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MOOCs: A new paradigm in teacher professional development

Basant Moustafa Hegazy
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MOOCs: A New Paradigm in Teacher Professional Development

A Thesis Submitted by

Bassant Moustafa Hegazy

Submitted to the Department of International & Comparative Education

May 2020

In partial fulfillment of the requirements for
The degree of Master of Arts
in Educational Leadership
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The American University in Cairo

Graduate School of Education

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Basant M. Hegazy

under the supervision of Dr. Gihan Osman

May, 2020

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Abstract

Quality teaching is considered the most significant in-school factor that affects students' learning and achievement (Darling-Hammond, 2000; Donaldson, 2011; Hattie, 2008). Therefore, providing teachers, as lifelong adult learners, with many opportunities to update their professional knowledge and enhance their skills in continuous professional development (CPD) programs has gained increasing importance in the educational policy field. This qualitative multiple case study aims at providing an in-depth exploration of the experience of seven purposefully selected middle and high school STEM teachers who utilized a five-week instructor-facilitated MOOC about assessment for learning as an optional model of CPD. The teachers' online participation was supported by further reflections on practice in their onsite professional learning community (PLC) at their workplace. Document review and interviews were administered through and at the end of the program respectively. Four participants completed the program according to the timeline with a high level of satisfaction with the content and mode of learning. The adult learning theory and Kirkpatrick's evaluation model construct the foundation for data analysis. Within-case analysis of each participant as a unique case and cross-case analysis revealed the themes of autonomy, experiential learning and reflection, engagement, contextualization, and effectiveness. In conclusion, the participants viewed this model as an informative, flexible, and convenient mode of learning. However, learning through a MOOC needs more adaptation to their context, which was partially supported by attending with colleagues, discussing the concepts, and reflecting on the new practices.

Keywords: Continuous professional development (CPD), massive open online courses (MOOCs), case study, teacher autonomy

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1. Introduction

Quality education has always been a central concern of educational policy planning in order to equip all learners with considerable knowledge and skills to achieve equity and contribute to their societies' economic and social development. A large body of the literature concludes that the quality of teaching constructs the most impacting in-school factor on student learning (Darling-Hammond, 2000; Donaldson, 2011; Hattie, 2008; OECD, 2005; OECD, 2009). Furthermore, a growing body of evidence found a positive correlation between teachers' substantial learning opportunities and students' achievement (Cohen & Hill, 1998; Wiley & Yoon, 1995). Accordingly, focusing on enhancing teachers' content knowledge and skills can consequently foster student learning (Odden, Archibald, Fermanich & Gallagher, 2002). Therefore, teacher continuous professional development (CPD) has grown to be a foremost policy priority in recent education reforms worldwide.

CPD is a strategy that aims at developing, enhancing, and strengthening the professional practice of faculty throughout a professional career (OECD, 2009). It includes different models, modes, and activities that accommodate different contextual and learning requirements. Throughout the paper, CPD refers to different models of ongoing in-service training that takes place throughout the teaching career after the induction period (Craft, 2000; Ondri & Croll, 2008).

Taking into consideration the extremely broad body of knowledge in teaching, the dynamic and diverse teacher professional demands throughout their careers, and the significance of reflections and discussions concerning professional practice, there is an immense need for diversifying CPD models and methods to accommodate different professional goals, learning styles, and budget and/or time constraints to sustain elevated professional performance.

Additionally, CPD constructs a significant approach to maintain professionalism by providing ongoing opportunities to broaden teachers' knowledge and fortify their autonomy to make informed decisions in order to improve teaching and learning.

In recent decades, emerging technological advancements have provided great opportunities to revolutionize education and training in modern society. Notably, the Internet, in particular, Web 2.0, which supports users with the technological means to create and share online information and material, continues to have substantial impacts on advancing knowledge formation and communication among individuals around the globe. "Given the speed of change, governments and businesses throughout the world recognize that education and training are the keys to the future, and they emphasize the vital need to develop powers of creativity and innovation" (Robinson, 2011, p. 6).

Massive Open Online Course (MOOC) is a recent innovative model of online educational technology that aims at widening access to quality education supported by leading providers and elite higher education institutions at low or no cost. Shah (2018) reported that the number of MOOC learners around the globe has exceeded 100 million in 2018. Not only do MOOCs provide social networks that connect participants of similar interests through accessible reliable digital resources, but they are also facilitated by acknowledged professional experts to foster learning through active engagement (El-Hmoudova, 2014). Thus, MOOCs represent a transformative amalgamation of globalization and technology as they are built to accommodate and connect millions of global participants via online platforms.

According to Garet, Birman, Porter, Desimone, and Herman (1999), education reforms will be effective only if teachers are engrossed in their classroom practice whilst cultivating basic knowledge, critical thinking, and problem-solving skills. Accordingly, providing a

scalable high-quality CPD program can support policy makers, school governors, and teachers working in both national and international schools in Egypt to improve the quality of teaching in order to have a positive impact on student learning.

Within the Egyptian educational context, The Ministry of Education (MoE) recognizes the significant role of CPD to enhance teachers' knowledge and skills in national schools. Therefore, it established the Professional Academy for Teachers (PAT) in 2008 in Cairo with many extended branches all over the country (PAT, 2019). However, the number of teachers who need CPD exceeds the capacity and resource limitations of PAT. However, it is widely acknowledged that MoE advocates for the notion of 'knowledge for practice' mainly through workshops, conferences, and award-bearing programs, rather than the school-based 'knowledge of practice' models (Cochran-Smith & Lytle, 1999) that provide multiple ongoing opportunities for teachers to learn from each other and reflect on their practices; a preference that has important consequences for the public school system serving the majority of Egyptians.

International schools in Egypt belong to the private sector, and as such depend solely on its human and fiscal resources to implement effective CPD programs, and are not subject to teacher professional development practices followed by MoE. This provides the possibility to experiment with new models that combine best practice of community buildings as well as more traditional models of standardization, related to serving massive numbers of teachers.

1.1 Statement of the Problem

According to Gore, Lloyd, Smith, Bowe, Ellis and Lubans (2017), improving teaching constructs a fundamental policy goal to provide quality education and ameliorate student performance. Given the fact that there are increasing economic limitations to disseminate quality CPD to enhance teacher performance and autonomy, Robinson (2011) indicates that

technology holds a massive potential to cause fundamental changes in the ‘education paradigm’. Despite the fact that MOOCs hold great potential to provide a cost-free comprehensive CPD model, there is little research addressing the aspects of effective ongoing online teacher professional development (oTPD), especially in low and middle-income countries that have limited financial resources such as Egypt where the research took place. Furthermore, there is a gap in literature addressing the effectiveness of applying a blended model of online and onsite PLCs while learning through a MOOC.

Dede, Jass Ketelhut, Whitehouse, Breit, and McCloskey (2009) not only recognized that the research conducted on oTPD worldwide is limited, but also stressed the need to surpass the anecdotal nature of stating the ‘lessons learned’ to administering more rigorous research by providing learners profile, setting, data collection instruments, and analytic strategies.

1.2 Significance of the Study

Kennedy (2005) recognized the significance of building the capacity for teacher autonomy through shifting from the traditional CPD models that transmit knowledge to other transformative models that hold the power to change the status quo through metacognition and reflection on practice. MOOCs, as a potential CPD paradigm, can enable teachers and administrators to promote their professional knowledge base via exchanging ideas, interacting, and collaborating on a virtual professional learning community (PLC). Furthermore, Teachers hold the power to select what they need to learn from thousands of available MOOC topics to match their professional needs. Accordingly, educators can enhance their professional practice and make informed professional cognitive critical decisions on ‘what’, ‘how’, and ‘why’ to choose certain methodologies in different situations in their practice.

Furthermore, a blended instructor-facilitated MOOC with an onsite PLC can provide an opportunity to contextualize the newly learned concepts and reflect on practices among other professionals at school to improve student learning. In addition, MOOCs may open doors for self-reflection and metacognition through participating in onsite and virtual (PLC). Accordingly, administrators and policy makers can consider MOOCs as an emerging transformative CPD model that can enhance through professional performance, self-evaluation, and self-direction.

1.3 Purpose of the Study

This qualitative study aims at exploring in-service middle and high school science, technology, engineering, and mathematics (STEM) teachers' perceptions, benefits, and challenges when adopting an instructor-facilitated MOOC about assessment for learning which is designed mainly for in-service teachers as a model of CPD. Middle and high school STEM teachers interact with adolescent learners while teaching different disciplines and experience similar challenges in their practice; therefore, they can benefit from taking a MOOC together to communicate through the discussion board and exchange their reflections on teaching and learning in their classes in their onsite PLC.

The study follows a qualitative multiple-case study approach with a purposeful sampling strategy (Patton, 2002). All participants are middle and high school STEM teachers working in the same K-12 international school in Cairo, Egypt that follows the American curriculum. They are English language proficient users who demonstrate a basic level of digital competency which enables them to utilize digital resources and participate in online discussions. Each participant represents an instrumental particular case that operates in real-time in a unique system, whilst maintaining a contextual similarity among the cases in terms of the teaching

experience, workplace, age level taught, and utilizing the same CPD model. Data was collected through different methods such as document review and individual semi-structured interviews. The data was analyzed through generating codes and themes that describe the unique experience of each individual while operating in real-time (within-case analysis), and the cross-cutting themes across the cases, (cross-case analysis).

Participants' learning experiences and viewpoints were analyzed through the lens of the andragogy theory (Knowles, 1980) and Kirckpatrick's (1994) evaluation model. The key principles of the andragogy theory are: 1) The adults' choice on what they will learn; 2) following experiential learning and problem-solving approach; 3) adults would learn best when the topic is relevant to them. Kirckpatrick (1994) analyzes the effectiveness of training programs to participants in four levels: reaction, learning, behavior, and results. The reaction level entails the level of satisfaction toward the program, while learning level measures the gained knowledge as an outcome of attending the course. The third level of evaluation examines the change in attitudes and behavior and the fourth level evaluates if the training program has impacted the institution positively.

However, the results are limited to the number of respondents who contributed to data collection as a representative of thousands of middle and high school teachers in a semester time. There are no financial resources limitations regarding the cost of the online courses as the MOOC is provided free of charge. This concept will be discussed thoroughly in the MOOC and challenges to CPD sections in the literature review.

1.4 Research Questions

- What are middle and high school STEM teachers' perceptions regarding the effectiveness of instructor-facilitated MOOCs as a model of CPD?

- What are the benefits and challenges teachers experience utilizing MOOC-based CPD?
- How does the newly formed virtual PLC affect STEM teachers' professional knowledge and practice?

In sum, this qualitative multiple case study aims at exploring the experiences of middle and high school STEM teachers, as lifelong adult learners, regarding the effectiveness of a blended model of onsite PLC and instructor-facilitated MOOCs to enhance teacher autonomy, professional knowledge and skills. Additionally, it sheds light on the potential benefits and challenges that participants experienced while utilizing this MOOC-based model. Finally, it examines the effect on taking part in a virtual PLC in building capacity for teacher knowledge and skills about planning for student learning. Ultimately, it aims to provide policy makers insights into the potential effectiveness of using MOOCs in CPD, especially in developing countries where resources are scarce, and its impacts on teachers' performance and onsite teaching practices.

2 Literature Review

In recent years, using technology has gained substantial importance in teaching and learning. Although the literature discusses e-learning from different angles, this review focuses on five themes that construct different dimensions of using MOOCs as a CPD model. The themes outline how CPD is rooted in professionalism, effective CPD models and challenges, MOOCs as an emerging model of CPD, and finally andragogy as the theoretical framework used in the paper. Although the literature discusses learning through MOOCs in different contexts, this paper will principally focus on the effect of enrolling with other teachers from different departments in the same instructor-facilitated MOOC to build a virtual PLC that is parallel to the physical one at school.

2.1 Profession and Professionalism Underpinnings

Teacher continuous 'professional' development resides on the conceptualization of teaching as a profession and how teachers demonstrate professionalism in their practices and maintain development, but what is a profession? and what are the aspects of professionalism?

According to Cambridge dictionary, the word 'profession' is defined as "any type of work that needs special training or a particular skill" (Profession, n.d.). Hart and Marshal (1992) categorized the most significant aspects that set different professions apart from each other: "1) specific body of knowledge; 2) ideal of service; 3) ethical codes; 4) autonomy; and 5) distinctive culture" (p.2).

Each profession represents a systematized body of knowledge that distinguishes professionals from laypeople. The nature and length of education and training to gain this specific knowledge is different from one profession to the other. The ideal of service comprises both providing needed service to the society as a whole and to individuals as an outgrowth of

the profession. Thus, there is a dual responsibility of professionals towards the general public and also to the members of their occupation to ensure efficient contribution to both parties. Hence, this idiosyncratic conceptualization of being a member of a particular profession has developed over many centuries. It is anchored through professional preparation and continued professional training. In a more defined manner, professionals in archetypal fields such as law and medicine follow clearly confined rules and expectations for their roles that delineate their roles, responsibilities that restrict their occupational behaviors (Hart & Marshal, 1992).

A profession's ethical codes outline 1) the consequences of certain conduct; 2) guidance at times of uncertainty; and 3) enhance the public trust in professionals by publicly acknowledging their commitment toward the profession and society (Hart & Marshal, 1992). Collective professional autonomy refers to the ability to regulate the entrance and conduct of professionals, encourage and/or oblige continued training, and provide a self-governing institutional body for its members (Hart & Marshal, 1992). Whilst individualized professional autonomy describes the freedom to exercise and evaluate professional practice. Additionally, each profession has its identifiable norms, values, and symbols, which determine its distinctive culture and outlines how it can serve the society (Hart & Marshal, 1992). Accordingly, self-regulation constructs an integral part of collective and individual autonomy as it recognizes members' responsibility for professional practice evaluations and demonstrates society's trust in the profession.

Although 'professionalism' describes the conduct, ultimate goals, and qualities of a certain profession (Merriam Webster, n.d.), nonetheless, achieving a consensus on the meaning of the terminology and the status of the teaching profession among scholars is highly problematic as it is multifaceted in different spheres. Ultimately, demonstrating professionalism

incorporates technical and moral aspects, which shape human judgment, and bridge factual and conceptual knowledge and situated practice. In addition, every profession has its own drives for existence which are shared by each member of this occupation.

2.1.2 Professional Knowledge Domains and Contexts

Professions are not simply conduits for taking knowledge from the academy and applying it to the field" (Shulman, 1998, p. 519). Professional knowledge constitutes both the knowledge of 'what' and 'how', and 'why'. Krathwohl (2002) modeled the cognitive processes dimensions in an epistemological representation to include 4 major knowledge levels: 1) factual; 2) conceptual; 3) procedural; and 4) metacognitive. Factual knowledge includes basic elements such as terminology and particular details and facts of content, while conceptual knowledge entails drawing functional interrelations among the factual elements within a greater structure such as theories, principles, and models (Krathwohl, 2002). In view of that, conceptual knowledge refers to the declarative understanding of concepts and distinguishing their relevance to various applications and situations. Both factual and conceptual knowledge domains serve the 'what' aspect of professional knowledge.

The procedural knowledge comprises knowing subject-specific skills, methods of inquiry, and criteria for utilizing appropriate techniques, and skills. Metacognitive knowledge includes strategic and self-knowledge about cognitive tasks; it entails knowing the intellectual demand of different tasks and recognizing personal strength and weakness points to develop (Krathwohl, 2002). Accordingly, procedural knowledge describes the 'how' aspect of knowledge as it utilizes techniques and methods and the metacognitive facet represents the 'why' aspect of cognitive knowledge as it entails thinking cognitive thinking processes and reflections. Ultimately, teachers need to integrate these domains of knowledge in order to be autonomous in

taking decisions of ‘what’ they should teach their students, which teaching strategy to use which resembles the ‘how’ aspect while evaluating the reasons ‘why’ they made that choice.

According to Eraut (1994), professional knowledge can be gained in three major contexts: academic, institutional policy, and professional practice. Correspondingly, teachers can enhance their professional knowledge throughout their careers depending on the formal teacher academic education, post-graduate academic degrees, participating and reflecting on the procedures in their schools, and learning through practice itself. Accordingly, these contexts are interrelated and knowledge acquisition is neither exclusive nor explicit to a specific one. Thus, these contexts are rather ‘potential sites’ and possible channels of enhancing professional capacity (Kennedy, 2005).

2.1.3 The Teaching Profession and Professionalism

In historical context, teaching as a professional status has been a debatable issue for decades (Eraut, 1994; Hart & Marshal, 1992; Leiter, 1978; Samuels, 1970; Shulman, 1998; Stevenson, Carter, & Passy, 2007). On this account, Whitty (2000) reported that having different competing dispositions regarding teacher professionalism is better than molding it to fit an essentialist designation of professionalism. Some authors considered teachers as ‘semi-professionals’ due to the limited individual autonomy and restricted decision making about what they teach to students and how they teach the material (Leiter, 1978; Samuels, 1970). Additionally, from an ideological lens by focusing on hegemonic occupational control on teachers by school districts and governors, teacher professional self-direction is limited (Eraut, 1994; Stevenson, Carter, & Passy, 2007). Possibly, the highly structured administrative hierarchy in schools and districts can be at the expense of cultivating teacher professionalism.

