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by

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In Partial Fulfillment of the

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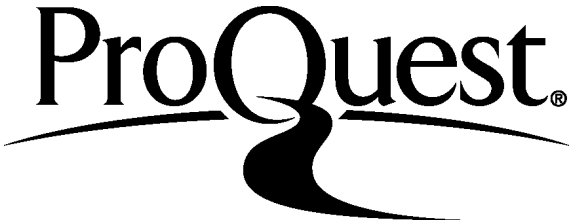

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GLOSSARY

affordances - "refers to the perceived and actual properties of a thing, primarily those functional properties that determine just how the thing could possibly be used." (Salomon, 1993, p. 51)

community of Inquiry – "is a concept first introduced by early pragmatist philosophers Charles Sanders Peirce and John Dewey, concerning the nature of knowledge formation and the process of scientific inquiry" ("Community of inquiry," 2014).

massive open online course – "is an online course aimed at unlimited participation and open access via the web. In addition to traditional course materials such as videos, readings, and problem sets, MOOCs provide interactive user forums that help build a community for students, professors, and teaching assistants (TAs)" ("Massive open online course," 2014).

open educational resources – "constitutes a world widespread community, which aims to create a common cultural background in the educational field through the Internet and through the creation of really usable courses on the web, which should be under the conditions of being adaptable, improved and redistributed under open licenses" ("Open educational resources", 2014).

rubric – According to Heidi Andrade's commonly accepted definition, a rubric is "a document that articulates the expectations for an assignment by listing the criteria, or what counts, and describing levels of quality from excellent to poor." (Andrade, 1997)

LIST OF ABBREVIATIONS

CoI - Community of Inquiry.

EE – Expert Evaluator.

MOOC – Massive Open Online Course.

OER – Open Educational Resources.

SME – Subject Matter Expert.

OLE – Online Learning Environment.

ABSTRACT

Javier Ruiz, Miguel A. M.S., Purdue University, May 2015. A Case Study of Introductory Programming with MOOCs. Major Professor: Alejandra J. Magana.

Computational thinking has become a crucial skill for the 21st Century learners in all disciplines. Research suggests that the best and fastest approach to understand the concepts of computational thinking is through developing programming skills. However, finding effective and affordable learning environments to introduce programming skills to a massive scale of students remains a challenge. Currently, the unprecedented utilization of MOOCs represent an opportunity to achieve this goal. But, existing introductory programming MOOCs have failed to provide instructionally-sound experience for learners. The purpose of this descriptive research is two-fold: (1) Identify the affordances of fifteen MOOC's platforms that are best suited to design and implement basic programming skills courses based on the community of inquiry (CoI) framework, and (2) Describe and compare how CoI framework-based instructional strategies were implemented in six basic programming skills MOOCs.

CHAPTER 1. INTRODUCTION

1.1 Introduction

The ferocious hunger for technology in which the current world is immerged has its root with the introduction of the Internet to society in early 90s ("History of the Internet," 2014); since then, computers have become an intrinsic part of people's lives. In fact, computing devices have become so pervasive that people may not realize when or how they are using them. Computing is present in the most insignificant and significant daily routines such as turning on the light, watching TV, listening the radio, talking by phone, surfing the web, etc. But more importantly, computing has changed the way people interact with each other and how they think. In other words, computing has become a language and a new way of communicating in our world. This is why it is not surprising that the Bureau of Labor Statistics predicts that from 2010 to 2020 there will be an anticipated growth of 30 percent in software developer jobs. It is important to point out that this report does not include other areas in computer science like system analysis, computer support, system administration and web development (Guzdial & Adams, 2014). As a result, more than ever, computational thinking has become a crucial skill for the 21st Century (America, 2001). Research suggests that the best and fastest approach to learn and grasp the concepts of computational thinking is through

programming (America, 2001). However, finding an effective and affordable learning environment to teach programming to a vast scale of students remains a challenge for online education and learning management systems (LMS). In this regard, MOOCs seem to be the ideal solution to this conundrum, since MOOCs were originally designed to deliver open online education to a massive number of students; hence the M in MOOCs (Guzdial & Adams, 2014).

This research explores the most popular MOOC's platforms and the affordances that they support to guarantee a reasonable success in teaching basic programming skills. For this purpose, this research uses the extensively validated Community of Inquiry model to evaluate both MOOCs platforms and MOOCs implementation of basic programming courses.

1.1 Problem Statement

Massive open online courses (MOOCs) and their platforms have been already implemented in multiple fields ranging from liberal arts to quantum mechanics (Liyanagunawardena, Adams, & Williams, 2013). However, one field that has gained more attention, even from the beginning of MOOCs, is Computer Science (CS), especially in the area of programming. For instance, Udacity, which is one of the biggest MOOC's platforms in the market, just recently announced a close collaboration with Google to develop new courses in this area (Dhawal, 2014). However, this is not new for Udacity, as in the past it teamed up with other giant tech companies like NVidia and AT&T to provide students around the world with the curriculum and skills they need to pursue

careers in technology (Heussner, 2013). In a similar vein, but with a different approach, Edx and Coursera, which are also major MOOC's platforms, added new academy institutions to their consortium. Although this seems to be great news for the online learning community, the hype of MOOCs has also raised some concerns among faculty members regarding quality and the capacity of MOOC's platforms to provide instructionally sound learning experiences for the learners (Kolowish, 2013). Mahraj (2012) emphasized this problem by stating that "many MOOCs replicate lecture-based, 'sage on the stage' instruction and lack effective instructional design" (p.363). As a teaching method, lectures do not work in helping students acquire programming skills alone. According to Jenkins (2002), lecturing or reading textbooks are not sufficient to learn programming. He argued that "programming is learned by programming…" (p.55).

1.2 Significance of the Problem

The cardinal goal of this research study consists of exploring the realm of facilitating introductory programming courses through MOOCs based on the Community Inquiry (CoI) pedagogical framework. Consequently, this research fosters awareness on educators and instructional designers regarding the appropriate affordances that leverage the implementation of instructionally sound courses in basic programming. In addition, this research identifies the top fifteen MOOC's platforms that afford the principles to implement an effective CoI environment.

