instructors, (3) interaction with peer students, and (4) learner autonomy.

The quality of *course design* is a factor that facilitates learning outcomes in MOOCs. Specifically, participants are more likely to engage in active and meaningful learning if curriculum content and learning materials are well-structured for coherent learning (Brophy, 2000). Explicit illustration of instructional objects and required effort helps learners to realize learning outcomes efficiently in MOOCs (Barman et al., 2019; Pilli & Admiraal, 2017). Moreover, a user-friendly platform has a positive influence on learner perceptions of course satisfaction (Joo et al., 2018).

Interactions between instructors and learners or among learners (e.g., in discussion forums, peer-review tasks, or group work) may benefit learners' construction of knowledge and social connections and communication. Instructors can offer learners pedagogical, social, managerial, and technical online support, which contributes to the construction, processing, and enhancement of knowledge as well as engaging participants in learning (Berge, 1995; Hew, 2016). Learners' mutual interactions in discussion forums, providing peer-review feedback,

cooperation in group work, and exchanging individual information significantly predict learning performance (Huisman et al., 2018; Kurucay, 2015; Kurucay & Inan, 2017). As these studies indicated, both learner-learner and learner-instructor interactions have positive consequences for learning outcomes.

Concerning *learner autonomy*, MOOCs enable learners to be flexible in terms of time and space, as well as to make decisions for a personalized learning pace and learning strategies (Littlejohn et al., 2016). Furthermore, learners can take advantage of ample learning opportunities, such as practices, applications, and test attempts, which are beneficial for learners for reaching better individual learning outcomes (e.g., Abbakumov et al., 2020; Margaryan et al., 2015).

1.5.5. Self-regulated learning

In lacking instructors' direct monitoring, learners' self-regulation is crucial when interacting with pre-prepared video lectures and learning tasks in MOOCs. The use of self-regulated learning strategies shapes personalized learning paths, and learners with a higher level of capability in self-regulated learning are more likely to complete courses and achieve better academic outcomes (e.g., Min & Nasir, 2020). Given learners are required to self-regulate their learning in the asynchronous learning environment of MOOCs, it is essential to examine the role of self-regulated learning in influencing learning engagement and perceived learning outcomes.

Self-regulated learning has been conceptualized and interpreted in various theories and models (Panadero, 2017). Following Pintrich's model (Pintrich & De Groot, 1990), self-regulated learning refers to learners employing cognitive (i.e., rehearsal, elaboration, organization, and critical thinking), metacognitive (i.e., planning, monitoring, and regulating), and resource management strategies (i.e., time and study environment, effort regulation, peer learning, and help seeking) to regulate learning on their own. In the online learning environment, researchers highlight that it is essential for learners to engage in self-regulated learning (e.g., Jansen et al., 2020), which significantly relates to learning outcomes. For example, in a study by Cheng and Chau (2013), students' self-regulated learning capabilities were examined in a language program. The findings showed that five strategies (i.e., elaboration, organization, critical thinking, metacognitive self-regulation, and peer learning) were positively correlated with the scores of e-Portfolio achievement. Broadbent and Poon (2015) reviewed 12 studies published between 2004 and 2014 and concluded that self-regulated learning strategies, such

as critical thinking, metacognition, time management, and effort regulation, significantly predicted the academic outcomes of online learning. According to prior research, several self-regulated learning strategies were identified as predictors of learning outcomes in MOOC learning, namely goal setting, help-seeking, effort regulation, and time management (Kizilcec et al., 2016; Littlejohn et al., 2016; Milligan & Littlejohn, 2016; Nawrot & Doucet, 2014). Moreover, Lee et al. (2020a) discovered that time management, environmental structuring, and metacognitive activities were positively related to perceived learning outcomes of MOOC completers. Additionally, Magen-Nagar and Cohen (2017) examined high school students' applied self-regulated learning in a MOOC. The findings indicated that self-regulated learning strategies played a mediating role between motivation and perceived academic achievement.