Additionally, multiple education reforms viewed teacher professional practice according to achieving certain standards. In the same context, Phelps (2006) outlined teacher professionalism as achieving the highest standards in effective teaching and related proficiency to demonstrate responsibility, respect, and risk-taking.

Using the fundamental characteristics of a profession as a framework, Hart and Marshal (1992) recognize a divergence from this basis is lacking an explicit body of knowledge, restricted autonomy, and distinctive culture deficiency. However, subject matter knowledge, fostering social, emotional and intellectual human growth and development, ability to use multiple teaching strategies to maintain a positive classroom environment, designing comprehensive assessment, being committed to the professional code of conduct values, and CPD construct the foundation of the majority of teaching professional standards throughout the teaching career worldwide.

"Teachers have a right to be professionals but they also have a responsibility to be professionals. Part of this responsibility is to engage in meaningful continuous professional development, which benefits them, their organization, and above all, their learners" (Scales, 2011, p. 1). According to the Organization for Economic Co-operation and Development (OECD), teacher professionalism entails the totality of knowledge, skills, and practices embodied in teachers to be effective practitioners (OECD, 2016). This paper will adopt Demirkasımoğlu's (2010) definition of teacher professionalism as the "professional work field with its sociological, ideological and educational dimensions aims at achieving the highest standards in teaching profession which are based upon the professional formation, knowledge, skills, and values" (p. 2050). Accordingly, CPD is fundamentally required to maintain teacher

professionalism by providing different ongoing opportunities to update their professional knowledge, strengthen their instructional skills, and build capacity throughout their careers.

Kennedy (2005) recognized continuous professional development (CPD) as a key component to maintaining a high level of professional performance by updating professional knowledge and enhancing skills and attitudes. In the teaching profession context, initial teacher training constructs the admission phase into the profession. It aims at providing novice teachers with subject matter content knowledge, skills, and attitudes needed to fulfill their duties and responsibilities in the classroom. Despite the significance of this induction period to support the newly qualified teachers to achieve the regulatory standards of the profession, it has its limitations in acquainting teachers with all the challenges that they will encounter throughout their careers (OECD, 2009). Perceptibly, CPD facilitates the acculturation process of the neophytes to conceptualize how to be successful in his or her career (Greenwood, 1957).

Additionally, CPD programs aim at maintaining a high level of professional practice by enhancing communication among practitioners. Likewise, they will be well-versed in the latest developments in their fields and maintain a homogenous social culture to anchor the professional ethos. This notion is much related to the professional teacher's knowledge of ‘what’, ‘why’, and ‘how’ aspects of teaching. Therefore, teacher professionalism enhances when CPD models supply teachers with ongoing opportunities to be reflective practitioners.

2.2 The Cultural Perspective of CPD in Egypt

The strategic plan for pre-university Education 2014-2030 provides insights into the Egyptian national outlook regarding CPD. The MoE recognizes the substantial effect of having CPD programs to update teachers’ knowledge and enhance their professional practice.

However, there are many substantial impediments for achieving an effective model that can address different professional needs. For example, 30% of the total number of teachers in the public sector lacks an academic educational qualification (MoE, 2014). Additionally, the CPD programs are scarce and of low quality despite the huge infrastructure for training in a K-12 setting.

Hence, the MoE established the teachers' cadre system to enhance professionalism by providing a framework for PD (MoE, 2014). The Teachers' Cadre system allocates the members of the educational sector on five steps of the career ladder according to a combination of subject matter content knowledge, pedagogical skills, and experience. Also, it provides supervisors, expert teachers, and senior teachers with incentives to promote better performance.

Additionally, the Professional Academy for Teachers (PAT) was established in 2008 to design and review standards essential for performance quality and promotion system (PAT, 2019). Furthermore, PAT has an effective partnership with academic institutions such as faculties of education and schools to assure the quality of CPD and provide reliable consultation to MoE.

Despite the governmental efforts to adopt an effective CPD program, most programs focus on knowledge dissemination rather than practice-based learning opportunities. Additionally, teachers are largely interested in attending award-bearing programs to earn a certificate to mark achievements and get promoted. In most cases, there are limited chances of examining the impact of such programs in the natural class setting. However, the strategic plan advocates for having ample CPD every five years to update teachers' knowledge (MoE, 2014). Reflectively, teachers need to have periodical ongoing engaging CPD opportunities in a shorter

timeframe to help them improve their practice and overcome the challenges they face in their contexts.

2.3 Effective Continuous Professional Development (CPD)

2.3.1 CPD between Theory and Practice

Over a century ago, Dewey (1904) argued that "adequate professional instruction of teachers is not exclusively theoretical, but involves a certain amount of practical work" (p. 9). Eraut (1998) differentiates between 'Continuing Professional Education' (CPE) and 'Continuing Professional Development' (CPD). The former term refers to formally structured events such as conferences and courses rather than 'work-based learning', whilst CPD entails both modes of learning.

Learning from experience is a formidable attribute that the academic knowledge base is insufficient to provide (Shulman, 1998). Furthermore, a large proportion of professional development takes place through practice and reflection (Cohen & Hill, 1998; Dewey, 1904; Wiley & Yoon, 1995). It is widely recognized that reflecting on practice can provide a foundation for theory formulation, knowledge of the subject matter, and educational principles.

Cohen and Hill (1998) analyzed the impact of teachers' CPD to improve mathematical instruction on students' performance on the 1994 CLAS. They proposed that students' achievement was the critical dependent variable of instruction policy and teachers' practice (Cohen & Hill, 1998). In a similar fashion, Wiley and Yoon (1995) examined the impact of teachers' extended opportunities to learn on students' achievement in mathematics on the 1993 CLAS and concluded that higher student performance is associated with extensive CPD. According to Joyce and Showers (2002), some modes of CPD generate substantial gains in comparatively short duration by building PLCs of teachers and administrators.

In view of that, when teachers have multiple chances to learn not only from their own experiences in their classroom but also from other educators' experience and contemplation in the PLC, learning opportunities are folded. Similarly, Joyce and Showers (2002) suggest that the best practices in CPD embrace job-embedded ongoing collaborative school-based models rather than solitary workshops; since CPD is more effective when it engages teachers in more meaningful analysis of teaching and learning. The PLC utilizes the collective formative curricular and instructional knowledge base in relation to student performance to inform instruction and enhance student learning. This model has four elements in common: 1) establishing a PLC that studies, shares results, and reflects on the professional practices to improve instruction; 2) tailoring CPD content to focus on effective curricular and instructional strategies that foster student aptitude to learn; 3) following a transformative scope of change supported to enhance students' knowledge and skills; 4) applying CPD activities and processes that foster skill development and implementation while learning (Joyce & Showers, 2002).

Furthermore, Odden, Archibald, Fermanich, and Gallagher (2002) analyzed the most significant aspects of "effective" CPD depending on empirical research findings with reference to six key dimensions: 1) the nature of CPD model, 2) the activity duration, 3) collective participation, 4) the degree of in-depth content focus, 5) the availability of active learning opportunities, 6) the coherence with the federal, state, district, and school educational policy goals. Accordingly, effective CPD entails considerably long-term programs to allow active learning, actual implementation in classroom practices, and reflection on these practices. Also, CPD can be utilized to focus on the content to enhance subject matter knowledge, discuss the best practices to learn this subject, and relate it to effective instructional strategies. Besides,

active learning suggests coaching and mentorship facilitate the learning of the new methodologies. Collective participation helps build PLCs of reflective teachers in schools.

2.3.2 CPD Models

Teachers are lifelong learners; teacher preparation programs and CPE are essential approaches to establish a solid foundation of subject matter content and strategies, but they continue to learn on-the-job by engaging in institutional policy discourse, and by reflecting on their own practices. According to this disposition, educators can continuously develop their cognitive knowledge base of ‘what’, ‘how’, and ‘why’ and relate the academic knowledge base to practice throughout their careers.

There are a wide variety of choices in the way that CPD is structured, administered, and organized to tailor different needs in each educational institution. These CPD models will be analyzed in light of their structure, professional knowledge domain acquisition, and potential context. Further discussion will be built upon the interaction of different models to support teacher professionalism. Kennedy’s (2005) framework outlined the core CPD models to include (pp. 236-237):

- training;
- award-bearing;
- deficit;
- cascade;
- standards-based;
- coaching/mentoring;
- community of practice;
- action research;
- transformative model

The **training model** is a dominant approach in CPD over the last half a century (Kennedy, 2005). This model is widely recognized to be effective in introducing new factual, conceptual,

and procedural knowledge in a structured manner regardless of the contextual setting. It fosters mainly the technocratic aspect of teaching through coherence and standardization (Kennedy, 2005). This model is normally supplied by ‘experts’ in the field, whilst teachers play a passive role in the learning process. In a sense, training has a specific agenda that will be administered in a relative behaviorist manner. Therefore, this model demonstrates a high degree of central control inducing the notion that equivalence in training equates improvement of teaching and learning. It may take place in the institution where teachers work, but most commonly, it is organized off-site to accommodate a big number of participants, such as conferences.

Despite the great potential of this model, there are some challenges of being largely fragmented, unrelated to the context of teaching practices, or lacking the relevance to classroom practices (OECD, 2016). According to OECD (2016), the one-time workshop is the most-frequently-used model, yet research concludes that it is ineffective and insufficient to cause continuous impact. Additionally, another drawback originates from the restricted coordination between the proposed training content from one side and the needs of teachers and the critical moral purposes of professionalism from the other side (Day, 1999).

In common cases of limited resources allocation, the **cascade model** suggests a potential solution to disseminate generally procedural skills-focused knowledge, and sometimes factual and conceptual levels to a larger body of teachers in institutional settings (Solomon & Tresman, 1999). This model engages individual teachers to cascade the knowledge gained through attending training events such as conferences and workshops to their colleagues (Kennedy, 2005). The success of this model highly depends on the institutional policies and practices to foster cooperation and collaboration among teachers. Solomon and Tresman (1999) critique the

cascading process articulation to giving attention mostly to the technical aspect of teaching but seldom focuses on attributes and values.

The award-bearing model demonstrates the completion of an externally validated academic program, which is mostly, but not exclusively, provided by higher education institutions to ensure quality and accountability (Kennedy, 2005). Due to the 'academic' highly structured setting, it could be perceived as opposed to 'practice-based' professional action; therefore, there is an immense need to ensure tying these accredited courses to classroom practice (Solomon & Tresman, 1999).

The duration of this model can largely vary from one day to longer periods such as postgraduate programs. Online/blended learning courses and MOOCs provided by universities are contemporary modes of this model. On the other hand, Burchell, Dyson, and Rees (2002) argue that long-term postgraduate award-bearing programs can have more potential to impact professional practices in the school context as being engaged in research fosters self-reflection and self-direction that are essential for making professional decisions. Besides, most award-bearing programs require reflection on different educational challenges, data analysis, and educational plan design which induce autonomy capacity.

The deficit model is normally set within the institutional policy to remedy the weakness in individual teachers and enhance their performance. Accordingly, it requires a prior evaluation and an explicit action plan to introduce the level of knowledge needed to enhance professional performance effectiveness, efficiency, and accountability. Rhodes and Beneicke (2003) propose that the grounds of poor teacher performance can be related not only to particular teachers but also to organizational leadership malfunction.

In view of that, this model turns a blind eye to collective knowledge, shared responsibility, and a sense of the whole system interdependence and focuses on individual underperformance (Boreham, 2004). The deficit model attributes blame for apparent poor performance on individuals as working on isolated islands; for that reason, it falls short on nurturing an interrelated community of professionals with collective responsibility.

The standards-based model of CPD values the notion of creating a system of 'evidenced-based' standardized practice to indicate teacher effectiveness. Standards can be viewed as a source of uniformity by providing a common language among teachers and demonstrating benchmarks to scaffold professional development (Draper, O'Brien, & Christie, 2004). However, 'standards' may be perceived as contrasting to 'competence', it largely depends on how these standards or benchmarks for performance are applied (Kennedy, 2005).

On the other hand, Kennedy (2005) argues that this externally imposed model advocates for a behaviorist perspective of learning and reliance on a central pathway and its consequential rewards with the sacrifice of collaborative learning as it focuses on showcasing specific standards attainment behaviors in implementation. Moreover, this model disparages the complexity of teaching practices, the power of different institutional contexts, and the ultimate moral endeavors of education by molding professional performance in a standardized system.

Coaching/mentoring CPD models imply a close critical professional relationship that aims at improving performance through dialogue among colleagues within the school context. Although coaching and mentoring share many characteristics, coaching is slightly different from mentoring as it does not apply the hierarchical relationship in guidance; one partner who is more knowledgeable (mentor) guides the other partner (mentee) who is less competent.

In the same vein, ‘clinical supervision’ and ‘peer-coaching’ stem from this CPD model by providing critical feedback to reflect on current practices in order to refine it through observation and discussions. Both modes focus on the importance of a professional one-on-one critical friendship relationship (Rhodes & Beneicke, 2002).

Professional teachers can apply peer-coaching to reflect on current practices, suggest practical solutions, refine and develop new skills, and collaborate in problem-solving of current challenges in their professional practice. Therefore, the main goal is providing guidance and counseling to develop abilities and skills. It is vital to clarify the goals of peer-coaching as fostering positive feedback and not evaluating current practices before formulating the peer groups. Additionally, Robbins (1991) stresses the significance of confidentiality among the teachers who participate in peer-coaching to ensure the intended close critical friendship nature of this model.

Slater and Simmons (2001) indicated that peer-coaching has a positive effect on enhancing teaching skills by gaining new professional ideas. In addition, the companionship in this model supports teachers to overcome isolation, enhance the communication among team members, and foster a positive attitude towards collegiality. This model involves contextualized metacognitive knowledge with the help of another professional which endorses the ‘how’ and ‘why’ aspects of effective teaching and learning. However, it requires supportive institutional policies to reach the intended learning goals.

In a similar fashion, the community of practice model provides learning opportunities and support within a community that generally involves more than two professionals. It entails less extent of confidentiality, close relationship, hierarchy, and assessment nature than coaching/mentorship model (Kennedy, 2005). This model relies heavily on Wenger’s social

theory of learning as it conceptualizes learning as a result of the interactions within the community of practice, rather than pre-planned learning events such as conferences and workshops.

Wenger (1998) argues that learning within communities of practice depends on three vital processes: mutual engagement, understanding endeavor, and enhancing discourses. However, the effectiveness of this model in sharing and learning from individual and collective practices relies on the participants' collective awareness of being a part of a supportive community and the different roles they play within a wider team to internalize learning. Therefore, teachers could be either proactive exhibiting a positive approach or having a passive and marginalized attitude towards the community.

Action research is the inquiry process that involves the researchers themselves aiming at enhancing and/or refining the actors' actions (Sagor, 2000). Educational action research can be performed by one educator, by a group of educators, or by the entire school teaching staff. Alternative terms of the same model are participatory action research, practitioner action research, and collaborative action research. The inquiry process goes in a cyclic manner that starts with: (i) selecting a focus; (ii) understanding the theoretical framework that addresses the phenomena; (iii) identifying the research questions; (iv) collecting data; (v) analyzing data; (vi) reporting the results, and finally (vii) taking an informed action based on evidence (Sagor, 2000).

Craft (2000) concludes that teachers' engagement in the action research approach in CPD is highly rewarding due to the enduring sense of ownership that teachers experience throughout the process. This model enforces the 'what', 'how', and 'why' aspects of knowledge acquisition as it entails critical thinking and analysis of factual data to enhance instruction based on

professional practice. However, the quality of action research is determined by the advanced comprehension of the current situation and the depth of involvement in the practice (Kennedy, 2005).

According to Herbert and Rainford (2014), transformative models of CPD allow teachers to explore and reflect on their professional practices. Kennedy (2005) indicates the CPD transformative model entails a combination of processes and conditions that aim at a metamorphic improvement in professional performance. There is no specific definition of this model; nevertheless, it depends on the effective integration of a multitude of models, together with an explicit awareness of issues of power to cause its transformative impact on teaching and learning.

2.2.3 Professional Learning Community (PLC)

The professional learning community (PLC) is another approach that is largely based on the community of practice conceptualization. Despite the various debates on its dimensions that can be applied to a department, an entire school, or the whole district, there is a consensus that its main capacity and the ultimate goal is supporting all professionals in the school community to work together in order to meet students' learning needs. According to Dufour (2004), there are three main aspects that construct PLCs: (1) ensuring that students learn which entails a simple shift from the traditional focus on teaching to focusing on students' learning; (2) maintaining a culture of collaboration among stakeholders; and (3) focusing on enhancing student achievement through continuous monitoring and developing action plans to attain the desired improved results. The sustainability of school-based PLCs depends mainly on having a supportive leadership that shapes a positive school culture while maintaining effective

organizational structures and procedures to help teachers reflect critically on their practices and collaborate to implement various methodologies to improve student achievement (Dufour, 2004; Pang & Wang, 2016). Ultimately, positive teacher collaboration is considered the fundamental aspect to improve student performance and teachers' practice (Vescio, Ross & Adams, 2008). Additionally, PLC can positively improve school culture.