Based on the aforementioned, this research tackles some of the concerns expressed by many researchers and educators regarding the quality of the e-learning experience

facilitated by MOOCs. This is the case of Swan et al. (2014), who stated that "the empirical evidence on the effectiveness of MOOC's pedagogy is hard to find" (p.2). However, regardless of these concerns, MOOCs have been addressed as the evolution of higher education (HE) (Bali, 2014). Therefore, this research focusses on describing the most effective affordances, based on the CoI framework, to design instructionally sound courses in introductory programming.

1.3 Statement of Purpose

The purpose of this descriptive and exploratory study is to characterize existing MOOC's platforms in the current market that support pedagogical components based on the CoI model; hence facilitating the implementation of instructionally sound courses in introductory programming. Concurrently, the research also pinpoints some of the most effective ways to leverage MOOCs affordances to implement programming courses following the CoI framework.

1.4 Research Question

The research questions of this study are:

1. What affordances of MOOC's platforms are best suited to design/implement basic programming skills courses based on the community of inquiry (CoI) framework?
2. How CoI framework-based instructional strategies are currently used in a set of six basic programming skills MOOCs using Python?

1.5 Assumptions

This research is grounded on the following assumptions:

- Programming skills are best taught using the learning community methods supported by CoI.
- Expert evaluators have previous knowledge or experience with online learning.
- The number of MOOC's platforms analyzed in this research is significant for a qualitative study.

1.6 Delimitations

The delimitation of this research study include the followings:

- Using as criteria the number of enrolled students and number of courses in CS offered by each platform, only the top fifteen MOOC's platforms are evaluated.
- In order to comply with MOOCs' definition, all the courses evaluated in this research are free of charge.
- Out of the top fifteen MOOC's platforms, only six MOOCs in introductory programming using Python were analyzed using the CoI instrument as a framework.

1.7 Limitations

This study takes in consideration the following limitations:

- Not all the MOOC's platforms in the current market were selected due to limited access to all of the features.
- Only MOOC's platforms that offered their content in English were used in this study.

1.8 Summary

This chapter provided a description of the main components of this research aimed to explore MOOCs characteristics. Topics like the statement of purpose, significance of the problem, and scope of this research were presented. Additionally, this chapter provided an overview of the limitations and delimitations as well as the assumptions contemplated in this research.

CHAPTER 2. REVIEW OF LITERATURE

The main goal of this chapter is to situate this research by describing previous studies in the same area of this research; hence exposing gaps that may be covered in this study. Additionally, this section addresses other relevant topics such as (a) MOOCs and their effect on both the academic and corporate environments; (b) MOOCs on introductory programming courses; (c) Python as the preferred computer programming language to teach introductory programming; and (d) the relevance of the CoI model to leverage effective learning of computing concepts.

2.1 History of MOOCs

The concept of MOOCs is not as revolutionary as many have claimed (Waldrop, 2013; Bali, 2014). The online learning movement has been growing for decades (Butcher & Wilson-Strydom, 2013), while open educational resources (OER) has been around, since the beginning of the millennium ("Open educational resources," 2014). Therefore, it is safe to assume that MOOCs are the next logical step of these two major phenomena (Bali, 2014; Yuan, MacNeill, & Kraan, 2008). The term MOOC was initially coined in 2008 when Dave Cormier and Bryan Alaxander introduced an online course called Connectivism and Connective Knowledge (a.k.a CCK08)(Rodriguez, 2012). The course

was originally designed for twenty-five tuition-paying students; however, in an unconventional move, the course was opened to the online learning community free of charge. More than 2,200 students enrolled to the course without gaining any credit (Yuan, Powell, & CETIS, 2013). The premise behind this new educational model was based on the philosophy that generally the event of learning happens not when the professor is lecturing the students, but when students explore course materials and they are involved in critical thinking and debates with other students (Meister, 2013, p.1). McAuley, et al. (2010) described MOOCs as the integration of three main components: (1) aspects of social networking, (2) instructors facilitation, and (3) a collection of open educational resources (OER) (p.4). In conjunction with this philosophy, the goal of conveying free distance education to a large number of learners make MOOCs a very attractive educational model to the cyber-world.

2.1.1 Relevance of MOOCs in the current market

In the last five years eLearning communities on both fields, academic and corporate, have experimented a vertiginous growth, which is mainly attributed to technological advancements and the ever-growing Internet population (Ensher, Heun, & Blanchard, 2003). For example the implementation of MOOCs by elite universities such as Stanford, MIT, and Harvard, just to mention a few, has become the norm of their online learning communities. Similarly, corporate learning has been taking advantage of this rising technology to educate and develop their work force across geographical locations. An article published by Jeanne Meister on 2013 titled "*How MOOCs Will*

Revolutionize Corporate Learning and Development" exposed how corporates have struggled to provide an optimal education environment based only on on-site training model. The article also explained the concept behind MOOCs and how, by applying one of the MOOCs' tenets called "flipping the classroom," corporates are addressing the problem of unsatisfactory and sporadic educational development. As an example of the deployment of this approach in a corporate environment, we could cite the case of McAfee that attributed the elevation of its sales to the skills acquired through this new training model (Meister, 2013). In a similar move, other Silicon Valley tech giants have also jumped into this so called the revolution of higher education (Heussner, 2013). This is the case of Google that released its first MOOC in March 2014, titled "Making Sense of Data"; and more recently, in partnership with Udacity, announced four new introductory courses in the area of software development (Dhawal, 2014). It is obvious that the MOOCs event has not only stormed the academic world, but it also has made an impact on the training models of corporate universities. Hence, delivering a new schema to promote creativity, innovation and explore new pedagogical practices, as well as business models with flexible learning paths (Yuan, Powell, & CETIS, 2013, p.18).