1.5.6. Social construction of knowledge in forum discussions

MOOC discussion forums allow learners to interact with peer participants and instructors for information transmission and idea exchange. Meaningful social interaction occurs when learners undertake interactive behaviors such as posting, commenting, and replying to not merely share ideas, but also make constructive meaning and produce new knowledge through productive communication. Facilitation of meaningful social interaction in forums encounters challenges, as the massive and heterogeneous nature of MOOC cohorts makes it challenging to start and sustain dialogues. For example, a few participants actively contribute to discussions, while passive observers rarely engage in communication (Sunar et al., 2016), and participants (e.g., residents and visitors) tend to disengage with discussions as the course progresses (Poquet et al., 2020). Despite its challenges, it is promising that meaningful social interaction in MOOC discussion forums has a positive impact on various learning outcomes, such as course grades (He et al., 2018), certification (Z. Liu et al., 2022), and course performance and completion (Sunar et al., 2016). Social interaction in MOOC discussion forums involves learners in the social construction of knowledge in a networked community. This dissertation measures the number of messages learners created, degree centrality, and authority score in the social network to demonstrate individuals' social interaction in forum discussions.

Number of messages, which is a commonly used measurement for the social aspect of learner participation (e.g., Sanz-Martínez et al., 2019), estimates the direct social interaction in terms of the total number of content-related contributions learners make in discussion forums. *Degree centrality* (Wasserman & Faust, 1994), which is estimated by the total number of social connections individuals have, demonstrates the prominence of individuals in a social network.

The higher the degree of centrality learners have, the more centralized, prominent, and influential they are in the network. *Authority score* is a measure originally from Kleinberg (1999) to estimate the influence or credibility of a page in a hyperlinked environment using the *Hyperlink-Induced Topic Search* algorithm. A page with a higher authority score is pointed to by many other authoritative pages, which means the page is regarded as a more credible and relevant source of information on a given topic.

Earlier studies employed social network analysis to identify the underlying social structure and interaction patterns, and their effects on learning outcomes. Direct social interaction in MOOC discussion forums has been shown to predict course grades. For example, in a MOOC study of Houston et al. (2017), direct learner interaction in discussions, in terms of the number of threads that an individual contributes to and the number of learners that an individual interacts with, had strong correlations with course grades. Galikyan et al. (2021) found that the number of threads contributed positively predicted course grades, and the number of threads contributed was a strong moderator between lowest level of cognitive engagement and course grades. When looking at the relationships between social network measures and learning outcomes, there were inconsistent findings in MOOC learning communities. For example, Joksimović et al. (2016) revealed different roles of centrality measures in predicting certification in two programming MOOCs. Specifically, in one MOOC, weighted degree centrality was significantly related to distinction certification, while closeness and betweenness centrality had non-significant effects. However, in the other MOOC, all three types of centralities had no significant impact on predicting obtaining a certificate or a distinction certificate. Wise and Cui (2018) found that learners who contributed to content-related discussions had higher course grades than those who did not contribute to content-related discussions. They further established a predictive model combining the number of forum contributions and social network measures to predict course grades, which demonstrated that the quantity of the learner's contribution to content-related threads explained a small proportion (3.2%) of variance in course grades. In this predictive model, social centrality variables (i.e., degree, weighted degree, betweenness, closeness, and eigen-centrality) did not improve the explained variance in course grades. Moreover, researchers have discovered that the authority score in the forum network emerged as a significant negative predictor of dropout rates during MOOC learning (e.g., Rosé et al., 2014; Yang et al., 2013). This highlights the role of a learner's influence and centrality in discussions in shaping their engagement and persistence. Although prior studies have gained knowledge of social centrality (e.g., degree, weighted degree, betweenness, and authority score) predicting various MOOC learning outcomes, we lack

knowledge of how individual social interaction influences varied levels of cognitive engagement with discussions. Addressing this concern is necessary, as social interaction and knowledge construction in forum discussions work synergistically to foster cognitive development and acquire knowledge and skills (Schrire, 2006; Vygotsky, 1978).

1.6. Research objective

In this dissertation, we aimed to advance our knowledge about learning assessment in MOOCs and contribute valuable insights into how we can make MOOC learning more effective and engaging to optimize learners' learning experience, ultimately leading to better experienced learning benefits. In the context of online higher education, to achieve the aim proposed, four studies were designed to gain knowledge about learning assessment, learning engagement, and perceived learning outcomes 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).

Firstly, this dissertation begins with exploring the assessment of learning outcomes in higher education MOOCs in the literature. Although there is a debate about various methods that can be used as learning assessments in MOOC, in a wide range of disciplines in higher education, it lacks a focus on the connection between learning outcomes and assessment instruments. Thus, in Chapter 2, a systematic literature review was designed to determine the dimensions of learning outcomes assessed, related instruments, and assessment characteristics across different disciplinary fields in higher education MOOCs.