PLC shifts PD conceptualization from 'knowledge for practice' to 'knowledge of practice' (Cochran-Smith & Lytle, 1999). The transmitting models of CPD assume that teachers are empty vessels that should be watered with the appropriate professional knowledge to apply it in their own classrooms. However, PLC shifts the mindset from this traditional outlook of PD to utilizing the previously generated knowledge and theory for examination and interpretation depending on evidence from the teachers' fieldwork. In recent years, technology opened doors for extending these onsite PLC to virtual ones available online for professionals across the globe. The MOOC discussion boards are examples of such online PLCs that help learners to share knowledge and reflect on practices in different contexts.

Ultimately, there is "no one size fits all" in CPD; it depends on the teachers' needs, model preference, learning style, and willingness to adopt new ideas in one's own practice (Crow, 2010). However, Social interaction signifies a substantial component as it facilitates understanding and enhances co-constructing a knowledge base depending on diverse perspectives (DuBois, Krasny, & Russ, 2019). Moreover, building professional social networks in communities of inquiry expands educators' capacity to deploy potential pedagogical methodologies in their classes. Furthermore, the relevance of the topics discussed in the teachers' context can enhance motivation to learn and engage. Therefore, being a part of a

community of practice using different means of whether onsite or online social interaction enriches CPD.

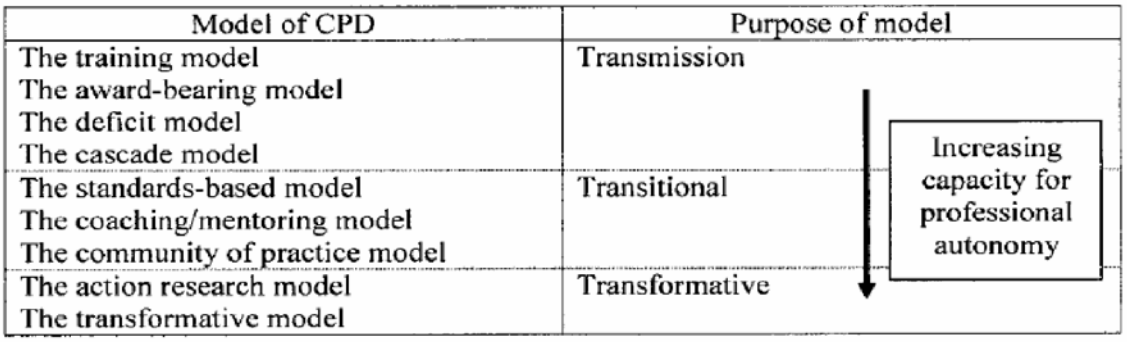

Figure 1: Spectrum of CPD Models (Kennedy, 2005, p.248).

Kennedy (2005) analyzed and categorized CPD models according to increasing levels of teacher autonomy starting at transmission, then moving to transitional, and finally attaining the transformative category. In my review, teacher autonomy refers to the degree of power that allows teachers to make informed autonomous decisions to teach ‘what’, ‘how’, and ‘why’.

Furthermore, the justification of the classification can be also related to increased levels of metacognitive knowledge via reflecting current performance, developing action plans to improve it, and enriching research through professional practice. Kennedy (2005) proposed that the capacity of professional autonomy largely depends on forming ‘communities of inquiry’ the activity parameters and the interplay of the position of power whether internal to the teacher body or some other external party. However, the potential tensions due to power dynamics, conflicting agendas, different dispositions, and philosophies can lead to transformative sustainable educational change (Kennedy, 2005). Nonetheless, these transformative CPD modes

hold a potential power to influence the policy agenda as they generate evidence-based results that can be considered in the educational policy formulation stages.

In a nutshell, these models demonstrate a wide spectrum of activities with perceived purposes to maintain CPD; rather they cannot be appraised as stand-alone approaches. There is a consensus that the majority of formal teacher training programs are extremely important but insufficient to sustain novel teaching practices and methodologies in the context of practice (Herbert & Rainford, 2014). The transformative CPD model is largely related to the different needs in the teacher body, the institutional context, types of knowledge base that needs to be introduced, and endorsed in professional practices (Herbert & Rainford, 2014). Hence, needs analysis and differentiation in CPD are essential aspects to reach quality teaching. Therefore, policy discourse should conceptualize both the purpose and the methods in order to enhance professional autonomy capacity.

2.3.4 CPD Challenges

Given the fact that there are rapid changes in the complex and dynamic school environment, teachers are required to communicate and share ideas with peers to understand, explore, and reflect on their own practices in their particular context (Scales, 2011). Therefore, as lifelong learning professionals, they need to engage in a personalized learning experience, not only formal CPD models. This notion implies developing a system that facilitates teacher autonomy to follow unconstrained individualized routes while actively participating in the PLC (Burchell, Dyson, and Rees, 2002).

Notwithstanding the significance of CPD, there are various fiscal, technical, and functional challenges to promoting a transformative model in the complex and dynamic school

environment. Odden, Archibald, Fermanich, and Gallagher (2002) depicted the fiscal costs of CPD in the cost-framework. It constitutes six programmatic elements: “1) teacher time; 2) training and coaching; 3) administration; 4) materials, equipment, and facilities; 5) travel and transportation; and 6) university tuition and conference fees” (p. 73).

Taking an active part in a PLC requires dedicating adequate time apart from instruction and preparation. Additionally, the availability of professional teacher trainers, securing funds for university tuition fees and resources to implement CPD construct an obstacle for many schools and districts. Hence, using Information and Communications Technology (ICT) can offer educators a good opportunity to enhance professional knowledge while communicating with other professionals around the globe by utilizing online learning modes (Dlamini & Mbatha, 2018). Using ICT in learning entails different modes such as webinars, virtual classrooms, video-based learning, online collaborative learning through social learning platforms and discussion forums, and web-based learning. These models offer a blend of synchronous and asynchronous modes of e-learning.

2.4 Massive Open Online Courses

Massive Open Online Courses (MOOCs) are one of the exponentially rising e-learning models in the 21st century. The word’ massive’ implies the possible accessibility of thousands of participants at the same time. This asynchronous open-access nature of this revolutionary approach of learning as anyone can enroll just by utilizing an internet connection. Hence, these online courses enable wide global reach to maintain and nurture lifelong learning regardless of one’s physical location. They are largely free of charge to audit; a symbolic fee may be paid to receive a certificate of achievement. As these courses are web-based, learners have the

opportunity to replay the recorded videos, have online reading resources, take an online assessment, and discuss ideas in a virtual learning environment.

Originally, the term was first coined in 2008 describing an online open course entitled "*Connectivism and Connectivity Knowledge*" that embraced 2200 participants across the globe to instantiate the 'connectivist' approach in learning by George Siemens and Stephen Downes at the University of Manitoba (Margaryan, Bianco, & Littlejohn, 2015). This 'connectivist' design intended to explore the impact of internet technologies such as web browsers, wikis, and online discussion forums in sharing information and creating learning opportunities through a connected community that can physically exist in any part of the world which has an internet connection. Later on, other models developed which focused on providing the online course material such as videos, readings, and assessment at the expense of online collaboration and exchanging experience through discussion.

2.4.1 cMOOCs Vs. xMOOCs

MOOCs can be classified according to their instructional design into 2 types: cMOOCs and xMOOCs. cMOOCs emerged in 2008 based on the 'connectivist' learning representations that enforce online collaboration and participation in discussions (Kurt, 2008). Accordingly, learners exchange information and ideas, upload materials that contribute to the course content by means of tweets, blogs, or wikis via the learning platform. Therefore, participants' contributions construct a major part of the learning experience in addition to the posted online course readings and presentations. In view of that, the instructor in this model is a facilitator of learning by guiding, aggregating, and assessing the learners' contributions.

xMOOCs emerged in 2011 when some leading universities offered MOOCs via online learning platforms such as Coursera and Udacity (Milligan, Littlejohn, & Margaryan, 2013). Furthermore, xMOOCs focused on delivering content through a set of short pre-recorded lectures and videos followed by automated multiple-choice testing to assess the learners' level understanding of the content. Moreover, students are required to complete online readings and participate in virtual discussions that are thoroughly organized by the course instructor or team from a higher education institution (Kurt, 2008). Unlike cMOOCs, xMOOCs are typically linear, self-contained, hyper-centralized, and behaviorist in nature that rarely use learning resources external to the core predesigned content delivery. However, xMOOCs are considered the dominant model provided by most educational institutions and providers.

2.4.2 Instructor-paced Vs. Self-paced MOOCs

The course pacing refers to how the course is scheduled, timed, and administered. Besides, it indicates how learners can utilize and interact with the course material. Instructor-paced MOOCs follow a schedule designed by the course instructors with particular due dates for assignments and assessments. Course material will be available at particular times. Participants are required to finish the course in a defined time period.

In contrast, learners in self-paced MOOCs can progress at their own speed while having assignments without due dates. All course materials will be available once the course starts. There are indicators for assessment dates to be taken at certain points according to the course design, but they are not due dates. Usually, they lack collaboration or discussion forums as each learner may have a different preference in moving forward in the course. Learners have the freedom to progress according to their own preferences until the course end date.

2.4.3 Engagement Dimensions in MOOCs

An increasing body of research described how MOOC learners engage in this online learning experience (Deng, Benckendorff, & Gannaway, 2020; Furlong, Whipple, Simental, Soliz, & Punthuna, 2003). The MOOC learner engagement has four dimensions: behavioral, cognitive, emotional, and social (Furlong et al., 2003). Behavioral engagement can be detected through active participation through multiple activities such as postings, note-taking, and tasks (Deng, Benckendorff, & Gannaway, 2020). Emotional engagement involves the spectrum of emotional attachment connections that learners make with their MOOC ecosystem that includes instructors, other learners, and course content. Social engagement entails the quality of learner-instructor and learner-learner interactions. Cognitive engagement incorporates the learners' mental investment in comprehending convoluted ideas and master complex skills (Furlong et al., 2003). Accordingly, engagement plays a vital role in determining if the MOOC learner will maintain his e-learning experience or detach due to the lack of one or more of these dimensions.

2.4.4 Public and Academic Discourse on MOOCs

MOOCs trajectory has created a bubble of attention since 2012 (OBHE, 2013). Noticeably, there has been a recent surge in the number of MOOCs production initiatives supported by many elite higher educational institutions, governments, and international organizations. Coursera, EdX, Futurelearn, and Udacity are among the major MOOC providers. In this context, an increasing number of universities have endorsed MOOCs as a key advancement of tertiary education. In the last decade, more than 900 higher education institutions have launched free online courses with an enrollment that exceeded 100 million

learners (Shah & Pickard, 2019), whilst public and academic conflicting perspectives about their quality and effectiveness have escalated.

Similarly, learning practitioners have conflicting views regarding the value of MOOCs; enthusiasts perceive MOOCs as an innovative pedagogical approach that enhances access, empowerment, and equity, skeptics recognize the potential benefits of MOOCs to match the older models of online and distance learning (ODL). MOOC learners are generally enthusiastic about their positive learning experience, however, lurking and auditing are common patterns that are identified among MOOC learner profile, yet they are valid learning activities within MOOCs (OBHE, 2013).

Nonetheless, skeptics critique the MOOC format in terms of weak content, lack of accreditation, poor differentiation and less support to weaker learners, and ruling out learners with poor networking and digital skills (OBHE, 2013). Furthermore, some professional bodies indicate that the MOOC approach lacks novelty, and therefore, its impact on higher education reform may be exaggerated. Additionally, in a study with 106 respondents about MOOCs participants' views on its pedagogic innovation, 84.9% opposed this view, furthermore, more than 50% of the respondents critiqued the structure of many MOOCs to represent a collection of resources in one place with limited or no personalized feedback on work (Armellini & Padilla Rodriguez, 2016; Mehta, 2017). In addition, there are critical problematic pedagogical implications regarding the effectiveness and efficiency of the online assessment system to validate the learners' progress in MOOCs to grant them full-fledged course credit towards a higher education degree.

2.5 MOOCs as a Model of CPD: Initiatives and Experiences

A large body of literature acknowledges the momentum that MOOCs provide to reform, research, and academic innovation. Misra (2018) conceptualized that MOOCs-based teacher training can complement traditional CPD models due to their cost-efficient and easily accessible nature while providing a variety of educational resources that accommodate different learning styles. Furthermore, this mode of CPD can be easily adapted to different languages and cultures. Recent studies have shed some needed light on the effectiveness of the use of MOOCs in teacher CPD (Kellogg, Booth, & Oliver, 2014; Laurillard, 2016; Milligan, Littlejohn, & Margaryan, 2013; Ramírez-Montoya, Mena, & Rodríguez-Arroyo, 2017; Sia, & Cheriet, 2019).

Possibly, MOOCs provide a number of valuable advantages compared to face-to-face CPD models. Pre-recorded lectures, uploaded resources, and asynchronous discussions enable thousands of participants to learn conveniently and confidently while reducing onsite performance pressure (Dede, 2006). Also, attending an online course can fit the busy schedule of most educators and save them time and effort to commute and have the same course face-to-face. Additionally, a substantial number of MOOC developers enable participants to audit the course and learn at no cost and generate a certificate of achievement to mark their effort at a much-reduced cost than attending similar courses onsite. All these factors suggest that achieving the learning outcome can be more conveniently attainable in online courses.

Thus, there has been a growing interest in designing courses tailored to in-service K-12 teachers. In 2013, Coursera, in partnership with chief schools of education and cultural institutions, started launching an increasing number of multifaceted teacher professional development courses (Kellogg, Booth, & Oliver, 2014). Similarly, EdX offered a large number of online education courses in different languages covering a wide range of educational and teacher training topics such as curriculum design and teaching techniques. Also, Edraak, an

initiative of Queen Rania Foundation, in collaboration with Google.org and elite higher education institutions, commenced premium educational resources and courses in the Arabic language to overcome the language barrier in the MENA region and increase linguistic diversity of MOOC contributions. The courses on the platform are categorized into different disciplines; the 'Education and Training' tab is dedicated solely to teachers to explore different teaching strategies in instructor-or-self-paced courses (Edraak, 2019).

Correspondingly, this innovative learning model instigated a rising academic discourse to explore and examine the effectiveness of MOOCs as a form of CPD. Although MOOCs provide an easily accessible means of communication among learners, many participants find it arduous to engage in online meaningful discussions; therefore, MOOCs turned to many social media channels to enhance professional social interaction (Kellogg, Booth, & Oliver 2014; Margaryan, Bianco and Littlejohn 2015; Laurillard 2016).

Due to its simultaneous 'massive' nature, MOOCs enable thousands of participants to enroll in the same course, learners mostly need peer support networks to enhance engagement and collaboration. Li, Krasny, and Russ (2016) explored the dynamics of interaction among participants, participant-instructor, and participant-content in an online environmental education PD course offered by Cornell University in the United States. The researchers examined the social dynamics within the MOOC through analyzing participants' and instructors' online posts and concluded that participant-participant interaction has positively enhanced their motivation to learn and extend professional networks (Li, Krasny, and Russ, 2016). Additionally, participant-instructor online communication had a substantial positive effect on participants' professional network advancement (Li, Krasny, & Russ, 2016).

In a study that encompassed 863 in-service teachers from different setting such as elementary, high school, higher education instructors and supervisors who participated in an xMOOC about designing and using open education resources (OER) in instruction, it was analyzed that achieving the course is strongly dependant on teachers' self-perceptions of mastering digital competence (Ramírez-Montoya, Mena, & Rodríguez-Arroyo, 2017). Besides, the SWOT analysis results for this study revealed that MOOCs hold a potential capacity to acquaint a hefty number of teachers to enhance their knowledge about the basics of OER as a technological educational tool. However, the study focused on teachers' beliefs and opinions and did not measure their actual performance in practice.

In the Algerian higher education context, 180 teachers were surveyed to explore their familiarity, perceptions, and experiences in utilizing MOOCs for CPD. Nearly half of the respondents (48.6%) were unfamiliar with MOOCs, (24,3%) had limited familiarity, (21.6%) had moderate familiarity, and (5.4%) were highly familiar with MOOCs in general (Sia & Cheriet, 2019). Only (26,2%) of the respondents indicated their experience in using MOOCs as a mode of CPD. In contrast, 71.4% of the respondents in this study reflected on their experiences and believed that MOOCs can moderately impact their practices as teachers.

Sia and Cheriet (2019) outlined that 51% of the participants in a MOOC course for CPD indicated strong interest in adopting this model in the future as they found it informative and efficient. It is worth noting that most respondents indicated that their participation in the MOOC was an eye-opener as they hypothesized that CPD is limited to conference rooms and university courses. Therefore, they concluded that higher awareness is needed to incorporate this innovative method of learning in the CPD agenda as most of the teachers who participated were unfamiliar with MOOCs at first (Sia & Cheriet, 2019).