2.1.2 Types of MOOCs

As the world is entering into a more modern technological era, distance education has evolved and adapted at the same pace. In fact, the technology involved in facilitating distance education generally defines the methodology used to implement MOOCs (Anderson & Dron, 2011). As a consequence, the number of methodologies used to facilitate MOOCs could be staggering. cMOOCs and xMOOCs are the most dominant methodologies in the online learning ecosystem. The terminology of x and cMOOCs was introduced by Stephen Downes to segregate connectivist MOOCs from the others, since their pedagogical framework differ from each other. Connectivist MOOCs (cMOOC) methodology has its roots in the philosophy of connectivism and the application requires conceptual changes on both ends, educators and learners (Rodrigurez, 2012). Downes (2005) suggested that the core characteristics that define connectivist courses should be based on the following criteria: First, diversity, which promotes crowd thinking and echo-chambers by engaging participants with different social backgrounds to collaborate in discussions and settings. Second, autonomy to allow learners to decide for themselves what topic they want to learn, and when and how they want to achieve this. Third, openness, which means that educational resources should be freely available and accessible to learners. Last, connectedness, which specifies that the learners should have at their disposal the tools that leverage online social interaction among students; without this last component cMOOCs would not be feasible. The first MOOCs were based on this philosophy. This is the case of the online courses CCK08 and *Personal Learning Environment and Knowledge* (a.k.a

PLENK2010), where their content was made available through Rich Site Summary RSS feeds. Students located remotely were able to collaborate or connect using different technologies, including blogs, threaded discussions in Moodle, social network services (e.g., LinkedIn, Facebook), and Second Life meetings ("Massive open online courses", 2014).

On the other hand, the xMOOCs term was used to classify courses in the MITx and EdX MOOC's platforms, hence the "x" (Rodriguez, 2012). xMOOCs uses a pedagogical framework that is based on a behaviorist approach, which is fundamentally different from the connectivism and networking philosophy of cMOOCs. xMOOCs fundamentally rely on information transmission, computer marked assignments and peer evaluation. Bates (2012) stated that:

> "Behaviorist pedagogy has its value, especially where there are right and wrong answers, facts or procedures that must be learned, or students lack higher level cognitive processing skills. In other words it works reasonably well for certain levels of training. But it is extremely difficult if not impossible to teach higher order skills of critical thinking, creative thinking, and original thinking using behaviorist pedagogy, the very skills that are needed in a knowledge-based society" (p.1).

In the fall of 2011 one of the first xMOOCs was launched by Stanford University, titled "*Introduction to Artificial Intelligence"* (CS221). The course was a collaboration of two eminent computer scientists from Stanford University and Google. The course was opened worldwide and approximately 160,000 students registered to the class. The

tools used in AI-Stanford CS221 course were mainly based on a centralized webpage where students were able to access the course materials and watch video tutorials hosted in YouTube. At the end of the class the students had to complete a small test that was offered in the form of multiple choice ("Massive open online courses", 2014). Feedback and a statement of accomplishment were provided to all students. Although 20,000 students were able to successfully complete the course, which only represented a 12.5 percent of the total students, the class was an unquestionable success. In the words of their creators, it was "a bold experiment in distributed learning" (Rodriguez, 2012). As a domino effect, the AI-Stanford CS221 course marked the beginning of the MOOC-mania (Vardi, 2012). In 2012 Stanford University took a big step forward when they announced that they would offer 13 more classes in a format of xMOOCs. Following the same initiative, MIT, which has been one of the main contributors to the OER movement, also announced in 2012 that they would offer MOOCs. Since then, the MIT has partnered with other elite universities to promote and foster MOOCs worldwide.

In conclusion, both MOOCs formats share many common features, however they differ in the learning theory and pedagogical model on which they stand.

2.2 Collaborative learning in introductory programming courses

In his article *On the difficulty of learning to program*, Jenkins affirms that lecturing or reading textbooks is not sufficient to learn programming. He argued that "programming is learned by programming…" (p. 55). However, this is not the only

approach that has been proven to be beneficial for student learning programming. Another research conducted by Cavus and Ibrahim (2007) showed that students' performance improved when employing advanced and standard collaborative tools in teaching introductory programming online. Similar studies have also demonstrated the advantages of using collaborative learning to teach programming skills.

A study performed by McDowell et al. (2002) demonstrated that students working in pairs performed significantly better on programming projects compared to those who were only working by themselves. Another research conducted by Sabin and Sabin (1994) obtained a similar result where collaborating students showed considerably greater improvement pre-test post-test, and rated the course higher. However, the most interesting discovery from an educational perspective was the one found by Chase and Okie (2000), where the introduction of peer instruction and collaborative learning to the curriculum of their CS101 courses decreased the combined attrition and failure rates from 56% to 33%. Nevertheless, social media tools like chat rooms or discussion forums are being underused by the online learning community according to a study realized by Zhai and Liu (2005).

2.3 Learning computational thinking through introductory programming

Computational thinking provides students with the skills to leverage the strengths of computing to solve analytical problems (Senske Nick, 2011). In a seminal article published in 2006, Jeanette Wing described computational thinking (CT) as a way of using fundamental concepts of computer science to solve problems, design new

systems, and understand human behavior. Computational technology is around us in a pervasive way that people do not realize how dependable they are on technology (Bundy, 2007). We use computers for watching TV, web browsing, word processing, playing games, etc. Computing has revolutionized research in all disciplines, both in sciences and the humanities. Take, for example, the areas of health, energy, biology, and social studies where state of the art computing projects are being built every year (America, 2001, p.13). Hence, it is not a surprise that the 21st century has been called "the Information Revolution" or "the Age of Digital Information". Consequently, some research suggest that by the middle of the 21st Century, computational thinking will be a crucial skill utilized by everyone in the world, just like writing, reading, and arithmetic. Therefore, computing professionals and educators have the responsibility to develop computation thinking in learners across all disciplines (Guzdial, 2008). As it was pointed out in the problem statement section, the best and fastest approach to learn and grasp the concepts of computational thinking is through programming (America, 2001). In this regard Grover and Pea (2013) also stated that programming is much more than a fundamental skill of CS or a key tool to foster the cognitive tasks involved in CT, but an evidence of computational proficiencies as well (p.40).