Second, across Chapter 3, 4, and 5, the role of individuals' motivation in driving learner-determined learning in MOOCs is examined. Inspired by the systematic literature review in Chapter 2, we realized the importance of aligning how learners are motivated, to what extent they are engaged, and what learning benefits they have perceived in MOOC learning. As one of the antecedents of participation in MOOCs, individuals' motivation serves as the impetus for engaging a learner in MOOC learning. Their motivation then drives them to learn and achieve their intended outcomes. Effective learning happens when one is motivated and actively engaged in learning. Learner motivation in MOOCs can be diverse, concerning either quality or quantity, which fundamentally influences their learning processes and outcomes. In this regard, the key exploration in Chapter 3, 4, and 5 emphasizes how learners are motivated to

participate in a MOOC, and how their motivation explains the individual differences in both independent and collaborative learning.

The third theme focuses on estimating the effects of self-regulated learning on MOOC learners' learning processes and outcomes (Chapter 3). Given that in an asynchronous teaching and learning environment, MOOCs are designed to provide learners with a complete course experience that requires a high degree of autonomy to shape their learning experience and achieve educational outcomes. In the absence of instructors' direct monitoring, learners' self-regulation is crucial when interacting with pre-prepared video lectures and learning tasks. More understanding is needed on how learners are motivated to attend a MOOC, how they employ self-regulation to contribute to developing a deep understanding of learning content and exerting effort toward learning success.

Fourth, our interest extends the exploration to social learning contexts, examining the social construction of knowledge in MOOC (Chapter 2, 3 and 5). Overall, MOOCs provide learners with opportunities to engage with instructors and peers, and assessments to measure learning through social interaction (Chapter 2), which supports social learning within a large community (Chapter 3). A collaborative learning community for social learning emerges when MOOC learners actively engage in discussions to demonstrate their understanding of specific topics by sharing their perspectives within discussion threads, and they interact with peers through constructive dialogues, ultimately deepening their comprehension of the subject matter (Chapter 5). Our focus is on investigating how learners are motivated to be engaged in the social construction of knowledge, which can illuminate how learners process information individually and co-construct knowledge with their peers through MOOC forum discussions.

These four themes are interconnected. While each study emphasizes one or more themes, together they offer a comprehensive understanding of how learners drive and experience learning in MOOCs. For example, individuals differ in their motivation to study in a MOOC (Theme 2), which often requires self-regulation (Theme 3), and can manifest in both independent and collaborative learning processes and outcomes (Theme 4). Consequently, through addressing these themes across different studies in this dissertation, we expect to provide MOOC researchers and practitioners with both theoretical and practical implications on learning assessment and making learning more effective and engaging for learners, ultimately benefiting learners in achieving their educational goals.

1.7. Dissertation outline

This dissertation comprises six chapters. From Chapter 2 to Chapter 5, four studies were carried out to contribute knowledge about four themes toward achieving the primary aim of the dissertation, each of which focuses on at least one or more of the thematic strands stated above. In the final chapter, we summarize and discuss the main findings of all four studies. Figure 1.1. shows the schematic overview of chapters in the dissertation, and Table 1.1. depicts the design details of studies included in the dissertation.

Chapter 2 describes a systematic literature review on the assessment of learning outcomes in higher education MOOCs in the literature. This review study aimed to explore the dimensions of learning outcomes assessed, related instruments, and assessment characteristics across different disciplinary fields within higher education MOOCs. The research questions that directed this systematic literature review are: (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-review articles published between 2017 and 2019, and selected from 12 electronic databases.

In ***Chapter 3***, an exploratory study utilizing a mixed-method design examined factors influencing perceived learning outcomes in MOOC learning. This exploratory research aimed to investigate the interplay between motivation, perceived learning support, learning engagement, self-regulated learning strategies, and perceived learning outcomes. The self-determination theory was adopted to establish the theoretical framework to explore motivational profiles. Three research questions proposed to drive this study are as follows: (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? An online survey was administered to 546 participants from four MOOCs. The qualitative and quantitative data were analyzed using multiple methods, such as content analysis, One-way MANOVA, multiple regression analysis, and mediation analyses.