Whereas, in a one-year pilot study recognized as a small MOOC (sMOOC) with only 300 participants to study how MOOCs can impact institutional organization and pedagogies. The MOOC implementation represents a cross-institutional initiative particularly that was designed and led by the Norwegian government and two higher education institutions (HEIs) to examine how MOOCs can maintain continued education in the didactics of mathematics pedagogy, primarily for teachers of fifth to tenth grade level in Norway (Tømte, 2019). Despite the various sorts of resistance and administrative challenges in the implementation process as reported by the initiative stakeholders, Tømte (2019) outlined that more than 80% completed the accredited online course. Based on empirical data, this particular Mathematics MOOC had enhanced institutional change in terms of adopting new online delivery models and initiated the conceptualization of online assessment models. Despite the fact that this study is neither ‘massive’ nor ‘open’ to external participants, it provides insights for the potential effect of online learning as a transformative CPD model.

The digital divide refers to the technology gap between demographics and regions, which may construct an obstacle to those teachers with limited or no access to modern ICT to utilize MOOCs in CPD. Moreover, taking an active part in a MOOC takes more than just surfing the internet to find a relevant MOOC topic and signing up for it to be digitally competent. Digital competence (DC) surpasses the basic use of digital platforms to combining a set of capabilities such as knowledge, skills, and proficiencies appropriate to the knowledge society (Gallardo-Echenique, Minelli, Marqués-Molias, & Esteve-Mon, 2015). In line with this disposition, the demographics of MOOC analytics depict that the mainstream of MOOC participants is highly qualified professionals, contrasting the originally foreseen assumption of being the global community of underprivileged learners who have limited access to quality HE (Laurillard,

2016). Accordingly, DC is central to efficient utilization and interaction on ‘open’ and ‘online’ forums.

In an attempt to bridge the digital divide gap, Laurillard (2016) examined the efficacy of utilizing MOOCs as a co-learning model of CPD for primary teaching community to promote Information and communication technology (ICT) use in pedagogy with a focus on the emerging economies. The MOOC understudy hosted more than 9000 participants from 174 countries over the duration of the course. Laurillard (2016) revealed that MOOCs can be effective when teachers participate in collaborative learning, issue-focused community discussions, and peer-assessment opportunities. In addition, the MOOC format which is used in this study enabled teachers to link to off-platform digital tools to share resources and experiences to enhance knowledge contextualization and promote professional e-environments. Despite the enormous challenge that developing countries have to build and maintain professional teacher capacity, MOOCs hold a genuine potential to engage adults in comprehensive CPD via using technology (Laurillard, 2016).

In the same vein, activities that induce learning through practice such as online discussion forums that permit constructive feedback, production, and peer-evaluation enrich the meaningful learning experience (Kellogg, Booth, & Oliver, 2014; Laurillard, 2016). However, in order to provide basic knowledge, careful MOOC design needs to be considered regarding elaborated task explanation, content distribution, assessment, and feedback (Ramírez-Montoya, Mena, & Rodríguez-Arroyo, 2017). Kellogg, Booth, and Oliver (2014) concluded that the use of technology in online discussion forums in MOOCs facilitates peer-supported learning and knowledge construction in professional social networks.

2.5.1 Opportunities and Challenges to using MOOCs in CPD

Hew and Chung (2014) analyzed the students' motivations to sign up for MOOCs to in four key rationales: 1) the aspiration to learn about a new topic or to enhance current knowledge regarding a certain topic; 2) the curiosity to experience a MOOC; 3) for a personal challenge, and 4) the desire to accumulate many completion certificates. Additionally, MOOCs enable learning at low or no cost while saving time and resources needed to travel to attend training, conference events, or onsite award-bearing courses.

However, this learning journey does not reach its final destination by completing the course with all its episodes for most MOOC learners; up to 90% drop out (Hew & Chung, 2014). The reasons vary from lacking incentives, motivation, or support to understand the material in order to complete the course. Also, feeling less obliged to complete the course as there are no consequences for dropping out.

Tondeur, Forkosh-Baruch, Prestridge, Albion, and Edirisinghe (2016) summarized the CPD technical and functional in 5 key challenges in the digital age: 1) contextualization while enhancing ICT sociocultural awareness; 2) maintaining a sustainable and scalable CPD system; 3) empowering innovative pedagogy through ICT; 4) technology perspicacity; and 5) lifelong learning approach to maintain systemic and systematic CPD (Tondeur et al., 2016).

Li, Krasny, and Russ (2016) reflected that the social learning aspect in MOOCs enables participants around the globe to interact, exchange, and reflect on diverse ideas and rich experiences representing a multiplicity of cultural perspectives. However, there are considerable social and cultural challenges to learn in MOOCs such as experiencing social identity threats, language barriers, and the digital divide. Besides, MOOC experience requires baseline aptitude and skill in digital social networking, which may present a hindrance to many learners.

Furthermore, MOOCs may provide a potential opportunity for participants in emerging economies to learn, interact with virtual PLC, and develop their knowledge in different disciplines. Moreover, the wide varieties of MOOC topics provide teachers with different pathways to gain knowledge according to their individual needs. Therefore, MOOCs can provide an opportunity to foster reflection on professional practices, promote self-direction, and endorse professional autonomy.

2.6 Theoretical Framework

The online learning CPD model can be analyzed through the lens of adult learning theory, andragogy. Andragogy is derived from the Greek word ‘aner’, meaning “adult”. Knowles (1980) defines andragogy as the art and science of facilitating learning for adults. Andragogy is an additional model of assumptions about learners that can be applied to test out the postulations with particular educational situations. The term pedagogy is derived from ‘paid’ and ‘agogus’; meaning ‘child’ and ‘leading’; therefore, it means the science and art of teaching children. In this context, Knowles (1980) views pedagogy and andragogy as two ends of a spectrum rather than following a dichotomous classification pattern.

According to Knowles (1980), the pedagogical model of assumptions about teaching young children, the characteristics of learners, curricula, and teaching practices evolved in the European monastic schools in the seventh century and dominated by the twelfth century in secular schools. In the eightieth and nineteenth centuries, elementary schools have largely spread throughout Europe, North America and many other parts of the world, especially by missionaries. Many educational psychologists started to theorize how didactic teaching takes place depending mainly on observing children and animals in the twentieth century (Knowles, 1980). After World War II, when studies on adult learning flourished, more emphasis about

learning, not only teaching, started to appear when teachers of adults faced several problems in applying the pedagogical model in their classes due to the rapid cultural changes (e.g. technological innovation, substantial inputs of knowledge, major changes in political, economic systems, and social fabric) that took place in the early part of the twentieth century. Accordingly, under the new malleable conditions, the knowledge and skills that are gained at any point in life become functional for a certain period until it is modified by the new bodies of knowledge.

Children start to develop their self-identities when they consider themselves as detached entities after a relative period of complete dependence on an adult to fulfill their different needs. The self-concept of dependency is therefore reinforced by adults of children being passive receivers of information. This learner's self conceptualization of being dependent on a teacher is so deeply conditioned by long years of schooling. Providentially, once adults take responsibility for their own learning similar to the other aspects of their lives, they demonstrate excitement in and involvement in learning rewarding experiences.

The crucial assumptions about the andragogical learners' characteristics in contrast to traditional pedagogy are 1) the self-concept shifts from the reliance on a teacher who transmits knowledge to being a self-directed learner; 2) accumulating new experiences on prior ones to create an emerged reservoir of experiences; hence learning is organized around real-life situations; 3) the readiness to learn experientially and the immediate application in relation to the learners' social roles; 4) advanced performance self-orientation; as learners view education resembling a vehicle to enhance competency and achieve their full potential (Knowles, 1980).

Knowles (1980) recognizes some implications of andragogy to be: 1) the learning environment should be adult-friendly to feel accepted, supported, and respected by peers and the

teacher; 2) identifying the learning needs of adults to maintain engagement and motivation; 3) involving learners in the planning process enhances commitment to learning; 4) engaging learners in active learning experience makes the learning experience more meaningfulness; 5) giving the learners the opportunity to evaluate their own learning.

Furthermore, Houde (2006) emphasized that the core principles of andragogy delineate from pedagogy as adult learning entails self-direction, and experience intrinsic motivation and the autonomous decision on the content and the process to learn it. Hence, the andragogical practices view teaching-learning as mutual activities that highlight the joint responsibility of teachers and learners. Accordingly, the andragogical model considers a teacher as a facilitator of learning who accepts learners as figures of worth and helps them utilize their experiences as resources for ongoing development.

Based on this andragogical model, using MOOCs as an online mode of CPD provides a virtual learning environment that learners can enroll according to their educational and professional needs, exchange ideas through the online forum, and engage in meaningful learning opportunities that allow them to build upon their prior experiences. In addition, the instructor's role in MOOCs is minimized due to a large number of participants, which anchors self-direction and autonomy.

In a nutshell, CPD is a fundamental part of any profession, a large part of it lies in practice and reflection (Cohen & Hill, 1998; Dewey, 1904; Wiley & Yoon, 1995). Furthermore, CPD is required to promote teachers' instructional knowledge and skills to enhance student learning and achievements. There is a multitude of CPD models that are utilized in different contexts with various levels of supporting teacher capacity of professional autonomy to make decisions of what, how, and why certain procedures should be followed to improve student achievement.

However, there are many technical, functional, and fiscal challenges to provide effective CPD. Utilizing MOOCs in CPD can empower teachers to select the areas they need to develop, save travel time to training centers, and decrease financial burden as many MOOCs can be audited for free.

The research conducted reveals a substantial potential in MOOCs as a model to improve professional knowledge (Kellogg, Booth, & Oliver, 2014; Laurillard, 2016; Milligan, Littlejohn, & Margaryan, 2013; Ramírez-Montoya, Mena, & Rodríguez-Arroyo, 2017; Sia, & Cheriet, 2019). Furthermore, MOOCs enhance networking by building virtual PLCs that facilitate ideas and experiences exchange. The adult learning theory, andragogy, describes how teachers are self-directed and self-oriented learners who accumulate and relate new knowledge to old experiences.

In order to answer the study questions, the researcher contacted the science, math, and computer science heads of departments (HoDs) working at the same K-12 international school to propose the idea of utilizing an instructor-facilitated MOOC with their teachers in middle and high school stages for five weeks as a new model of CPD. Four teachers in addition to the three HoDs showed interest in taking part in the same MOOC and participating in the study.

3. Methodology

The methodology chapter outlines the research design, participants' profile, and sampling strategy. Furthermore, it describes the school context and its CPD program and the MOOC context detailing its structure and learning outcomes. Additionally, this chapter demonstrates the different data collection strategies followed such as document analysis and interviews, and how the collected data was analyzed.

This study adopts a qualitative multiple case study design to explore the perceptions and experiences of a group of middle and high school STEM teachers (N= 7) about the effectiveness of using an instructor-facilitated MOOC to broaden their professional knowledge and enhance their professional practice. Also, it explores the various challenges the participants faced while participating in *Planning for Learning: Formative Assessment* MOOC provided by *FurtureLearn* with their colleagues.

Case studies are in-depth explorations of a system that can demonstrate a single person, program, event, or community supported by gathering data from multiple resources to give a vivid idea about the case (VanderStoep & Johnston, 2009; Yin, 2015). In this regard, in many single case studies, the whole examination is confined to a particular individual. Multiple case studies entail examining the situational complexity of each case, a teacher, in order to the differences and similarities among different cases that are bound in a larger system, the MOOC (Baxter & Jack, 2008; Stake, 2013).

According to Stake (2013), multiple case studies examine the experience of real cases' functioning and activities while operating in authentic situations in real-time. Although each case constructs a unique system, there should be a degree of contextual similarity among the

instrumental cases in a multiple case study. The participants were working at the same school (referred to as School X) and the MOOC was a supplementary model of job-embedded CPD. The selection of the MOOC topic was done in consultation with the department heads in School X to align with their PD objectives. Within this framework, the participants experienced the same MOOC during the same timeframe for five weeks while working together in School X. The experience under study is an optional component of the PD plan at their school.

According to Stake (2013), the qualitative understanding and interpretation of cases require close monitoring of the cases' activities in particular situations contained by their context. Although the MOOC is supported by two facilitators, the researcher enrolled with the participants as a MOOC taker to be able to mentor them and gain more understanding of how they operate in real-time while taking the MOOC. This mentorship was done totally online through commenting on the participant's reflection grids, suggesting solutions in relation to coursework, following up on their progress online, replying to their questions on the discussion boards, keeping a track of their submissions, and motivating anyone who has lagged behind by sending reminders through email. In this regard, it was a good opportunity for the researcher to keep tabs on how each participant experienced this new mode of online learning and the challenges they face while being supported by a designated trainer for follow up.

3.1 Research Design

The case study approach endeavors to describe a specific bounded system in depth and aims at understanding the complex interplay among its interdependent components (VanderStoep & Johnston, 2009; Yin, 2015). In this context, the qualitative study design can help the researcher explore the newly formed virtual learning community, interpret human behavior, gain a deeper understanding of participants' experience through their reflections and

evaluations of this mode of learning that they engaged in for the first time, namely MOOCs, and its potential effects on their professional attitudes and behaviors (Creswell, 2009; Yin, 2003).

Data collection instruments include document review such as self-audit forms and reflection grids supplied by MOOC developers and submitted to the researcher, online communication posts and lesson plans on the MOOC discussion forum and semi-structured individual interviews upon completing at least 90% of the MOOC to explore the participants' perception, reaction, satisfaction level and evaluation of their experience of using MOOCs to enhance professional knowledge and practice. The rationale for deploying many research procedures on the same phenomena is providing in-depth clarification of the gathered data. Triangulation of methods enhances data validity and reliability (Plano Clark & Creswell, 2015; VanderStoep & Johnston, 2009).

The qualitative multiple case study employed both within-case analysis to recognize the individual nuances of each teachers' experience and cross-case analysis to identify the cross-cutting themes that bind the participants' in their online learning PD model.

The adult learning theory and Kirkpatrick's (1994) evaluation model were deployed to analyze participants' perceptions, interactions, and appraisals of their experience. This framework examined how teachers, as andragogical learners, reacted in the newly-formed MOOC virtual learning environment. As the volunteer teachers were self-directed to participate in this online learning opportunity, they were driven by their intrinsic motivation to look for practical and focused professional knowledge to help in enhancing their performance at work. Additionally, Kirkpatrick's model gauges the reactions of participants upon taking part in the MOOC, gained knowledge, any change in the behaviors and attitudes in the workplace as a

result of the training, and the overall evaluation of the effectiveness of the program is enhancing the learners' performance. Furthermore, it explores if the new behaviors delivered results (Kirkpatrick, 1994).

3.2 Reflexivity

As qualitative research is based on interpretative and contextual data that involves the subjective viewpoints of the researcher who constructs the foundation of data collection and analysis (Tufford & Newman, 2012), it is important for me to articulate my own assumptions, values, and subjectivities upfront. [The researcher has worked as a middle and high school teacher and a teacher trainer throughout her career in K-12 school settings. Furthermore, the researcher worked previously with the participants in this study as an administrator and PD coordinator in School X. In this context, the researcher had a good idea about their teaching styles, motivations to develop their skills, topics they need to know more about and the challenges they face in their context; however, she was not a member of the School X's community during data collection; hence she did not have any power over the participants.

I assume that educators show higher levels of motivation to learn when they are active participants of a community of practice than learning in isolation (Wenger, 1998). Therefore, the research design focused on one MOOC as a vessel for learning and communication to formulate a virtual informal PLC that aligned with the physical one the seven teachers had in their school. Assumingly, this would give them a better opportunity to support, guide, and learn from each other as well as other participants in the MOOC.]

3.3 Ethical Considerations

Institutional Review Board (IRB) approval (see Appendix A) for conducting research that involves collecting data from human participants was obtained prior to data collection. Sufficient information about the research intent and potential harms was communicated to participants through the consent form (see Appendix B) to guarantee their informed decision making. The autonomy of individuals who took part in the research was acknowledged in the consent document. Additionally, the personal data collected during the study is protected and anonymized through appropriate and rigorous procedures to preserve confidentiality.

The author declares no conflict of interest whether for financial or personal considerations that may affect the professional judgment in conducting or reporting results. Additionally, the researcher had no power over the participants or any involvement with school X during the research time that can affect teacher evaluation, any form of financial gain to the participating teachers, or career advancement in the workplace.

3.4 Participants and Sampling Strategy

The site and participants were selected through purposeful sampling as they can provide a rich foundation to understand the phenomena (Patton, 2002). According to Plano Clark and Creswell (2015), purposive/purposeful sampling involves devising and selecting competent and experienced individuals or groups pertaining to the phenomenon of interest.

School X is a K-12 international school in Cairo, Egypt that applies the American curriculum, and 2019-2020 is the first operating academic year for both teachers and students. The school hosts 350 students of different age levels who are educated by 45 teachers of various specializations and competency levels. Teachers of each subject are supervised by an HoD who acts as a subject matter expert and a mentor for the teacher in his/her department. The academic

director and professional development coordinator tailor PD plans for all teachers to enhance their performance. School X resembles an inbound physical site where teachers interact and are accustomed to providing comprehensive feedback to each other about their professional practice as a part of their onsite PLCs.

All participants are experienced in using technology as this is required and applied in their daily professional practice. Besides, the participants conduct their classes in English language and are familiar with using a range of digital platforms such as the School X' learning management system and other platforms they use to communicate with their students.