2.4 Python for novice programmers.

Python is a programming language named after a 1970s British television comedy sketch. This programming language is gaining an enormous popularity in colleges across the US. A recent article stated that Python has become the number one option to introduce U.S. students to programming and computer science, even surpassing Java (Jackson, 2014). Similarly, a research conducted by Guo (2014) showed that Python is currently the most popular language for instilling introductory CS courses at top-ranked U.S. departments. More specifically, eight of the top ten CS departments (80%), and twenty seven of the top thirty nine (69%), chose Python to teach introductory computer science courses. Figure 2.1 illustrates this result:

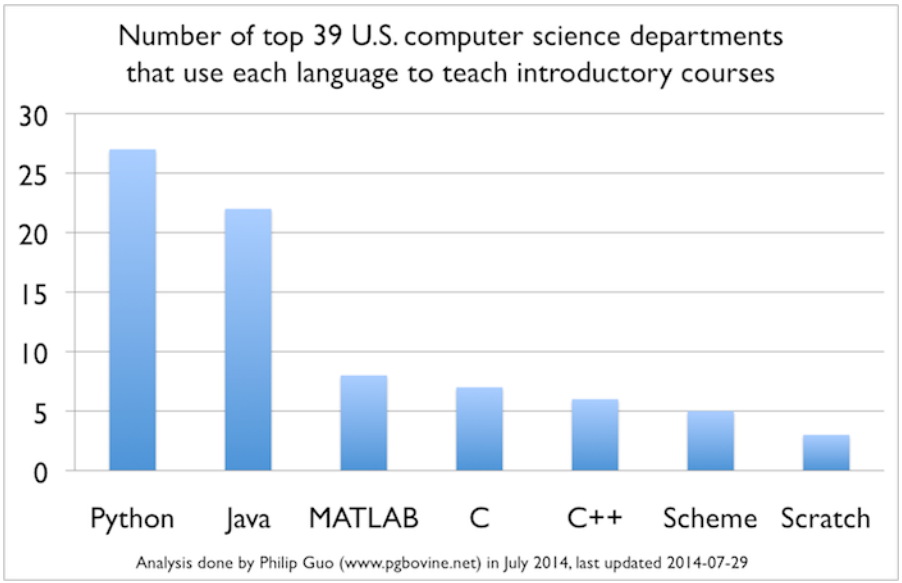

Figure 2.1 Programming Languages used in CS

Pears et al. (2007) stated that despite the popularity of languages such as Java, C and C++, there has been a great dispute regarding the suitability of these languages to introduce novice learners to programming. The research also points out that these languages have not been specifically tailored for educational purposes, as opposed to other languages that have been designed with this specific goal in mind (e.g., Python, Logo, Eiffel, and Pascal). The following code (Figure 2.2) shows an example of the difference between the complexity of Java and Python to print a simple "Hello World" message:

Java

```
class HelloWorld {
    public static void main (String[] args) {
        System.out.println("Hello World");
    }

}
```

Python

```
print "Hello World"
```

Figure 2.2 Syntax: Java vs Python

The Python syntax on the right side of Figure 2.2 is very close to the English language, so it is easier to understand and implement. Java, on the other hand, is more convoluted, hence more difficult to explain. When teaching programming skills to novices, instructors want to focus their efforts in teaching computing ideas such as Object Oriented Programming or computational thinking, rather than on implementation details. Additionally, the simplicity of the Python's syntax may encourage students to start writing programs almost immediately. These are the

characteristics that make Python as one of the optimal choices to introduce novice programmers in the realm of computational thinking.

2.5 Summary

This chapter reviewed some of the most relevant literature regarding the four specific areas of interest to this research, such as: MOOCs and their effects on the online learning community; computational thinking as a key skill of modern society; simplicity of Python which makes it the ideal computer programming language for novice programmers. Thus, this chapter provided the cardinal resources to elaborate a course of action that could be optimal to the requirement of this research study.

CHAPTER 3. THEORETICAL AND METHODOLOGICAL FRAMEWORKS

3.1 Theoretical Framework: Community of Inquiry

Needless to say, applying a robust instructional design model to evaluate the effectiveness of the learning experience, as it pertains to programming skills, is a crucial component of this research. For this main reason, the community of inquiry (CoI) framework constitutes an excellent candidate to achieve this purpose. The CoI framework has been used in hundreds of studies in online learning, hence it has been validated throughout multiple research studies (Garrison, Cleveland-Innes, & Fung, 2010). The CoI framework, as stated by Garrison, Anderson and Acher (2000), describes three types of particular presence or support to an educational experience (teaching, social and cognitive), and lays out ways for analyzing online discussions to evaluate contributions of each form of presence. The philosophical foundation of the CoI framework is collaborative constructivism. CoI is also theoretically grounded in the research on deep and meaningful approaches to learning (Garrison & Archer, 2000). Constructivism is a theory based on the premise that students actively engage in a learning activity by integrating new information, and on building knowledge and skills based on prior knowledge and experience rather than just passively absorbing what is

presented to them. Which is precisely what Jenkins (2002) states regarding learning programming

3.1.1 CoI elements

The Community of Inquiry (CoI) framework was first introduced in 2000 by Randy Garrison, Terry Anderson and Walter Archer. The philosophical foundation of this theoretical framework is a social constructivist nature that is grounded in John Dewey's notion of practical inquiry (Swan & Ice, 2010). According to John Dewey, an instructive experience must connect the interests of the individual and society, and the development of each individual was reliant on community (Swan, Garrison, & Richardson, 2009, p.1). Dewey also believed that in a collaborative environment, individuals are responsible to actively construct and confirm knowledge. The community of inquiry (CoI) framework and methodology has grown in its prominence and has been implemented in numerous research studies in the last decade.

The CoI framework identifies three core elements or components of a collaborative constructivist learning environment considered indispensable to create and sustain a purposeful learning community. These elements are the cognitive, social and teaching presence; and their overlap provides the structure to understand the dynamics of a deep and meaningful online learning experience" (Garrison, Cleveland-Innes, & Fung, 2010, p.2). Figure 3.1 shows these three elements and how they overlap to create a meaningful learning experience.