Chapter 4 contributes insights into how attitudes and motivation impact learning engagement and perceived learning outcomes in MOOCs. The expectancy-value theory provided a theoretical perspective for examining achievement motivation multidimensionally

(i.e., self-efficacy, task value, and perceived cost), and it was employed to construct the theoretical framework for measured variables in this study. To fulfill the aim of this study, we performed a three-stage examination. Firstly, we explored the relationships between independent variables (i.e., attitudes, self-efficacy, task value, and perceived cost) and dependent variables (i.e., learning engagement, and perceived learning outcomes) in MOOCs. The following four research questions were formulated to probe the relationships between every two latent variables: (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? Secondly, we estimated the indirect effects of task value and perceived cost on the relationships between attitudes/self-efficacy and learning engagement/perceived learning outcomes. According to the hypotheses of mediators in the original expectancy-value model, we came up with RQ 5 and RQ 6 to estimate the mediating effects of task value and perceived cost on learning engagement and perceived learning outcomes: (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? Thirdly, if there were no significant results of mediation analyses coming out, moderation analyses (RQ7 to RQ8) would be performed to estimate whether task value and perceived cost play a moderating role in learning engagement and perceived learning outcomes: (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? An online survey was administered to 232 MOOC learners to collect quantitative data. Structural equation modeling, mediation analyses, and moderation analyses were implemented to address research questions.

Proceeding to ***Chapter 5***, the mixed-method study focuses on how motivation and social interaction influence cognitive engagement in MOOC discussion forums. Learner participation in discussions is insufficient to promote learning, and learners are diverse in cognitive engagement with discussions. To optimize learning through discussions, we need to gain knowledge on how learners cognitively engage in knowledge construction and co-construction

in discussions. The interactive, constructive, active, and passive theory of cognitive engagement provided a theoretical framework to identify the modes of cognitive engagement in MOOC discussion forums. Although it is known that motivation and social interaction are vital determinants for learning in MOOCs, what remains unclear is how motivation and social interaction shape individuals' cognitive engagement in discussions. Therefore, this study first examined the modes of cognitive engagement manifested in MOOC discussion forums by analyzing the dialogue content. Second, we explored the extent to which learner motivation influences these modes of cognitive engagement in MOOC discussion forums. Third, we estimated the effects of social interaction on these modes of cognitive engagement in MOOC discussion forums. The following research questions directed 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? Multiple types of data (e.g., demographic information, pre-course surveys, log events, and discussion forum logs) were collected from 5465 enrolled learners in a MOOC related to circular economy provided on the edX platform. Learning analytics were adopted to mine and process raw data, and sub-datasets were built to answer research questions. Content analysis, social network modeling, and zero-inflated negative binomial regression modeling were performed to analyze quantitative and qualitative data.

Chapter 6 provides a summary of the main findings of chapters 2 to 5, a general discussion about the main findings, limitations and future research, and practical implications of these studies.