3.4.1 Participants

The participants (N= 7) are grades 6-12 Egyptian STEM teachers working at School X. The participants' selection criteria encompass being an in-service STEM teacher who is capable of using technology to allocate, compose, interact, and evaluate comprehensible information in the English language. It is worth noting the MOOC targets mainly the teachers from STEM disciplines where English is the medium of instruction.

Maximal variation sampling strategy in terms of age, gender, years of experience was adopted to embrace diverse perspectives and experiences (Plano & Creswell, 2015). The sample includes four female teachers and three male teachers. They belong to different departments: natural sciences, mathematics, and computer science. The age range is between 27 and 46-year-old and the length of teaching experience varies from 2 to 25 years among participants; therefore, the sample is diverse in terms of age, experience, and competence. Pseudonyms were assigned to refer to the teachers' first name in order to promote anonymity. Table 1 devises

teachers' profiles which include the subjects taught, grade level, highest degree earned, and years of experience including the current academic year.

Table 1: *Teacher profiles*

Teacher (Pseudonym)	Subject(s) Taught	Grade Level	Highest Degree Earned	Years of Teaching Experience
Ms. Ann	Science – Chemistry	High school	Bachelor's degree	20 years
Ms. Suzan	Science – Biology	High school	Bachelor's degree	4 years
Ms. Rana	General Science	Middle school	Bachelor's degree	3 years
Mr. Narmer	Computer Science	High school	Bachelor's degree	8 years
Ms. Nelly	Computer Science	Middle and high school	Bachelor's degree	2 years
Mr. Sameh	Mathematics	High school	Bachelor's degree	14 years
Mr. Adam	Mathematics	High school	Bachelor's degree	10 years

3.4.2 School CPD Program Context

All seven participants started working in School X in 2019. As it was the first year for the school, adopting a rigorous CPD program was significant to support novice teachers and cultivate the experience of competent ones. The CPD program entailed two phases: semester 1 (August- January) and semester 2: (February to June). It involved different models such as workshops, peer-coaching, mentorship, online learning, and teacher-led training sessions throughout the academic year.

The first phase of the PD program started with workshops conducted by professional trainers and professional development coordinators, then establishing communities of practice and applying mentorship and peer-coaching models. The workshops focused mainly on the fundamentals of teaching and leadership such as lesson planning, teaching strategies, assessment, and leadership skills.

Furthermore, school leaders planned ongoing monthly departmental and cross-departmental group discussions to establish the foundation of a professional community of practice to promote insightful reflection on classroom practices. HoDs acted as mentors to their subject teachers where they used to attend classes and reflect on their observations with the teachers at least once every two months. Teachers started to form informal professional learning communities in their departments and used to discuss different topics in relation to their professional practices. This was enhanced by a school-wide policy that promotes peer-coaching among the teachers from the same department that is followed by a post-meeting to provide feedback using a specific template.

The second phase of the CPD program took place from February 2020 until the end of the academic year. It entailed the prolongation with the implemented models in phase one in addition to optional enrollment in online learning courses according to teachers' preference.

This MOOC-led model of CPD was applied primarily to accommodate the participants' busy teaching lifestyle, as well as open up and expose local teachers to an international professional community, as well as cultivate reflective teacher attributes. Besides, this instructor-led MOOC is designed to induce online professionally moderated discussions which will allow teachers to interact with professionals from inside and outside the school.

3.4.3 The MOOC Context

3.4.3.1 Why this particular MOOC?

The researcher suggested several topics according to the course offering of instructor-facilitated MOOCs that start in the second term of the school year. The topics were either general to different disciplines or specific to science, math, and technology; however, the STEM department heads showed interest in taking *Planning for Learning: Formative Assessment* MOOC along with their staff members as it discusses a topic that they found significant to advancing student learning with a focus on STEM. As learning online was a new experience for most of them, the participants preferred to enroll in one MOOC instead of different ones. Additionally, the participating teachers can use the material as a base for their departmental and cross-departmental discussions. Furthermore, participants can collaborate to find solutions that fit their context as they are working together.

The design of the MOOC encourages teachers to share their experiences by answering questions about their previous practice and posting reflections on newly learned ideas every

week. In addition, the MOOC learners can share links to different external resources to support each other with additional information and clarification. Accordingly, it can be classified as a cMOOC due to its constructive approach (Kurt, 2008).

This cMOOC is provided by *FutureLearn* and developed by the *National STEM Learning Center* (https://www.futurelearn.com/courses/planning-for-learning). The selected MOOC promotes using diagnostic assessment to scaffold understanding and provides meaningful feedback to students using a multitude of teaching strategies to analyze data and collect evidence of student understanding to tailor instruction to students' needs.

It discusses formative assessment goals, strategies, and techniques with a focus on STEM classes. This MOOC entails a wide range of learning materials such as videos taken from actual classroom footage, graphic organizers, quizzes, polls, and additional scholarly journals to enhance professional knowledge about the topic. Besides, the course is facilitated by two instructors who provide online feedback and mentorship from February until April 2020.

The MOOC overview states the course structure and intended learning outcomes for learners. The course is divided into five weeks/modules which are further broken down into 13-16 steps; each week revolves around a main central idea that is chunked into steps. Each week/module requires approximately three hours to be completed.

The course covers the following topics:

- Week 1: Planning for Learning
- Week 2: Planning Starting Points For Teaching
- Week 3: Collecting Evidence and Forming Inferences on Student Understanding
- Week 4: Acting on Evidence During Lessons
- Week 5: Medium-term Planning Across Lessons

According to the MOOC developers, by the end of the program, learners will be able to:

- Explore the significance of formative assessment

- Plan to collect evidence to make informed decisions about student learning and how to tailor instruction
- Develop flexible plans to address misconceptions
- Create diagnostic activities to elicit information about how to move forward
- Apply a range of formative assessment approaches to respond to evidence during and in between lessons
- Examine students' starting points to plan for learning through devising data into specific evidence

Although the MOOC is instructor-facilitated, there are no required graded quizzes or specific assignments that should be submitted to the MOOC facilitators at certain times. All course material was published online since the beginning of the course except for the mentors' videos diaries, which are recorded synchronously while the course is available online to address the participants' frequent questions and comments. The platform provides an interactive progress graph to show the participants' advancement while taking the course. Accordingly, the participants can move forward according to their pace while having the facilitators' support. Therefore, it was favorable to plan and share weekly milestones schedule of the required activities with the participants either to view on the platform or to send via email according to their nature to be able to follow up on their progress, suggest ideas, and answer any potential questions related to the course material.

3.4.4 The Process

The researcher contacted the STEM department heads and teachers at School X via email to outline the purpose of the study, duration, and expected demanded assignments upon enrolling in the MOOC as a new model of CPD. The researcher asked each of the seven participants who volunteered to join the MOOC and participate in the study without remuneration to indicate his/her own objectives that they want to accomplish by the end of the course to have consensus on what the whole group aimed to achieve by the end of the course.

The participants enrolled in the five-week instructor-paced MOOC with the flexibility to complete the steps at their own pace according to their availability. In order to monitor the participants' reactions and progress while learning on the MOOC, the researcher enrolled in the same MOOC and suggested a weekly timeline schedule (see Appendix C) to keep everyone on track. The schedule was shared with the participating teachers via email. The required submissions and activities varied in nature from submitting pre-and post-self-audits, reflection grids, peer-review, and exit tickets. Some assignments such as applying and reflecting on certain techniques in classrooms were left optional to empower them to make their own choices if these exercises matched their lesson planning. Most of the requested submissions were done on the platform itself as part of the discussion, other documents such as self-audits, lesson plans, and reflection grids were submitted via email due to preserving the participants' data anonymity and confidentiality on the platform.

The researcher opted for the 'follow' feature on the platform to be notified on any activity that the participants commented on, liked, or responded to. Furthermore, they were encouraged to follow the same approach to focus on the posts from their colleagues in addition to reading posts by other MOOC participants. In this context, the researcher was able to provide assistance and follow up on the participants' activities and monitor their posts and comments. Besides, teachers were encouraged to discuss what they learn online in their departmental meetings onsite.

Upon enrollment in week 1, participants were advised to take a pre-course self-audit (see appendix D) provided in the MOOC materials to indicate their level of agreement with the different concepts and behaviors that are discussed in the MOOC such as planning for learning, using practice-based evidence to differentiate instruction, and responding during and between

lessons. Also, it enabled them to state their desired learning outcomes and another section to indicate the group's development objectives if they were taking it with colleagues, which is the case in this research design. This approach was recommended by the MOOC developers in the course introduction to induce contextual professional learning communities, model and clarify the different concepts discussed in the course.

Throughout the MOOC, teachers were required to watch the videos, complete the 'steps' of each week, reflect on lesson plans or professional practice, and submit the reflection grids provided by the course upon competition of week 2 and week 5 according to the suggested timeline shared by the researcher at the beginning of enrollment. In addition, teachers were encouraged to take an active part in the online discussions by posting their opinions, any questions, and reflections on what they have learned at least twice per week. Upon completion of week 5, the end of the course, the participants were encouraged to take a post-course self-audit (see Appendix E) and share it with the researcher. The form is provided in the last step of the MOOC and entails the same eight questions about concepts covered in the MOOC and the level of agreement with them as a method of detecting the impact of the course on the learners' knowledge and attitudes. Additionally, it entails another section reflect on the level of the fulfillment of the professional development needs and rate the overall quality of this CPD model. The third section gathers information about the relevance of content, instructional design, the usefulness of the material, and the course, in general, to improve planning for learning understanding and the related practice. Finally, phone interviews were conducted to explore their MOOC experience.

In brief, this study explores the experience of seven STEM teachers working at School X enrolled in the same MOOC about assessment for learning. The researcher monitored their

headway throughout the five-week on the platform and mentored them by following up on their progress. The participants submitted certain assignments to indicate their reflections on their practices and interaction with their colleagues, the MOOC facilitator, other MOOC takers, and the course material. Finally, the participants who completed 90% of the course were interviewed to describe their learning experience.

3.5 Data Collection Instruments

Data collection tools included document review, online communication posts and discussions on the MOOC discussion forum, and semi-structured interviews to collect data about teachers' perspectives, benefits, challenges, and impact on their professional practice regarding using MOOCs as a model of professional development. According to Stake (2013), deploying many research procedures on the same phenomena in a multi-case study augments the comprehensive representation of the self-centered uniqueness of each case and the commonality among the cases. In the same vein, triangulation of methods enhances data validity, reliability, and promotes the credibility of qualitative analysis (Stake, 2013; Plano Clark & Creswell, 2015; VanderStoep & Johnston, 2009).

Document review includes collecting samples of materials that are used by participants such as the **lesson plans** that demonstrate the newly learned concepts, **reflection grids,** and **pre-and-post-self audit surveys** that are utilized optionally in the MOOC. The participants are used to develop weekly lesson plans divided internally into sessions as a part of their teaching duties at school one week before executing the lesson. Teachers usually write a brief reflection on how the plan went and how it will affect their further planning in the short-term. The researcher searched for evidence of the newly learned concepts in their lesson design.

A **reflection grid template** (see appendix F) was supplied by the MOOC developer. The participants submitted via email two reflection grids: one after the second week/module and the second one was submitted after the fifth and last week. The reflection grids were utilized mainly to track their satisfaction and the newly learned concepts and how they applied them in their context, and how teachers evaluate their effectiveness. The first section of the reflection grid includes successes, problems, eureka moments (possible solutions for the problems faced), and questions. The second section demonstrates the changes that the teacher applied this week and the third section includes the topics that the teacher discussed in relation to the course material with his/her colleagues lately.

The MOOC designers recommended taking two short surveys: **pre-course** and **post-course self-audits**. The pre-course self-audit was administered in week 1 prior to discussing the course material to document the MOOC taker's degree of agreement and personal practice endorsement in relation to eight different formative assessment concepts that are discussed in the MOOC throughout the five weeks. In addition, it invites the participant to write his/her improvement objectives as a result of taking the course. Additionally, there was a part to state the group's learning objectives. The post-course self-audit was introduced by the end of the course material in week 5. It has the same questions found in the pre-audit in addition to an evaluation of the course material and organization itself and how much the course fulfilled the participant's needs. Each participant submitted two self-audits; one at the beginning of week 1 and the other by the end of week 5. The following table demonstrates the aspects that the MOOC developers asked about.

The participants were encouraged to communicate online by posting comments and replies on the **MOOC forum** and contribute to the discussion at least twice per module. Furthermore, the researcher opted for the 'follow' feature on the *FurturLearn* platform to mentor the participating teachers and monitor their progress. Also, the participants were encouraged to participate actively in the forum by commenting or replying to their peers or the other MOOC learners. All online discussion threads were scanned and stored securely for data analysis when the course ended.

The **interviews** with teachers followed a dialogic semi-structured format (see Appendix G) that encompassed predetermined questions thus provided the availability to ask further follow-up questions to elicit more information (Patton, 2002). Furthermore, the open-ended questions were designed to gain more insights into the impact of the program, if any, on their professional teaching practices.

According to Valenzuela and Shrivastava (2002), a brief description of the study goals and sampling strategy is significant to keep the interviewee well-informed of the purpose of the interview. The interview questions types varied to detect the interviewee's demographics, behavior, opinions, feelings toward the experience, and knowledge. The interviews were conducted in the same week after completing the MOOC to ensure apprehending as many possible thorough details that a participant can share, allowing providing more insights through probing questions. Thematizing and designing the interview questions constructed the foundation to understand what and how the participants can describe their experience.

The researcher held individual interviews with the participants to gain an in-depth understanding of the benefits and challenges they faced, likes, and dislikes while taking part in a virtual learning environment in the MOOC. The questions are categorized into four domains

echoing Kirkpatrick's evaluation model: 1) perception and satisfaction; 2) learning; 3) evaluation; and 4) closing questions.

The interviews lasted for 30 minutes on average. The purpose of the study was communicated prior to conducting the interview. All interviews were audio-recorded after taking the consent of the interviewee and transcribed verbatim (see appendix A & G). The collected data from the individual interviews were analyzed separately to form codes that constructed the base of the within-case analysis. The related emerging patterns from different cases were grouped to create cross-cutting themes.

3.6 Data Analysis

This qualitative multi-case study design considers each participant as a unique case of inquiry that interacts in a particular context (Stake, 2013), physically in their workplace and virtually on the MOOC platform, with other participants who construct also specific entities. Hence, the data generated by each teacher was used to formulate a personalized within-case analysis to demonstrate the unique distinctiveness of each case. It focused on nuanced individual perceptions and reactions. Whereas the cross-case analysis revealed insights into the common themes prevailing across all teachers, which bound them in their genuine learning experience.

The data was analyzed through the adult learning theory (Knowles, 1980) and Kirkpatrick’s four-level evaluation model which includes reaction, learning, behavior, and results (Kirkpatrick, 1994). Kirkpatrick (1994) clarifies the *evaluation* term in the field of education, training, and development to include increasing knowledge, enhancing skills, altering attitudes, and achieving better observable results. However, different educational and training programs may plan only for attaining specific levels in the course learning outcomes. Therefore,

evaluation becomes an important instrument to verify the effectiveness of an educational program (Kirkpatrick, 1994).

According to Kirkpatrick (1994), there are many factors that should be considered while planning for training/development programs implementation to attain positive outcomes (p.3):

1. Determining needs
2. Setting objectives
3. Determining subject content
4. Selecting participants
5. Determining the best schedule
6. Selecting appropriate facilities
7. Selecting appropriate instructors
8. Selecting and preparing audiovisual aids
9. Coordinating the program
10. Evaluating the program

Kirckpatrick (1994) demonstrates the gained aptitude in relation to a training program in depending upon four ordered levels criteria:

> Level 1: *Reaction*, it demonstrates the participants' response to the training program such as the level of satisfaction.
> Level 2: *Learning*, it analyzes the newly learned concepts and skills based on the training.
> Level 3: *Behavior*, it examines how participants applied what they have learned in relation to their jobs and any change in behavior affected by the training input.
> Level 4: *Results*, it evaluates if the training program had a positive impact on the institution.

Accordingly, this framework will help the researcher analyze teachers' level of satisfaction, application of newly learned concepts, and their self-assessment of the effectiveness of this CPD model upon completion. Moreover, it sheds light on the connection between theory and implementation as it examines the impact of the online MOOC-based CPD model on teachers' onsite professional practice.

In view of that, individual interviews would reveal the participant's perceptions and level of satisfaction concerning utilizing MOOCs in CPD. Lesson plans, reflection grids, self-audits,

and snapshots from the participants' online communication can demonstrate levels 2 and 3 regarding the truly understood concepts and how the participants think about the course material in their reflections. Finally, the semi-structured interviews that were done after completing at least 90% of the coursework and reflecting on the primary list of objectives the participants' synthesized prior to taking the MOOC can reveal how participants evaluated their experience after completing the program. The categorized codes emerged from the predetermined open-ended interview questions and the additional clarifying questions that were used during the semi-structured interviews, the online dialogue of the participants on the MOOC platform, documents, and artifacts that were shared with the researcher provided a foundation for data analysis.