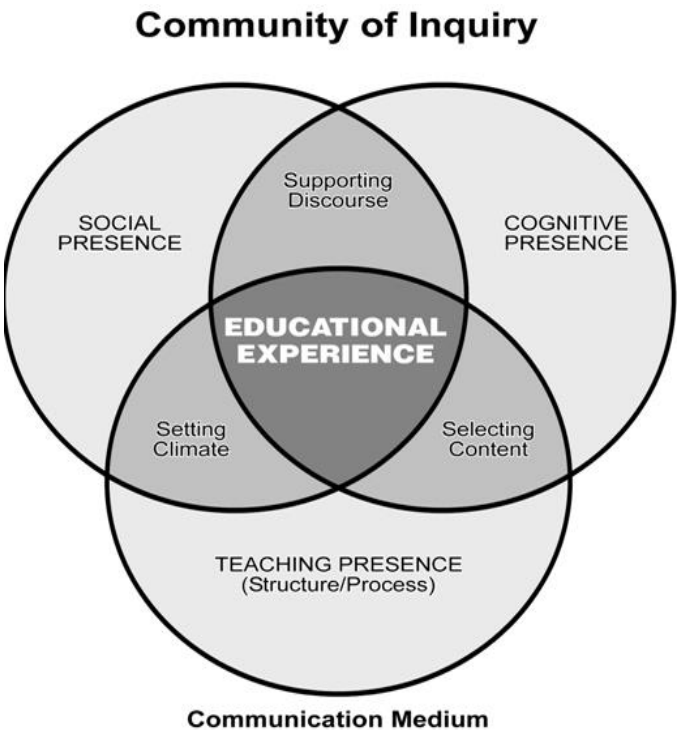

Figure 3.1 CoI Elements

3.1.2 Cognitive Presence

The CoI framework defines cognitive presence as the degree to which students are able to construct and confirm understanding through continued deliberation and dialogue (Swan, Garrison, & Richardson, 2009). In other words, learners in any given setting of a CoI environment are able to build knowledge through continued communication (Garrison, Anderson, & Archer, 1999). Garrison and Arbaugh (2007) stated that cognitive presence has been considered as an obvious characteristic of higher education, which is rooted in Dewey's construction of practical inquiry to promote critical thinking. Hence, the CoI framework describes cognitive presence as a four-phase process, which is grounded on Dewey's practical inquiry model (See figure

3.2). The four phases are described in the following lines. First, a triggering event where learners identify an issue that requires further inquiry. Second, an exploration process where the learners investigate or analyze the issue, both independently and as group through critical reflection and discourse. Third, an integration stage where learners build meaning from ideas developed throughout the exploration stage. During this process Garrison et al. (2001) recommends an active teaching presence in order to probe and identify ideas so learners will move to a higher level of thinking. Fourth and final, a resolution process where the learners apply the recently acquired knowledge to educational contexts or workplace settings.

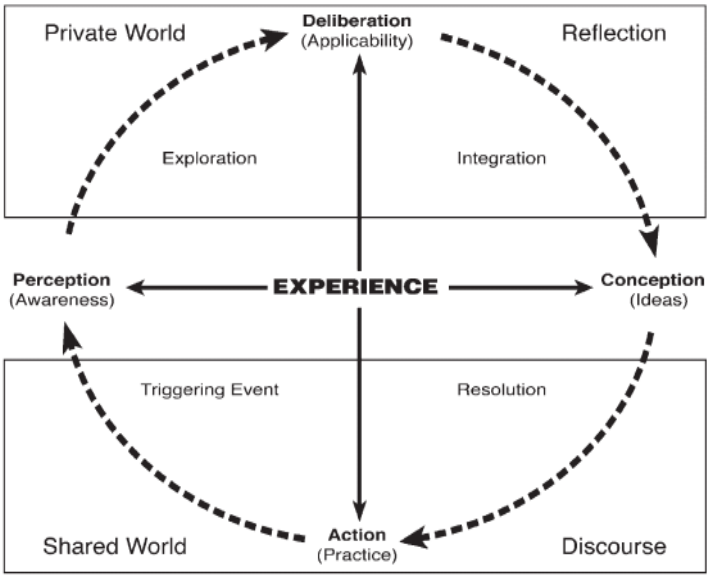

Figure 3.2 Events in a Practical Inquire Model

Garrison and Arbaugh (2007) pointed out that out of the three elements in CoI model, cognitive presence is the most challenging to study and implement in an e-

learning environment. They exposed a primary issue regarding cognitive presence and the progressive development of inquiry in an online learning environment. This issue reveals that learners have a great difficulty moving beyond the exploration phase of the practical inquiry model (Garrison et al., 2001). In this regard, Mayer (2003) found evidence of the relationship between the teaching presence element of the CoI Model and students' difficulty to move from the inquiry phase into the resolution phase of the practical inquiry model. More specifically, Mayer stated that instructors are completely accountable if their assignments do not contain the appropriate guidance. In a following study, Meyer (2004) explained that the triggering event of the online discussions directly affected the level of the replies from students.

A study conducted by Murphy (2004), based on online collaborative problem solving, demonstrated that by designing suitable tasks, learners do not encounter any difficulty in moving into the resolution phase of the inquiry model. "This speaks strongly to the purpose and design of the learning activity" (Garrison & Arbaugh, 2007, p.162). Based on the findings of Murphy (2004), Garrison and Arbauhg stated that if the nature of an activity or task is problem or case-based, participants in a community of inquiry would not have any problems iterating through the inquiry model circle.

In a similar note, Garrison and Arbaugh (2007) indicated that it is also feasible to foster and enhance critical thinking skills through the implementation of a variety of online course formats. A study conducted by Lee and Lee (2006) found that "student groups comprised of a variety of personalities may be more effective in developing

metacognitive interaction than do groups comprised of only extroverted or introverted learners" (Garrison & Arbaugh, 2007, p.162).