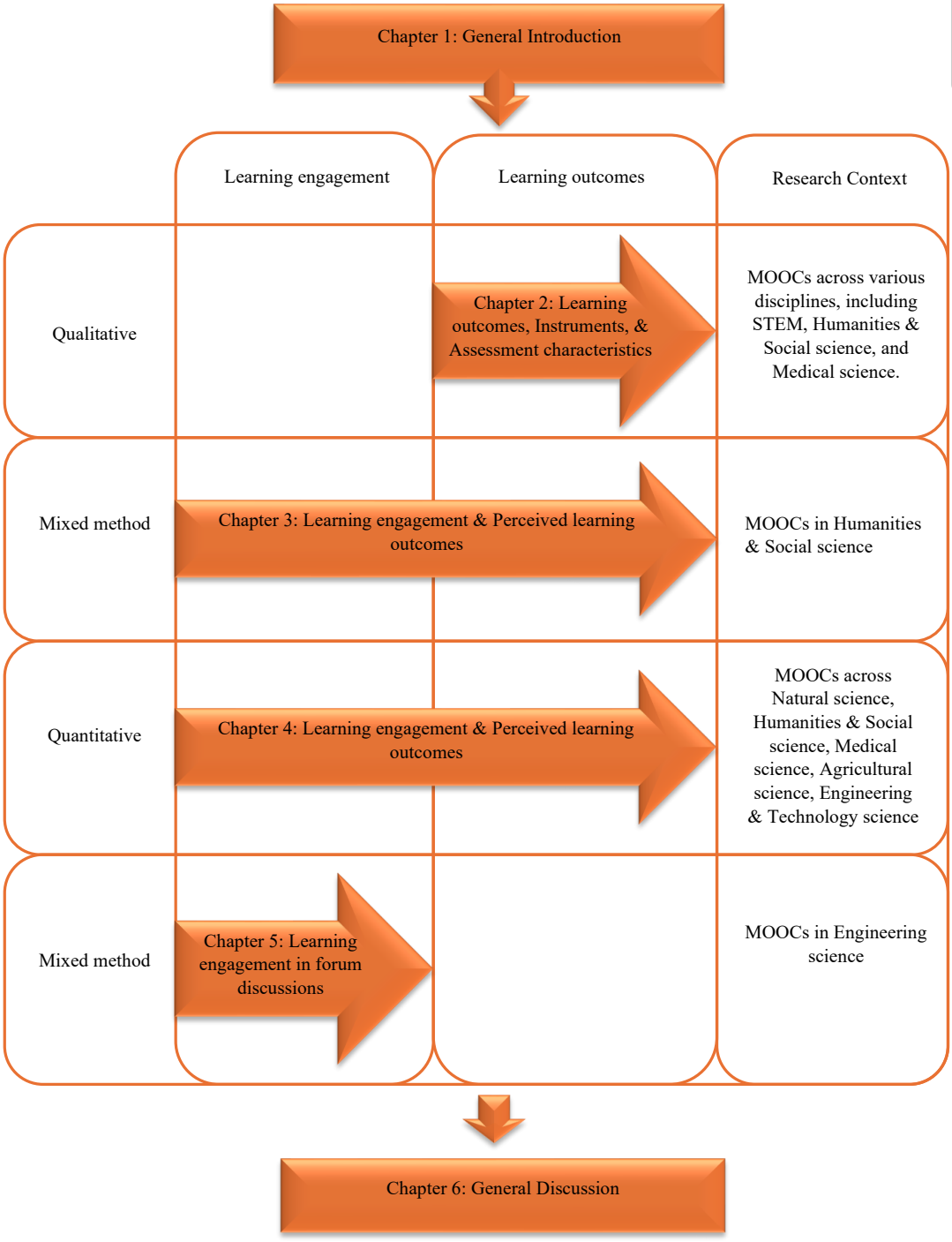

Figure 1.1. Schematic overview of chapters in the dissertation

Table 1.1.

Description of studies included in the dissertation.

Chapter	Title	Research questions	Methodology				
			Research design	Instruments for data collection	Number of participants	Data analysis	Thematic strands
Chapter 1	General introduction						
Chapter 2	Assessment of cognitive, behavioral, and affective learning outcomes in massive open online courses: A systematic literature review	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?	Systematic literature review	PRISMA framework	N/A	Content analysis	Theme 1 & 4
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	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?	Mix-method	Open-ended questions & questionnaire surveys	546 learners	Content analysis, One-way MANOVA, multiple regression analysis, & mediation analysis	Theme 2, Them 3 & Theme 4
Chapter 4	What rationale would work? Unfolding the role of learners' attitudes and motivation in predicting learning engagement and perceived learning outcomes in MOOCs	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?	Quantitative	Questionnaire surveys	232 learners	Structural equation modeling, mediation analysis, & moderation analysis	Theme 2

		RQ4: How is perceived cost related to (a) learning engagement and (b) perceived learning outcomes in MOOCs? 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?					
Chapter 5	Would you be an active learner in MOOC discussion forums? The interplay of motivation, social interaction, and cognitive engagement	RQ1: What modes of cognitive engagement characterize the co-construction of knowledge in MOOC discussion forums? RQ2: How is motivation related to different modes of cognitive engagement in MOOC discussion forums? RQ3: How is social interaction related to different modes of cognitive engagement in MOOC discussion forums?	Mix-method	Pre-course questionnaire surveys, log events, & discussion forum logs	5465 learners	Learning analytics, content analysis, social network modeling, & zero-inflated negative binomial regression	Theme 2 & Theme 4
Chapter 6	General discussion						

Note: Theme 1 = The assessment of learning outcomes in MOOCs (Chapter 1). Theme 2 = How individuals' motivation drives learner-determined learning in MOOCs (Chapter 3, 4, and 5). Theme 3 = How self-regulated learning shapes personalized learning paths in MOOCs (Chapter 3). Theme 4 = The social construction of knowledge in MOOCs (Chapter 2, 3, and 5).

"*Es ist nicht genug, zu wissen, man muss auch anwenden; es ist nicht genug, zu wollen, man muss auch tun.*"

— Johann Wolfgang von Goethe.
Wilhelm Meisters Wanderjahre.

"Knowing is not enough; we must apply.
Willing is not enough; we must do."