In summary, the research problem demanded an in-depth exploration of each case in the MOOC's inbound system to capture its complexity; therefore the study deployed many data collection instruments before, during, and after the MOOC completion to be able to answer the research questions. Document analysis and semi-structured interviews constructed the base for data analysis.

4. Results

The aim of the study is to explore in-service middle and high school STEM teachers' experiences and perceptions of the potential benefits and challenges of using instructor-led cMOOCs in enhancing professional knowledge and practice.

The mentor- facilitated MOOC lasted for five weeks and required online interaction through answering open-ended questions, posting opinions, replying to other participants, and submitting reflections about the newly applied methodologies studied in the course. Teachers were encouraged to post at least twice a week. Stake (2013) suggests that qualitative understanding and interpretation of cases necessitate experiencing their activities in particular situations in their context while they occur in real-time. On this account, the researcher enrolled in the same MOOC to be able to track their progress, monitor their reactions, and mentor them by replying to their inquiries in relation to the course material.

Mr. Sameh, Mr. Adam, Mr. Narmer, Ms. Suzan, and Ms. Nelly were interested in earning a certificate of completion (the certificate is available only upon upgrading from auditing free mode to the paid version of the course) when they finish the course to mark their achievement and show that they were always working to improve their professional skill set. However, they confirmed that they were largely interested in the learning experience itself and how they could benefit from it to foster learning in their classes.

Upon enrollment in the MOOC, six participants indicated their personal learning goals on the platform to designate their participation motives and goals, one participant did not enroll in the MOOC despite showing interest. It is worth noting that it is the first time for all participants to take a MOOC whether for professional or personal reasons. Ms. Ann depicted that "It is my

first time to join an online course. I joined this course to gain more ideas about planning for learning. I am looking forward to our online discussions." Also, she added that she is particularly interested in learning more about planning for differentiated learning. Ms. Suzan wrote "Looking forward to learning new and interesting ideas and to implement them in my classroom." Mr. Narmer added:

> I'm motivated to take this course as I believe that planning is the core of building a successful educator having in mind all aspects that contribute into making successful planning that triggers the learners' mind and critical thinking, I wanted to enhance my tools and broaden my ability to creating much more efficient plans also to recognize and evaluate others' plans.

Accordingly, the six participants compiled and agreed on the following collective objectives for taking this MOOC:

- Learn new teaching techniques
- Improve our professional skills to meet students' needs
- Enhance students' skills
- Collaborate with colleagues and other practitioners to find solutions for the challenges we face in class.

By the end of week 1, each enrolled participant posted what they learned as an exit ticket on the platform and their degree of satisfaction. Ms. Ann, Ms. Suzan, Ms. Rana, and Mr. Narmer indicated that they are largely satisfied by the relevance of the content to their practice and the quality of it. Ms. Nelly and Mr. Adam did not share their thoughts. Mr. Narmer shared his impression by sharing this post on the platform" I'd like to develop better planning techniques and ideas, and that's why I am happy to be here."

Noticeably, the structure of this cMOOC encouraged participants to vote for polls to indicate their perceptions or opinions, pinpoint the reasons behind their choices, and answer open-ended questions. Ms. Ann, Ms. Suzan, Ms. Rana, and Mr. Narmer were highly interacting on the discussion forum by sharing experiences and reflections about their practices throughout the weeks. Ms. Nelly designated that she was usually experiencing technical problems in her device and Mr. Adam indicated that he had a personal family obligation that may require a long time from him to dedicate which could interfere with his learning plans which banned them from abiding by the formerly suggested timeline.

It is worth mentioning that all schools experienced lockdown during the third week of the MOOC due to COVID-19 pandemic that forced all teachers to work online. Accordingly, the participants had fewer chances to interact with each other in workplace PLCs in the second half of the course. However, they continued to interact online on the MOOC discussion board.

By the end of the five-week MOOC, four teachers, Ms. Ann, Ms. Suzan, Ms. Rana, and Mr. Narmer, completed all the five modules of the course in five weeks, Ms. Nelly completed less than three modules of the coursework, Mr. Adam completed a few steps in the first module, and Mr. Sameh did not enroll despite showing immense interest in taking a part of the online course in the beginning. He owed that to the restricted time he had due to unforeseen increased administrative workload as he was promoted to a higher managerial post concurrently with the course.

Eventually, four participants out of the total number that actually enrolled completed 100% of the course in five weeks. The following table shows the nature of online postings on the MOOC forum and the overall progress of each of the participants throughout the MOOC.

Directed content analysis was employed to determine the initial coding scheme for data analysis (Hseih & Shannon, 2005). Using the andragogy theory and Kirkpatrick's evaluation model to identify the key concepts of reaction and insights, gained knowledge and learning, change in behavior, and reflection on practice were the initial coding categories for online discussions on the MOOC platform. As the goal of the study is exploring the phenomena in-depth, the content of the postings was highlighted manually using predetermined codes. Any text that deviates from these categories, was grouped to form a new code. According to Hseih and Shannon (2005), the findings from the content analysis can be compared meaningfully to rank the frequency of certain codes and the appearance of new ones.

Table 2: *Teacher Progress*

Teacher (Pseudonym)	# of posting / Content Description / interval	Completed modules
Ms. Ann	37 postings - signal newly gained knowledge - usually long with elaboration on her own context, reflective and analytical – distributed throughout the 5 modules	5 modules
Ms. Suzan	21 postings – signal newly gained knowledge - usually of average length, reflective and analytical - distributed throughout the 5 modules	5 modules
Ms. Rana	17 postings - signal newly gained knowledge - usually of average length, reflective and analytical - distributed throughout the 5 modules	5 modules
Mr. Narmer	22 postings – signal newly gained knowledge - usually long with elaboration on his own context, reflective and analytical - distributed throughout the 5 modules	5 modules
Ms. Nelly	2 postings – limited in demonstrating the newly gained knowledge - short and brief with a restricted connection to her own context – 17 days difference between them	3 modules
Mr. Sameh	No postings	---
Mr. Adam	1 posting to introduce himself and his personal learning goals	1 module

The following section is divided into two parts within- case reports and across- case thematic analysis. The within-case analysis is put first to outline the overall experience of each participant in relation to his/her prior experience of CPD. It focuses on three cases from two different departments with different levels of experience: veteran, middle -career, and early-career teachers to demonstrate the variation in their professional needs and evaluation of the effectiveness of this mode of CPD to their practice. Each within-case report demonstrates the nuanced teacher perception, benefits, and challenges that s/he experienced, and the impact of this CPD model on his/her performance at school. The cross-case analysis shows themes that evolved from the codes extracted from the four interviews with Ms. Ann, Ms. Suzan, Ms. Rana, and Mr. Narmer in addition to the document review. The themes include autonomy, experiential learning, and reflection, engagement, contextualization, and effectiveness.

4.1 Within-case Analysis

4.1.1 Ms. Ann

Ms. Ann has 20 years of teaching experience. In addition to being a veteran teacher, she is also leading the science department where Ms. Suzan and Ms. Rana are working. She acknowledged that since she has been a novice teacher, she was always motivated to enhance her teaching techniques through observing other teachers' classes, peer-observation, as there were minimum opportunities to enroll in courses or workshops due to the restricted resources for PD or the lack of engagement due to either irrelevancy or the dreary instruction approach. She elaborated on one workshop that she found beneficial by saying, "I think he [the instructor] managed to do certain activities to engage people, but the previous ones were not engaging enough."

Perception

Ms. Ann emphasized that she values the experience of taking this MOOC with colleagues in constructing knowledge together and improving practice together especially that the MOOC discussed evidence-based effective pedagogical approaches in relation to STEM which is largely relevant to her practice. She emphasized that the MOOC took into consideration the variation in knowledge and experience among participants in a sense that she felt empowered to focus on the parts that she needs to know more about and just check on the other concepts that she's familiar with. This kept her motivated to complete the course while feeling not forced to listen to ideas and techniques that she knows quite well and practiced for years as was the case in workshops.

Benefits and Challenges

Ms. Ann found writing comments and replies a 'clear' method of communication. Therefore, she used to elaborate on her ideas and reflection on practice through the platform. Also, she emphasized that she valued being among a group not only from the same school but also from the same department which shaped their professional discussions at school. She added that she used to take notes of interesting ideas and suggestions. And it happened that she advised Ms. Suzan and Ms. Rana to apply particular ideas discussed in the MOOC that she found suitable for the topics and grade level that they teach. She clarified,

> "It really helped a lot in sharing ideas, supporting each other to be able to understand or to consider how we all together can improve our students' learning."

This pattern was also useful for her to build extended social and professional communities with colleagues from other departments. Also, she used to check on any new comments or replies from other participants from other countries. She was particularly happy when an

external participant liked how she integrated a particular strategy in her class and asked to use her suggested methodology. This gave her a fulfilling reaction that her ideas could be of value to others even outside her school context.

Along the same lines, although she was using the techniques proposed by the MOOC, there was a difference between her students' mindset and the ones she watched in the short videos in the MOOC in terms of focusing on final summative assessment rather than the learning itself. Occasionally, she suffered from poor internet connection which interferes with her own plans.

Impact on Practice

Ms. Ann added that the MOOC encouraged her to think about her own and departmental planning for learning, trying new approaches, and reflecting on them with her colleagues and on the platform with a 'bigger circle' of practitioners. In week 2, she commented on how to gather evidence and connections to help students learn by posting,

> "Prior to discussing a topic, I used to ask students to create a concept map. Then while discussing the information, they can add to or modify their map to reflect their understanding of the topic. But after watching the video, I like the idea of giving them a concept map with mistakes which they need to spot and correct. I think it's a very nice approach."

Ms. Ann confirmed that she has largely benefited from the MOOC in enhancing her understanding of assessment for learning and improved her analytical thinking as she was always prompted to reflect either on her practice or other teacher's practice. She stated in her post-course self-audit about her reaction toward her learning experience "It helped me improve

my personal productivity and attain valuable skills. Also, giving attention to all members' ideas and inputs." Additionally, she rated the impact of her learning to be high on herself, her colleagues, and institution due to discussion and collaboration and medium on her students. She clarified that this is due to the longer time she needs to rate this aspect. Her interview and document review showed themes of autonomy, engagement, contextualization, experiential learning, and reflection.

4.1.2 Ms. Suzan

Ms. Suzan is an early career teacher with four years of teaching science in middle and high school stages. She depended mostly on workshops offered generally before the beginning of each school year and some scattered job-embedded ones. She indicated that she found them effective to a great extent as each workshop targeted an important practice-oriented topic.

Ms. Suzan believed taking a part of a PLC and communicating with veteran teachers can help her understand how to deal with the challenges she faced in her classes and orient her with more practical methodologies that she can apply in her context. Accordingly, she seized any CPD opportunity to enhance her competency as a novice teacher.

Perception

As this MOOC was her first encounter with online learning in general, she declared,

> Actually, I didn't expect that I'm going to learn that much from an online course. For me, I would like to have a personal interaction for any courses, that was my previous idea, but when I tried it, I liked it very much because it has an interaction; people are 'talking' to

> you, people who are asking you, people who are giving you tasks and taking back your feedback again, so there's a mutual interaction that I found very beneficial.

Ms. Suzan feels that students nowadays need innovative teaching approaches to improve their learning, so she was motivated to take the MOOC to know more about how the other teachers manage to plan for their classes. Ms. Suzan clarified that she used her spare time after the school day to concentrate and take notes. She reflected that she was largely attracted to watching the short videos taken from classroom footage and that prompted her to go from one step to the next without feeling that she's completing the modules. Additionally, she benefited from watching the short video introduced by the instructors who elaborated on the pedagogic planning approaches in a simple way and the tutorial of how the instruction would go. In her words, "I felt that they were talking actually to me."

Benefits and Challenges

Ms. Suzan explained that this MOOC helped her reconsider how to plan for learning and the different factors that could determine the approach she would select. She elaborated by saying,

> "I learned a lot. It gave me a lot of ideas; to make a different lesson planning. For example, to plan depending on their [the students'] prior knowledge…Also, planning from the misconception…to anticipate this part…students have to know what success looks like, they have to know what they are supposed to do at the end…what's the goal?"

Besides, Ms. Suzan found it useful to take a MOOC with colleagues, she clarified,

> "Every time one would read or study any part would come and discuss it with the others. "I saw this and I saw this and I learned that. Do you know that we can do this in the classroom?... It was helpful!"

She declared that she did not interact much with other participants but she was reading their comments. The only drawback she found was the lack of personalization; she needed more feedback on her postings to guide her if she is on the right track or not. In her words, "The feedback, not every time there's going to be a feedback on my answer or my reflection or in my opinion."

Impact on Practice

Ms. Suzan applied many techniques that were discussed in the MOOC which was usually paired with submitting a reflection on the effectiveness of such techniques in her context on the discussion forum. She reflects on planning with the attentiveness of students' misconceptions,

> "The benefit for starting to plan upon the misconception is that we will save a lot of time and effort as well with the students because we will be focusing on their weak points But, the drawback for this I think that not all the students in the class will have the same misconception so maybe this strategy will mislead their prior knowledge and it may waste time for them in the class."

In her evaluation, Ms. Suzan found that both online and onsite communication and course data impacted her professional practice positively. She added, "Actually when I finished, I was searching for another topic to learn about." Her interview and document review showed themes of engagement, experiential learning, and reflection.

4.1.3 Mr. Narmer

Mr. Narmer has 8 years of teaching experience in middle and high school. Lately, he started working as a lead teacher for the computer science department this academic year where Ms. Nelly worked. In his reflection about his previous experience in CPD, he depicted that he benefited from attending workshop sessions organized as part of conferences as he was empowered to select the topic he preferred to attend according to his professional needs.

Perception

Mr. Narmer compared his own prior experience in a technical online course regarding programming which included pre-recorded lectures and the possibility to send questions to the instructors to be answered asynchronously. That course did neither support collaboration nor discussions among participants, so he felt cut off in his remote e-learning experience. In his words regarding his motives and perceptions about taking this MOOC,

> ” What I liked about this course is there’s a mentor, my colleagues are entering with me so the sharing and collaboration between us will be really fruitful, this is number 1. Number 2, the idea of developing, of course… because I feel always that I’m more technical than pedagogical…I always use one or two teaching methods, so I felt I have a deficiency in this aspect [planning].”

On the other hand, he compares this experience with his former one of online learning,

> “I didn’t have this before, to brainstorm with colleagues, have comments on the website to read…actually, there were (comments), but there was no mentor or someone who would tell me I want you to do this and this, so I was totally free, and eventually sometimes I

> don’t continue the course till the end. I feel disengaged after a while...because I feel that I am on an isolated island.”

Benefits and Challenges

Mr. Narmer outlined the impact of taking the course with peers from the same school by saying,

> “when I talk with my colleagues who are sharing with me the same course, we brainstorm together…this was beneficial to me instead of being on different islands…I can add that brainstorming was there before the course, but we started to talk about it (the course material), tell each other, I will implement this, I tried this and it worked, so this gave me more engagement to the course.”

In addition to collaborating with peers, Mr. Narmer clarified that he also used to get feedback from his colleagues after implementing some new techniques that are suggested in the MOOC. Besides, he enjoyed reading the reflections of the other participants and receiving feedback from them, so he felt engaged. Furthermore, He valued the constructive feedback he got in online communication from his peers and the mentor.

By extension, Mr. Narmer felt that social interaction kept the momentum to learn sustained until the end. Furthermore, he appreciated the flexibility in logging in at any time and the optimum duration length of five weeks which complemented his busy schedule. Additionally, the formative assessment topic was really significant and relevant. He adds that he learned a lot from the short videos of how other teachers perform the suggested strategies in their classes and the reactions of their students taken, in his words,

> "When I do my research and do my writing and watch the video, I implement it, or at least if I cannot implement it because of the circumstances that we are in right now (all schools in Egypt lockdown and applied online learning due to COVID-19 pandemic), I discuss it."

Regarding the challenges, Mr. Narmer compared the difference between face-to-face courses with this online MOOC in terms of getting instant feedback which may affect the level of engagement, but in his evaluation, he did not feel that he faced a problem because of that. He elaborated that he studied online but discussed the material face-to-face and applied what they learned together which enhanced his critical evaluation of the impact of his learning on his students. Then he reflected," I did that with my colleagues whom I see, so maybe this gave me this balance."

Another challenge that was raised upon implementing the new teaching strategies that Mr. Narmer mentioned is altering his planning, classroom logistics, and teaching approach from teacher-centered to student-centered which sometimes affected his predetermined pacing. To clarify this point, Mr. Narmer reflected on his practice prior to taking this MOOC and its impact on his current teaching stance by saying,

> "I wanted to take my students from point A to point B 'technically'… the easiest way is a straight line, so I'll give it to you [the students]… I used to make sure that they know the right answer. I make sure that all the misconceptions are covered, but I usually don't give them a chance to fix their own misconceptions. I fix it for them. I want to make everything clear…but when I changed a little bit in my strategy, I started to benefit from their misconceptions and I started to create a discussion between them, and not involving

myself, …so this made them a part of the learning process rather than spoon-feeding them."