3.1.3 Social Presence

Social presence in an online learning environment has been explained as "the ability of learners to project themselves socially and emotionally, thereby being perceived as "real people" in mediated communication" (Garrison & Arbaugh, 2007, p.159). Social presence has been extensively studied, in both online and face-to-face course settings.

Research suggests a strong relationship between social presence and learning outcomes (Garrison & Arbaugh, 2007). This new research trend also indicates the development of a social presence in learners positively affects learners' satisfaction with the internet as a delivery medium for online education. In other words, successful collaborative activities can significantly increase learners' social presence, hence building a solid online community. This could potentially improve the social-emotional climate in online courses. Other research provides evidence that a significant degree of social presence could directly influence the development of cognitive presence in learners. Fabro and Garrison (1998) found social presence to be the cornerstone to create a critical community of learners.

Brown (2001) identified three stages that are necessary to cultivate a sense of belonging to a community. According to Brown, in the first stage, emotional expression, the online acquaintances were made. During the second stage, open communication, the participants start feeling a sense of community due to the thoughtful exchange of ideas. In the last stage, group cohesion, the participants start using humorous banter, teasing, and joking. These activities dissolve some of the differences among group members in a social environment (Eggins & Slade, 1997).

Sui Fai et al. (2010) affirmed that it is possible to provide a sense of social presence in MOOC through the implementation of blogs and forums. Sui Fai stated that blogs leverage participants' experience, so learners can use the blogs as a medium to communicate, self-express, self-indulge, and to critically distribute information. In the same way, forums "have been identified as an essential ingredient of an effective online course, providing the bulk of asynchronous communication and instructional interaction" (p.276). Anderson and Kanuka (1997) stated that forums are a great opportunity to enhance social networking and increase the collaboration and consultation with other professionals, hence promoting cognitive presence in a CoI environment.

3.1.4 Teaching Presence

Garrison et al. (2000) affirmed that although social and content-related activities among learners play an important role in e-learning environments, they are not enough to guarantee effective online learning. Garrison and Arbaugh (2007) described teaching

presence as the “design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes” (p.166). The teaching presence element is contextualized in the following three components: (1) instructional design and organization, (2) facilitating discourse, and (3) direct instruction.

The teaching presence element entitles the teacher with two general functions that could also be performed by any one of the participants in a Community of Inquiry environment; however, in education, these responsibilities are generally assigned to teachers. One function is the design of the educational experience, which includes the selection, organization, and primary presentation of course content, as well as the design and development of learning activities and assessment. In order to guarantee that the course design is in sync with the learning outcomes, it is recommended that an instructional designer should be consulted or made responsible for the designing stage of the course. The second function, facilitation, is a responsibility that may be shared among the teacher, teacher assistant, or other participants. Sharing the facilitation function is keen to instructors in an online learning environment where the number of students is too high. “The teaching presence in CoI model is a means to an end to support and enhance social and cognitive presence for the purpose of realizing education outcomes” (Garrison, Anderson, & Archer, 1999, p.90).

3.1.5 Summary

This chapter provided a description of the Community of Inquiry framework as well as the three main presences or elements that are required to implement it successfully. Table 3.1 illustrates these components and describes the characteristics and indicators of each element or presence.

Table 3.1. Elements of the Community of Inquiry Framework

ELEMENTS	**CATEGORIES**	**INDICATORS** (examples only)
Social Presence	Open Communication	Risk-free expression
	Group Cohesion	Encourage collaboration
	Affective Expression	Emotions
Cognitive Presence	Triggering Event	Sense of puzzlement
	Exploration	Information exchange
	Integration	Connecting ideas
	Resolution	Apply new ideas
Teaching Presence	Design & Organization	Setting curriculum & methods
	Facilitating Discourse	Sharing personal meaning
	Direct Instruction	Focusing discussion

3.2 Methodological Framework: Case Study

The second phase of this study used a case study approach as the research method to address or answer the second research question. It is believed that the case study method was firstly introduced around 1829, when Frederic Le Play presented his

studies of family budgets ("Case study," 2015). Since then, case studies have been exploited to develop or create new theory in social sciences, such as is the case of Barney Glaser and Anselm Strauss who unveiled their research method, Grounded theory, in late 1960s.

Case studies have been used in wide variety of topics such as a phenomena, persons, events, projects, institutions, etc. The analysis of these cases is normally delimited by a sustained period of time where researchers gather significant data about a specific subject or case. The case study is also described as a research strategy, which can be based on either a single or multiple cases. Although case studies are qualitative in nature, they can include quantitative evidence as part of the data analysis process, described in a research study (Eisenhardt, 1989). For example, single-subject research defines a statistical framework to analyze quantitative data. In this remark, Lamnek (2005) explained case studies as a research method, located between the techniques of gathering concrete data and methodological paradigms. These characteristics of a case study research method make this methodological framework an excellent candidate to explore and analyze the second research question of this study.

CHAPTER 4. METHODOLOGY

The goal of this chapter is to document the procedures used in this two-steps descriptive research study aimed at: identifying affordances of MOOC's platforms that are best suited to design basic programming skills courses based on the CoI framework; and using the CoI framework to describe instructional strategies implemented by different introductory programming skills MOOCs. These two goals are achieved in two phases. The first phase focuses on answering the first question of this research and implements a quantitative method for data collection and analysis. The second phase targets the second question of this study by implementing a qualitative approach to gather and analyze the data from six different case studies.

In summary, this chapter provides an overview of the research questions, design of the study, sampling methods, data collection, procedures, and data analysis methods implemented in each phase of this research study.

4.1 Research Team

This project was led by a graduate student in the Computer and Information Technology program and advised by a committee of three Faculty members. The Computer and Information Technology program is offered by a large University located in the Midwest of the United States for which all members of the committee serve as Faculty.

The research team was composed of three members: A subject matter expert (SME), a female faculty member in the Department of Curriculum and Instruction, who has extensive experience conducting research on the CoI framework and is one of the developers of the CoI survey. The other two members were expert evaluators, one of which was an external expert evaluator and the other was the leader of this research project. The external expert is a female adjunct faculty member in the Department of Curriculum and Instruction with expertise in learning design, online course development, and software engineering. The other evaluator is a graduate student in the Computer and Information Technology department, and author of this thesis work.