On the other hand, he sensed some difference between the 'idealistic' short videos from classrooms where everyone is quiet, engaged, and complying with the instructions and the other reality he normally faces in his classes when some behavioral issues may interfere with the instruction such as refusing to sit in a particular group. Accordingly, he suggested adding a part in the MOOC that discusses the common challenges that teachers face upon applying new techniques and possible solutions for them.

Impact on Practice

Mr. Narmer confirmed that this MOOC helped him 'rediscovering' some old teaching techniques he used before, adding new ones, selecting and applying what he considered useful to his context. Besides, he recognized in his post-course self-audit that the course has met his PD needs in gathering evidence to promote student learning. Additionally, he highly valued the impact he personally achieved along with his colleagues through discussions. In sum, Mr. Narmer stressed autonomy, effectiveness, engagement, and contextualization themes.

The with-in case analysis of the three demonstrated cases showed codes of gaining new knowledge, reflection on practice, and change in behaviors and attitudes that are grouped in effectiveness theme. Furthermore, the linkage between online and onsite communication and engagement was evident in teachers' voices. Additionally, the participants indicated that most of the learning was experiential in nature as it was gained through application followed by reflection. Besides, all participants referred to the significance of contextualizing the practices to their school context. In this regard, they benefited from the discussions with their colleagues

from the same school in their physical PLC that was extended to a virtual one in the second half of the course due to the lockdown.

4.2 Cross-case

4.2.1 Autonomy

The four teachers who completed the MOOC maintained high levels of satisfaction throughout the modules and indicated this in their interviews. Ms. Ann indicated in the interview about her perception of learning through MOOCs that she was motivated to take the course due to the relevancy and significance of the formative assessment topic to her staff and her teaching practice.

They agreed that the relevancy of the topic to their practice was the most significant factor behind being engaged until the end. Mr. Narmer declared that online learners are empowered to decide if they wish to continue or not according to their evaluation of the benefit they get from their learning experience. Ms. Suzan agreed, “To be interested and to want to learn about it, be keen to learn about this topic.”

Ms. Ann and Ms. Suzan revealed that they appreciated the flexibility and convenient aspects of the MOOC as they were able to access information and continue learning at any time of the day were the main motives behind completing it. Additionally, Ms. Ann indicated that the asynchronous online mode of the MOOC suits their demanding workload. She reflected that this is one of the advantages that she found in online courses.

All the participants indicated that they used to study in their free time at home. They preferred to take a few steps in the MOOC throughout the week whenever they find free time.

In this vein, Mr. Narmer indicated that he formulated a study plan, in the beginning, to manage his time and effort among the different commitments, yet it did not go accordingly either because of professional or personal commitment. However, he could modify his study plan easily.

They considered the 5-week duration an optimum length that kept them committed to completing it while feeling empowered because of its flexible nature. Also, Ms. Suzan and Ms. Rana valued saving their time and effort that are needed to commute to onsite courses.

4.2.2 Experiential Learning and Reflection

Learning in this cMOOC had an experiential aspect; the design was always encouraging teachers to share how they would plan, apply, and inquire about their practice with other participants. They discussed how they plan for learning in their classes and the role of formative assessment in anticipating the critical points of the lesson to collect and analyze data to make informed decisions. In this context, Ms. Suzan posted this in her exit ticket after completing week 1,

> "Actually I have learned a lot like diamond 9 and to let the students correct a wrong concept map and also how to collect data and can use them later on in a certain decision like what approach should I use in the next lesson. Question: How can I make all the students participate and interact in those techniques without leaving any student behind?"

Ms. Suzan indicated that some of her questions were answered by the mentors or colleagues. However, she declared that she needed more personalized feedback to guide her in her first years of teaching. Similarly, Ms. Rana indicated that the course design fostered her

analytical thinking. She used to share her professional choices at certain parts of the lesson and the reasoning behind it, she posted,

> "Open questioning from my point of view is more effective as it gives a chance for the students to discuss freely and allow the teacher to know a wider range of students' misconceptions."

On the other hand, the more experienced teachers, Ms. Ann and Mr. Nathan were sharing long and thoughtful reflections on their successes and challenges. Occasionally, Ms. Ann asked for recommendations from the virtual professional community on the MOOC forum,

> "It was a really great addition to me. It helped me a lot to decide on the best way to deliver my content and really make sure that my sessions are engaging as possible. The main challenge that I face now is the different types of students in a classroom, they have diverse learning needs, and satisfying all of them in the same way while approaching a particular curriculum is a serious challenge. Any suggestions?!"

The experiential learning also included reflection on pre-recorded instructional videos taken from elementary and secondary STEM classes. Participants shared mixed thoughts about the relevance of these videos to their own context; however, Mr. Narmer and Ms. Ann recognized that it helped them to analyze and reflect on another context that may be similar or different from what they experience in their teaching. Mr. Narmer commented on how he would respond in a certain point of a recorded lesson: "Regrouping students and get them to work for a solution is the choice I would make."

Also, the course design had polls to vote for the next steps to be done in class and the reason to do so. The teachers indicated that they found this activity engaging and meaningful. Ms. Ann commented on one of the polls about planning,

> " I am drawn to D&E [two choices in the poll], as some teachers cannot spot the misunderstandings except after having a test and grading it and by that time it's too late for students to be interested, we've got to take advantage of the moment. Then move to E, thinking of the next steps in teaching."

4.2.3 Engagement

The supportive and productive collaboration was recognized by all the participants who completed the course. It enabled them to exchange new ideas, create synergy by considering multiple perspectives in brainstorming, participating in creative thinking, and problem-solving. This collaboration was evident in online communication but largely supported by their onsite discussions.

Also, having an external mentor, the researcher, who has previously worked with the participants and knew many of the challenges they faced in their context helped them reflect on their learning by critiquing some decisions and asking open-ended questions about their practice to reach the intended outcomes. This social interaction kept them engaged to proceed. As an example, Mr. Narmer replied to the course facilitator about how he plans for collecting data in his class,

> "Usually I ask a question related to the main topic, so they have an idea of the direction, yes, but depending on the flow of their interest I could use this as key to approaching the intended section of the topic, it gets them more engaged learning something that they discussed at the beginning."
>
> Later on, Mr. Narmer reflected on a new grouping technique,

“It was really engaging more students, especially those who were passive, even when one was not much confident to answer; it was observed how it built a better sense of involvement and sharing in the creation of an idea.”

Also, the learner-learner interaction in a supportive virtual environment enhanced emotional engagement. Despite preferring to interact with her colleagues, Ms. Suzan responded to a participant from outside the school who shared some teaching techniques such as directed dialogue and debates that he uses in his class: “I liked the ideas, I didn’t try it before, but definitely I will.”

Ms. Ann indicated that her department members used to discuss the course material and the new teaching strategies they can implement during their meetings during the school day. She also elaborated this was useful in relating what they learn to deal with the challenges they face in their classes especially that they work under the same conditions. It happened many times that Ms. Ann and her colleagues in the science department referred in their online and onsite discussions to a certain idea or strategy that was mentioned in the course material or by a participant that can work well in their classes.

4.2.4 Contextualization

Teachers were open in discussing the challenges they face in their classroom and seek for possible suggestions to improve their practice. When teachers were asked about the significance of planning for learning and the possible obstacles they face, they analyzed their context and shared their views openly. Ms. Suzan explained:

> "I think that most of the time we don't have enough time to plan properly prior to the lesson and to design activities to it since we have to stick to the curriculum timeline. Also, most of the students are exam-focused so I have to exert more effort to make them interested in learning in the first place and how learning anything in school can be beneficial in our daily life routine."

Mr. Narmer and Ms. Ann revealed that they face many challenges in their classrooms which are different from the 'ideal' classes they watched. Accordingly, the discussion forum was also a channel to vent out and elaborate and reflect on the barriers which they face in their own context. Ms. Ann explained:

> "For me, right now i'm [I am] facing more than one barrier… sometimes I face an emotional barrier like sometimes some students believe that … they won't be able to understand what so ever I think this is due to negative past experience. Sometimes it's the language barrier as for the hard scientific expressions. Also having no available resources or even time to perform activities as we have to stick to the curriculum timeline…"

In later steps in the week after exchanging information about how they plan for learning in their specific contexts and devising the importance of data-driven decisions, teachers developed and shared their visions of the approach and goals they want to implement in their classes. Ms. Rana illustrated,

> "I would like to encourage my students to talk more, explore and research to reach the answers themselves not depending on the teacher to give them all the information they need".

4.2.5 Effectiveness

Teachers indicated that they have achieved their personal learning outcomes that they shared at the beginning of the course. Also, they reflected that their group learning goals were also largely achieved as they kept communicating and reflecting on their understanding regularly with their peers. To a large extent, this collaboration kept them engaged and motivated to learn and apply the new techniques together.

Ms. Ann shared that the MOOC provided a good foundation for her department discussions with Ms. Suzan and Ms. Rana. Besides, it helped in extending the PLC to the computer science department as well. On the other hand, as the math department members dropped out in the early stages, there were restricted chances of having common professional discussions. Mr. Narmer seconded her opinion about the effectiveness of joining a MOOC with colleagues by posting,

> "Of course we discuss and share our ideas and reflect on one another experiences over this platform and outside, and this is just one of these activities that help colleagues learn from one another, and I am already learning from everyone over here that is sharing his/ her experience."

All teachers indicated that they adopted new teaching approaches in their classes that were discussed in the MOOC. Ms. Suzan shared the most prominent techniques that she used and reflected on how they have affected student learning,

> "There are a lot of ideas that I liked there, collection of data, decision-driven data collection from the student that would require sometimes changing lesson plans within or before the lesson. Giving a wrong concept map and asking them to figure out the

> mistakes, I tried it and it helped her much to detect students' pitfalls and level of understanding."

Ms. Ann shared her evaluation of her learning experience when she completed the course by posting on the MOOC forum,

> " This course was extremely useful where I gained inspiration from other teachers and academics by sharing a combination of teaching strategies… Educators who are building a professional learning community recognize that they must work together to achieve their collective purpose of learning for all. We can seek the advice and experience of other teachers to learn some effective methods and a lot of ideas for differentiated instruction to allow every student to learn with his or her own learning style. For example, some teachers may have some advice on how to handle general disciplinary actions such as not completing an assignment or sleeping in class, others may help you utilize technology in a productive way. Lesson plans, teaching methods, and learning strategies can be shared to create the most enriching learning environment."

All the teachers agreed that the MOOC was effective in gaining knowledge and enhancing teaching skills. On this account, Mr. Narmer also stated that he would give 8 or even 9 out of 10 for the engagement and collaboration that made him more confident in planning. Besides, he reflected on the group PD objectives in his final post-course self-audit by stating,

> " We met our group development objectives perfectly as each one of us developed a certain area and lots of common ideas through discussions."

In summary, data analysis revealed 5 themes: autonomy, experiential learning, reflection, engagement, contextualization, and effectiveness. The generated themes are largely interconnected. All participants demonstrated satisfaction of the relevancy of course content to

their practice, whilst maintaining a consensus to contextualize the material to make it more relevant. Furthermore, the participants appreciated the flexibility of the online mode of CPD that empowered them to manage their own learning at their preferred pace while saving commuting time and tuition fees for similar onsite courses. The participants agreed that engagement with the course material and reflecting with colleagues on practices were significant factors to keep the momentum and complete the course according to the timeframe.

5. Discussion

The primary goal of the study was exploring the middle and high school STEM teachers' perceptions of the effectiveness of utilizing a blended model of onsite PLC aligned with instructor-facilitated MOOCs as a supplementary model of CPD to enhance knowledge and practice. Despite the reported statistics that MOOCs have always shown low retention rates with less than 10% completing the courses (Hew & Chung, 2014). Conversely, 4 out of the 6 participants who enrolled in the MOOC from School X as a part of this study completed the course with high satisfaction levels of their experience. Accordingly, understanding how teachers perceived MOOCs as a model of CPD is essential to evaluate factors that maintained their positive reaction toward this model and its effectiveness in guiding their practice.

5.1 The Role of Engagement and Motivation

According to Kirkpatrick (1994), trainees' reaction is shaped by many factors such as the content, audiovisual aids, efficiency of instructors, suitability of schedule, and effectiveness in meeting the learner's needs. The participants agreed that utilizing the MOOC as a foundation of CPD maintained their autonomy in adapting the course to their own schedule. This autonomy extended to selecting the topic with their supervisors to match their learning goals. Likewise, Knowles (1980) stressed that adult learners are self-directed in their choices and will tend to select the learning experiences that serve them to achieve their goals. Kennedy (2005) stresses the significance of self-direction and self-reflection to build teachers' professional capacity for autonomy as a crucial aspect of professionalism.

Kirkpatrick (1994) evaluated the effectiveness of training programs according to how participants reacted to training, the knowledge they gained, the on-job application of the learned concepts, and finally if the application is attaining the desired results. Five out of the six

participants who enrolled in the MOOC submitted the pre-self audit upon starting the first week. However, only three submitted the post-self audit that contains the same quantitative part in addition to other qualitative sections that relate to the relevance and effectiveness of the course to achieve the learning outcomes. All teachers indicated in their post-self-audit and interviews that they gained many ideas that they applied in their classes, which addresses the third level of Kirkpatrick's evaluation model, evaluating behavior. The teachers indicated that they wish to take another MOOC in the future with their colleagues; Ms. Suzan has already started searching for one that meets their pedagogical needs. This echoes Sia and Cheriet's (2019) findings that 51% of teachers who enrolled in a MOOC for CPD were interested in replicating their experience.

Solomon and Tresman (1999) argue that the theoretical nature of most of the academic degrees may not support the practice-based professional action needed to improve student achievement. Deng, Benckendorff, and Gannaway (2020) argue that MOOC learners' educational intentions of being a part of a professional community are different from the traditional ones in formal credit-bearing higher education courses.

Nevertheless, the mainstream of MOOC participants is motivated to earn a certificate of completion. Likewise, Mr. Sameh, Mr. Adam, Mr. Narmer, Ms. Suzan, and Ms. Nelly considered earning a certificate to mark their achievements; however, this motive alone could not sustain the momentum of completing the course as both Mr. Adam and Mr. Sameh from the math department dropped out in early stages and Ms. Nelly experienced many technical challenges that stopped her midway to mark other logistical challenges that can face e-learners especially in developing countries that have a poor technological infrastructure. Additionally, although Mr. Narmer and Ms. Suzan completed the course, they decided that they would not

apply for a certificate of completion as they had to pay a considerably high fee in relation to their income. Furthermore, they added that they wish that their workplace would consider supporting them in this endeavor.

Hone and El Said (2016) suggested that higher completion MOOC rates are strongly related to active engagement. Additionally, Furlong et al. (2003) advocate that there is an immense need to examine how engagement affects the learning context to be able to achieve the learning outcomes. According to all the participants who completed the course, the relevance of the course content to their learning goals was a prominent factor in keeping them engage and motivated to learn. Most teachers experience time limitations due to high teaching loads and having other additional job-related administrative tasks. Nevertheless, maintaining an intrinsic motivation to develop their professional competence is related to the individual professional needs (Knowles, 1980) and adopting a lifelong learning conceptualization.

5.2 Onsite vs. Online PLC

The literature supports the significance of social interaction between learner-learner and learner-instructor within MOOCs to motivate learners to learn while extending professional networks (Kellogg, Booth, & Oliver, 2014; Laurillard, 2016; Li, Krasny, & Russ, 2016). Laurillard (2016) indicated that participating in a collaborative learning community enhances the effectiveness of utilizing MOOC as a co-learning model. Likewise, the active learning and reflective learning approaches helped the andragogical learners to accumulate new experience on prior knowledge (Cohen & Hill, 1998; Dewey, 1904; Knowles, 1980; Wiley & Yoon, 1995).

In this blended CPD model, the online PLC on the MOOC was paired with an onsite one in the participants' workplace. It is noteworthy that all the members of the science department

maintained a high level of satisfaction and collaboration in the onsite PLC throughout the course. New inter-departmental professional discussions were initiated between the science and computer science teachers that motivated Mr. Narmer to complete the course while taking part in this onsite PLC. Furthermore, they found that taking the course with colleagues had a positive effect on overcoming isolation which is a drawback that Mr. Narmer had experienced before in taking an online course separately. Accordingly, learning within communities of practice maintained mutual engagement and enhanced the teachers' professional discourse (Wegner, 1998). Additionally, the onsite communication helped in contextualizing the knowledge in their practice which is a drawback Ms. Ann and Mr. Narmer indicated in the challenges they faced. Furthermore, the teachers owed the effectiveness of this joint MOOC and onsite PLC model to sharing context-related and school-based practical solutions for the challenges they face in their classes.

On the other hand, the members of the math department lacked such an onsite collaboration aspect such as Mr. Adam, the math teacher, who was taking the MOOC solely as his only colleague from the math department, Mr. Sameh, registered but did not enroll in the MOOC. Also, Mr. Adam had hardly collaborated with his colleagues whether onsite or online; he owed that to time limitations due to work and family commitments. In view of that, the onsite PLC can hold the potential of fostering engagement and perseverance to complete the course.