4.2 Study Design

The study presented in this thesis is a two-phase research method with one phase being quantitative and the other one being qualitative. The quantitative phase of this thesis consists of a comparative analysis of the affordances in MOOC's platforms based on the CoI model. The qualitative phase applies a descriptive multi-

case study design approach to describe how CoI framework-based instructional strategies are being used in six basic programming MOOCs using Python as the programming language.

4.3 Phase I: Evaluation of MOOC's platforms

This phase answers the first question of this research study:

- What affordances of MOOC's platforms are best suited to design/implement basic programming skills courses based on the community of inquiry (CoI) framework?

4.3.1 Sampling Method

To answer the first question, a dataset of fifteen MOOC's platforms were chosen among the most popular platforms in the current eLearning ecosystem. The criteria used to make this selection was based on the number of enrolled students and the number of courses in the computer science (CS) field offered by these platforms. It is important to point out that the number of CS courses offered by these platforms has higher weight than the number of enrolled students. Table 4.1 illustrates the most popular MOOC's platforms or providers based on the total number of Computer Science courses. This table also shows an approximation of the total number of enrolled students in each platform.

Table 4.1. MOOC's Platforms vs No. CS Courses

No	MOOC's Platforms	CS Courses	Total enrollees
1	Coursera	145	11.8 million
2	EdX	48	2.3 million
3	Udacity	46	1.6 million
4	Udemy	23	5 million
5	Alison	13	400,000
6	openHPI	12	13,000
7	Stanford OpenEdx	5	275,000
8	CourseSites	5	200,000
9	iversity	4	500,000
10	FutureLearn	4	370,000
11	Canvas.net	4	4.5 million
12	Janux	3	31,000
13	OpenLearning	2	125,000
14	Open2Study	2	320,000
15	NovoED	1	100,000

4.3.2 Data Collection

The design principles from the CoI model were drawn from the theoretical framework chapter of this research and by conducting a detailed analysis of the three elements that are essential to an educational experience (Garrison, Anderson, & Archer, 1999): social presence, cognitive presence and teaching presence. Similarly, MOOCs are divided into three important and distinctive areas (Brown, 2014): (1) the pedagogical method, which consists in lectures from professors at accredited universities worldwide (Teaching presence); (2) the scaffolding of students' tasks based on assignments, assessments solutions, and grading (Cognitive presence); and (3) the social interaction to foster and support students' engagement to the course; which is generally accomplished via online discussion forums and social media (Social presence). Given the structural similarities between the CoI model and MOOCs' components, this research used a CoI framework-based rubric as a data collection instrument to evaluate the MOOC's platform affordances. Specifically, items from the rubric consisted on a modified version of the items in the CoI survey instrument (see Table 4.2). The Appendix shows the modified version of the CoI survey instrument that was used to collect the data from different fifteen MOOC's platforms.

Table 4.2. Community of Inquiry Survey Instrument (draft v14)

Teaching Presence
Design & Organization
1. The instructor clearly communicated important course topics.
2. The instructor clearly communicated important course goals.
3. The instructor provided clear instructions on how to participate in course learning activities.
4. The instructor clearly communicated important due dates/time frames for learning activities.
Facilitation
5. The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.
6. The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.
7. The instructor helped to keep course participants engaged and participating in productive dialogue.
8. The instructor helped keep the course participants on task in a way that helped me to learn.
9. The instructor encouraged course participants to explore new concepts in this course.

Table 4.2. Community of Inquiry Survey Instrument (draft v14) (Continued)

Teaching Presence
10. Instructor actions reinforced the development of a sense of community among course participants.
Direct Instruction
11. The instructor helped to focus discussion on relevant issues in a way that helped me to learn.
12. The instructor provided feedback that helped me understand my strengths and weaknesses.
13. The instructor provided feedback in a timely fashion.
Social Presence
Affective expression
14. Getting to know other course participants gave me a sense of belonging in the course.
15. I was able to form distinct impressions of some course participants.
16. Online or web-based communication is an excellent medium for social interaction.
Open communication
17. I felt comfortable conversing through the online medium.
18. I felt comfortable participating in the course discussions.
19. I felt comfortable interacting with other course participants.

Table 4.2. Community of Inquiry Survey Instrument (draft v14) (Continued)

Social Presence
Group cohesion
20. I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.
21. I felt that my point of view was acknowledged by other course participants.
22. Online discussions help me to develop a sense of collaboration.
Cognitive Presence
Triggering event
23. Problems posed increased my interest in course issues.
24. Course activities piqued my curiosity.
25. I felt motivated to explore content related questions.
Exploration
26. I utilized a variety of information sources to explore problems posed in this course.
27. Brainstorming and finding relevant information helped me resolve content related questions.
28. Online discussions were valuable in helping me appreciate different perspectives.

Table 4.2. Community of Inquiry Survey Instrument (draft v14) (Continued)

Cognitive Presence
Integration
29. Combining new information helped me answer questions raised in course activities.
30. Learning activities helped me construct explanations/solutions.
31. Reflection on course content and discussions helped me understand fundamental concepts in this class.
Resolution
32. I can describe ways to test and apply the knowledge created in this course.
33. I have developed solutions to course problems that can be applied in practice.
34. I can apply the knowledge created in this course to my work or other non-class related activities.

4.3.2.1 Validity and Reliability of the Rubric

This CoI survey instrument was psychometrically validated and created by the collaborative research team. The members of the team are Ben Arbaugh, Marti Cleveland-Innes, Sebastian Diaz, D. Randy Garrison, Phil Ice, Jennifer Richardson, Peter Shea and Karen Swan. A modified version of this survey instrument was used to create the rubric that helped to address the first question of this study. The content of this rubric was validated by one of the authors of the CoI survey instrument, who served as the SME in this study. The SME recommended replacing the bullet points of each CoI element category with check boxes. These changes

helped the evaluator to clearly identify which category was being afforded by each MOOC's platform.