The empirical findings from the study support this argument and show that teachers valued the taking part of an online PLC on the MOOC platform as it enabled them to share resources and experiences in a supportive professional e-environments. However, the frequency

and breadth of the shared posts on the platform varied greatly among the participants according to age and experience. Ms. Ann and Mr. Narmer used to interact regularly on the online PLC using comprehensive comments and replies than Ms. Suzan and Ms. Rana.

5.3 Going Totally Online: COVID-19 Pandemic

It is worth noting that all schools were subjected to lockdown after the third week of the MOOC due to COVID-19 pandemic. Accordingly, this unperceived global restriction had limited the teachers' opportunities to practice the newly learned teaching methods in the normal face-to-face school settings and engagement in related onsite discussion in their onsite PLC.

Teachers indicated that they had many new techniques that they hypothesized that they may be efficient in the normal classroom setting, but the new online mode of instruction had added more challenges to them to master in a short time. Accordingly, it was largely challenging for them to apply new methods at the same time as this unexpected crisis.

In view of that, The experiential job-embedded CPD approach that the teachers had experienced enhanced the usefulness of perceiving knowledge from 'what' and 'how' to include 'why' this outcome turned out in different contexts; an attribute that basic academic factual knowledge is inadequate to provide (Shulman, 1998). The findings suggest that online discussion and classroom video-recordings that show real situations facilitate knowledge construction and promote engagement. Accordingly, MOOC designers can benefit from what teachers considered effective in selecting the course activities.

Briefly, the participants' intrinsic motivation to gain knowledge that they directly apply in their work context, autonomy in terms of course selection, and the flexible learning mode and studying time, taking a part of an online and onsite PLCs have contributed to high levels of

satisfaction upon course completion. Furthermore, the participants indicated that they found the course effective as they learned many new concepts and applied several techniques in their context. Though, they recognized that there is a need to contextualize the material to their own practice which is relatively different from the recorded videos on the MOOC.

5.4 Limitations

Stake (2013) suggests that the findings of multiple-case studies cannot be generalized in large due to the sturdy contextual reference to the case; however, the results provide an in-depth exploration of the studied cases by examining the complexity of the interrelationships among a small number participants and their context, which can largely give insights for further research. The number of teachers who participated (N= 7) in the study demonstrates certain criteria in the work context, digital, and language proficiency. Accordingly, the results can be different in other cases that may experience different reactions from stakeholders at the workplace, language barrier or digital divide.

Additionally, the school lockdown imposed by COVID-19 pandemic interfered with the application aspect of the second part of the course, week 3 to 5. Accordingly, had limited access to their onsite PLC and could apply only the techniques that could be used in the new online mode of instruction during this period.

Also, participating in the MOOC as a mode of CPD was an optional choice that was not mandated by School X. Therefore, the completion rates and collected data show only the behavior of these self-directed learners. Thus, it is relatively difficult to take a broad view of the derived conclusions to be valid beyond the examined cases. However, the insightful contributions and reflections of the teachers turn the spotlight on how educators, as adult learners, perceive a job-embedded instructor-facilitated MOOCs that are supported by an online

and onsite PLC. Furthermore, Van Schoor (2017) clarifies that the datasets in qualitative case studies are usually small but open to repeated examination.

5.5 Implications

The results hold several significant implications for devising an engaging self-directed CPD program to fulfill the different professional needs of adult learners. Firstly, empowering teachers to select the topics they wish to invest time and effort in as a personalized PD path can largely hold them to be behaviorally and cognitively engaged. Secondly, the results show the immense need for social communication whether online or onsite. It was perceived that job-embedded collaboration among teachers in PLCs as adult-learners to maintain social and emotional engagement while learning online. Recognizably, taking part in an onsite PLC while having a MOOC with other colleagues enhances content contextualization and makes the learning experience more meaningful to the learners. Thirdly, there is an immense need to enhance contextualization and personalization in MOOC design. Participants indicated that they have largely benefited from watching the short video from classroom footage showing how instruction and learning took place in different settings and age levels. Therefore, MOOC instructional designers can foster this practice and initiate additional communication channels between MOOC facilitators and participants to provide personalized feedback to overcome the challenges they face in practice.

5.6 Recommendations

Based on the results, firstly, the researcher recommends that school administrators and CPD coordinators promote institutional policies to establish onsite PLCs at the school level as a foundational aspect of a transformative CPD plan. The rationale behind this recommendation is linking theoretical and academic knowledge to real practice-based evidence in classrooms. This

can largely empower teachers to decide in different daily situations in their practice ‘what’ to teach and the best approaches to follow with different learners, ‘how’ to tailor these methodologies in their context, and ‘why’ these methods hold a potential to enhance student learning. Consequently, enabling educators to find evidence-based solutions together can improve student achievement. Secondly, administering a needs assessment to provide a selection of MOOCs that meet the most prominent teachers’ learning needs with more specialization in age level and subject taught.

A third recommendation would be administering further broader mixed-method research to recognize the impact of teacher online learning in MOOCs on student engagement and achievement. Fourthly, the study provides insights into the short-term pedagogical change outcomes that were observed as a result of taking the MOOC, but more research is recommended to examine the impact of such a model on the long-term teacher development and student engagement and performance. Finally, examining the scalability of the system in other contexts (Dede, Ketelhut, Whitehouse, Breit & McCloskey, 2009), such as governmental and community schools, and test reliability of this combined online and onsite model with a focus on teachers from emerging economies as human and fiscal PD resources are scarce.

6. Conclusion

The research findings support the significance of developing CPD systems that enable teacher autonomy to create individualized routes and modes of learning within a particular model (Burchell, Dyson, and Rees, 2002). The findings indicated that teachers feel empowered to select the MOOC that coincides with their needs as self-directed learners (Knowles, 1980). Accordingly, devising an effective and engaging CPD program that meets the individualized needs of teachers as lifelong learners can support a transformative opportunity to enhance teacher knowledge, attitudes, and skills.

The qualitative empirical findings from this multi-case study outlined a variety of perceptions of online learning in an instructor-facilitated MOOC context aligned with participating in onsite collaborative PLCs depending on age, experience, and gender. Themes such as autonomy, experiential learning and reflection, engagement, contextualization, and effectiveness were manifested in teachers' voices.

Teachers are autonomous adult learners with distinctive learning goals; therefore they need to feel empowered to select their learning pathways supported by a collaborative PLC. The research purpose echoes Dede et al.'s (2009) online teacher professional development (oTPD) research agenda to identify the aspects of PD programs and the learners' interactions that promote learning in oTPD. Nevertheless, there is limited literature to show the effect of combining e-learning with physical PLC at the workplace.

Despite the limitations in the study, the results give insights that the majority of in-service teachers show positive reactions toward utilizing MOOCs as a supplementary model of CPD along with collaborating in onsite PLCs. They viewed this method as an informative, flexible,

and convenient mode of learning. All the participants who completed the MOOC indicated that the topic constructs the main cornerstone of choosing their pathway as autonomous learners (Knowles, 1980). Therefore, the wide variety of MOOC choices empowered them to make personalized decisions that endorse their autonomy, which is a significant aspect of professional adult learners.

However, maintaining high levels of behavioral, social, emotional, and cognitive engagement are comparatively related to the MOOC completion rates. Accordingly, taking an online course with a group of teachers from the same school extended the social and emotional engagement aspects beyond the onsite PLC to a wider MOOC-based one. This combination provided a better opportunity for MOOC learners to discuss, apply, and reflect on different ideas onsite and online.

The study examines the short-term effect of this blended onsite PLC-MOOC CPD model on teachers' gained knowledge and practices. In view of that, there is a need to administer further research to examine the medium and long-term impact of this model on teachers' performance. Finally, the results suggest that instructor-facilitated cMOOCs can be a part of a comprehensive CPD program by providing the context for reflection on one's own and others' professional practices paired with a campus-based PLC to foster the missing contextualization dimension in MOOCs. Accordingly, the MOOC's role can extend from a transmitting model to a transformative one.

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Appendices

Appendix A

IRB Approval

CASE #2019-2020-080

THE AMERICAN UNIVERSITY IN CAIRO
INSTITUTIONAL REVIEW BOARD

To: Basant Hegazy

Cc: Dena Riad

From: Atta Gebril, Chair of the IRB

Date: March 1, 2020

Re: IRB approval

This is to inform you that I reviewed your revised research proposal entitled "MOOCs: A New Paradigm in Teacher Professional Development " and determined that it required consultation with the IRB under the "expedited" category. As you are aware, the members of the IRB suggested certain revisions to the original proposal, but your new version addresses these concerns successfully. The revised proposal used appropriate procedures to minimize risks to human subjects and that adequate provision was made for confidentiality and data anonymity of participants in any published record. I believe you will also make adequate provision for obtaining informed consent of the participants.

This approval letter was issued under the assumption that you have not started data collection for your research project. Any data collected before receiving this letter could not be used since this is a violation of the IRB policy.

Please note that IRB approval does not automatically ensure approval by CAPMAS, an Egyptian government agency responsible for approving some types of off-campus research. CAPMAS issues are handled at AUC by the office of the University Counsellor, Dr. Ashraf Hatem. The IRB is not in a position to offer any opinion on CAPMAS issues, and takes no responsibility for obtaining CAPMAS approval.

This approval is valid for only one year. In case you have not finished data collection within a year, you need to apply for an extension.

Thank you and good luck.

Atta Gebril

Dr. Atta Gebril
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Appendix B

Consent Form

THE AMERICAN UNIVERSITY IN CAIRO
INSTITUTIONAL REVIEW BOARD

Documentation of Informed Consent for Participation in Research Study

Project Title: MOOCs: A New Paradigm in Teacher Professional Development

Principal Investigator: Basant Hegazy

*You are being asked to participate in a research study. The purpose of the research is exploring in-service school teachers' perceptions, benefits, and challenges when adopting MOOCs as a model of CPD to enhance teacher professional knowledge and practice, and the findings may be published and presented. The expected duration of your participation is six weeks.

The procedures of the research will be as follows, reviewing documents and online communication done by the participant, interviewing, and class observation.

*There will not be certain risks or discomforts associated with this research.

*There will not be benefits to you from this research.

*The information you provide for purposes of this research is confidential.

*Participation in this study is voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue participation at any time without penalty or the loss of benefits to which you are otherwise entitled.

Signature _____

Printed Name _____

Date _____

Appendix C

Weekly Timeline

Course Milestones	***How can I show my progress?***
Week 1	**Step 1.4: Self-audit (via email)** - Please fill in the 5-minutes questionnaire, save it, and send me the pdf via email **Step 1.14: Reflect on your learning (on the platform)**
Week 2	**Step 2. 14: Task (<u>OPTIONAL</u>)** - as it requires both lesson planning and reflection afterward, it can be fulfilled whenever you execute the lesson in March **Step 2. 15: Reflection grid (via email)** - (a sample and an empty template are found on the platform) - Please fill in and send it via email.
Week 3	**Step 3. 11: Discuss (on the platform)** **Step 3. 13: Classroom Task (on the platform)** - Lesson plan
Week 4	**Step 4.10: Peer Review (on the platform)** **Step 4.14: Classroom Task – Responding to evidence (on the platform)**

	- Lesson plan
Week 5	**Step 5.8: Classroom task (<u>OPTIONAL</u>): Gathering students' thoughts** **Step 5.13: Self-audit (via email)** **End of Course Reflection grid (via email)** - Please fill in and send it via email.

Appendix D

Pre-course Self-audit

Planning for Learning - NE710B19

Response ID	Completion Date

Where are you base?	

Are you a:	Teacher (including trainee teacher)
	Teacher assistant
	Other

Please indicate your level of agreement with the following statements:

	Strongly disagree	Disagree	Agree	Strongly agree	Don't know yet / Not applicable
I am confident in being able to plan for the learning of my students.	○	○	○	○	○
I often use practice based evidence to inform my teaching.	○	○	○	○	○
I often use misconceptions to plan my activities.	○	○	○	○	○
I plan to share both learning intentions and success criteria with my students.	○	○	○	○	○
I often plan in advance probing questions anticipating the range of students' responses.	○	○	○	○	○
I am confident at responding during the lesson to unexpected or unusual answers.	○	○	○	○	○
I am confident at responding between lessons to students' ideas.	○	○	○	○	○
I often collaborate with other educators to develop my teaching approaches.	○	○	○	○	○

Retrieved from planning for learning: formative assessment, National STEM Learning Centre

Source: https://www.futurelearn.com/courses/planning-for-learning

Appendix E

Post-course Self-audit

Planning for Learning - NE710B19

Response ID	Completion Date

Where are you base?	

Are you a:	Teacher (including trainee teacher)
	Teacher assistant
	Other

	Strongly disagree	Disagree	Agree	Strongly agree	Don't know yet/Not applicable
I am confident in being able to plan for the learning of my students.					
I often use practice based evidence to inform my teaching.					
I often use misconceptions to plan my teaching.					
I plan to share both learning intentions and success criteria with my students.					

I often plan in advance probing questions anticipating the range of students' responses.					
I am confident at responding during the lesson to unexpected or unusual answers.					
I am confident at responding between lessons to students' ideas.					
I often collaborate with other educators to develop my teaching approaches.					

In what way did the course meet your professional development needs?	
How would you rate the overall quality of this CPD?	

How you rate the impact that has been achieved so far?		
On your students		
Low	Medium	High
On yourself		
Low	Medium	High
On your colleagues and/or organization		
Low	Medium	High
Overall		

Low	Medium	High

Did you take this course with other teachers at your school/college?	
Where are you based?	
If you are a teacher, what subjects do you teach?	
If you are a teacher, are you teaching a STEM subject outside your specialism?	
If you are a teacher, what age range(s) do you or will you teach?	
How many years have you been teaching/supporting teaching?	

Please indicate your level of agreement with the following statements				
My understanding of planning for learning has improved				
Strongly disagree	Disagree	Agree	Strongly agree	N/A
My practice of planning for learning has changed				
Strongly disagree	Disagree	Agree	Strongly agree	N/A
The course was well-organized and planned				
Strongly disagree	Disagree	Agree	Strongly agree	N/A
The course was relevant and useful				
Strongly disagree	Disagree	Agree	Strongly agree	N/A

I would recommend this course to a colleague				
Strongly disagree	Disagree	Agree	Strongly agree	N/A
Doing this course was good use of my time				
Strongly disagree	Disagree	Agree	Strongly agree	N/A

How much of the course did you complete?	
May we quote your anonymized comments in impact reports and research outputs?	
May we use anonymized responses to this survey when promoting online courses from the National STEM Learning Center?	

Retrieved from planning for learning: formative assessment, National STEM Learning Centre

Source: https://www.futurelearn.com/courses/planning-for-learning

Appendix F

Reflection Grid Template

NE710 Planning for learning

Successes	Problems
Eureka moments	Questions

Changes I have made this week to how I plan my teaching

Aspects of the course I have discussed with colleagues this week

Keep a record of your reflection grids each week and refer back to them as part of the final reflective activity at the end of the course. Post any outstanding questions to the question and answer session, discuss with colleagues or join us on the next run of the course.

This reflection grid is part of the MOOC material designed by the STEM Learning Center and provided by FutureLearn.

Retrieved from planning for learning: formative assessment, National STEM Learning Centre

Source: https://www.futurelearn.com/courses/planning-for-learning

Appendix G

Interview Protocol

Demographic Information

Interviewer: _____

Interviewee: _____

Date: _____

Location: _____

Gender: _____

Age: _____

Years of Teaching Experience including this year: _____

Subject(s) Taught: _____

Highest Degree Earned: _____

Permission to audio-record: The interview will be audio-recorded to review the data and transcribe verbatim. Do you give consent to audio-record this interview session?

Yes: ____

No: ____

Review the purpose of the study: To explore how teachers perceive massive open online courses (MOOCs) as a model of teacher continuous professional development (CPD). To explore teachers' perceptions of potential benefits of and challenges for using MOOCs in CPD. To evaluate the impact of this model of CPD on teacher acquisition of knowledge and professional teaching practice.

Perception and Satisfaction:

1. What are the models of CPD that you have experienced throughout your career?
2. What are the most effective models in your opinion? Why?

3. How would you describe a MOOC to someone who is unfamiliar with this type of course?
4. What motivated you to take this course?
5. Describe your experience with MOOC?

Probes: time, effort, cost, effectiveness, efficiency, convenience

Benefits & Challenges

1. How would you describe this MOOC as a method of learning?
2. Tell me about a concept/ idea/skill that you learned from the MOOC and found relevant to your professional practice.
3. In your experience, what factors affect the level of online learning from a MOOC?

Probes: relevance, length, content, activities

4. Tell me about some challenges that you faced while participating in this MOOC.

Learning

1. How do you find learning in an online professional discussion?

Probes: facial expression, choice of words, reaction time, context

2. How did this MOOC affect your professional practices?

Probes: Planning, analysis of results, differentiating learning & assessment, teaching methods, student performance, instructional content, classroom logistics

Evaluation of Practice

1. What is your overall evaluation of this model of training/PD in (1) enhancing professional knowledge; (2) developing online and onsite communication; and (3) improving professional practice?

Closing Question

1. Do you see yourself taking another MOOC to learn about another topic?
2. To what extent would you recommend MOOCs to enhance their professional practice?