The rubric was used to evaluate the fifteen MOOC's platforms. The rubric criteria asked the expert evaluators (EEs) to rate the level to which they perceived that affordances of each MOOC's platform supported or failed to support each criterion. All items were written using a positive question statement.

A reliability analysis was performed to ensure that the ratings of all MOOCs' platforms were consistent. For this purpose, only a third of the fifteen MOOC's platforms were evaluated by one of the EEs, while the second EE evaluated all fifteen platforms. Reliability coefficients were estimated using the Spearman correlation procedure.

4.3.3 Procedures

The evaluation process of the fifteen MOOC's platforms was conducted by two expert evaluators (EE). Convenience sampling was used to select the EEs. This sampling method was chosen due to easy access to and availability of qualified experts.

Upon the creation and content validation of the data collection instrument by the SME, the EEs were contacted through email. The email contained information about the purpose of the study and instructions to participate in the research. All the EEs were given a period of two weeks to complete and return their rubrics.

The data collection instrument was designed using an online survey system (Qualtrics), which facilitated the automatic data collection, analysis and reporting. The survey system generated a link for each MOOC's platform. These links were provided in the instructions file sent to the EEs to facilitate their easy access to the data collection instrument.

4.3.4 Data Analysis Method

Data was automatically received and analyzed by a survey system (Qualtrics) using measures of central tendency (Mean and standard deviation). Means and standard deviations were calculated for and grouped by each element of the CoI framework across MOOC's platforms. The rubric consisted of a categorical Likert-type scale (5-1) where the number "5" represented the highest level of agreement (strongly agree) and the number "1" the lowest (strongly disagree). The rubric also included a comment box where the specific affordances supporting the CoI elements were listed. The total mean scores for the CoI elements supported by the affordances of each MOOC's platform were compared among platforms. More specifically, CoI elements with a total mean score between 5.0 and 3.7 were perceived to be strongly aligned with the affordances supported by the platform. CoI elements total mean scores between 3.6 and 2.4 were perceived as somewhat aligned. Finally, total mean scores between 2.3 and 1.0 were perceived as poorly aligned. The three MOOC's platforms with the highest total mean score and

availability of basic programming skills MOOCs using Python were selected for study in the second phase of this research.

4.4 Phase II: Programming courses evaluation

This phase answers the second question of this research study:

How CoI framework-based instructional strategies are currently used in a set of six basic programming skills MOOCs using Python?

4.4.1 Sampling Method

The second question of this research was addressed by using a data set of six MOOCs in introductory programming using Python as the computer programming language. A sample size of six cases was significant to provide details of how a MOOC platform could implement the CoI framework instructional design principles. In addition, to ensure an equal distribution of MOOCs across all three platforms, only two of the most popular MOOCs were selected from each platform. The popularity of each MOOC was based on the following criteria: highest number of students enrolled in the MOOC; the target audience being novice programmers; and the course has been offered at least twice within the last three years.

4.4.2 Data Collection

The role of the researcher as a data collection instrument allowed me to implement a descriptive approach that leveraged a methodology similar to an

ethnography, to document how instructional strategies, used to design basic programming skills MOOCs are aligned to the CoI framework principles. Individual case descriptions were structured following the three components of the CoI framework and described how items from the CoI survey instrument were implemented by the six MOOCs.

4.4.3 Procedures

Upon selecting the six MOOCs, the researcher enrolled in each of the courses and audited them. As an observer of these MOOCs, the researcher wrote a description of how well the course elements met or failed to meet the CoI framework design principles. Additionally, this researcher documented the quality of the social interaction among participants to identify teaching, cognitive and social presences in these MOOCs. Following the structure of the CoI survey instrument, the researcher created categories and subcategories addressing each element of the CoI framework.

4.4.4 Data Analysis

The qualitative data in this research was analyzed using a comparative multi-case method. In other words, descriptions from each case were categorized based on the three major components of the CoI framework: teaching, cognitive and social presences. A matrix design tool, created in spreadsheet, was leveraged to facilitate the comparison and identification of patterns across categories. The patterns were

classified into strengths and weaknesses shared by the courses in addressing the CoI design principles. Each course was first analyzed individually, and findings from the six courses were then cross-compared to identify patterns of similarities and differences. These descriptions provided a rich profile of how the six MOOC's implemented principles associated with the CoI framework.

4.5 Summary

In conclusion, this chapter provided an overview of the research questions, design of the study, sampling methods, data collection, procedures, and data analysis methods implemented in each phase of this research study.

CHAPTER 5. RESULTS

Following the methodology chapter layout of this thesis, this section was divided into two phases in order to address each research question separately.

5.1 Phase I: Evaluation of affordances - MOOC's platforms

The purpose of the first phase of this study was to assess the fit of the affordances used to develop basic programming skill MOOCs, with the CoI framework design principles. The table 4.1 described in chapter four lists all 15 MOOC's platforms that were evaluated throughout this chapter. The table also illustrates the number of CS courses and number of enrolled students in each platform. Similarly, as it was described in the data analysis of this phase, the mean scores and standard deviation were calculated to measure the level of alignment between the affordances supported by each MOOC's platform and the CoI framework.

Reliability coefficients were calculated using the Spearman correlation procedure to determine the consistency of ratings between the two EEs for a 33% of the fifteen MOOC's platforms. As shown in Table 5.1, coefficients were above 80% which represents a strong correlation between evaluators' ratings.

Table 5.1. Platforms vs IRR

Inter-rater Reliability (IRR) Results	
Platform	Spearman Correlation Coefficient
Coursera	0.82
edX	0.87
Udacity	0.82
Udemy	0.85
Stanford OpenedX	0.82

5.1.1 MOOC's platform: Coursera

Mean scores obtained for teaching (M=4.3) and cognitive (M=4.8) presence were higher than social (M=3.0) presence of the CoI framework in Coursera. This means that the affordances used by this platform to support social presence in basic programming skill courses were only somewhat aligned to the categories within this element of the CoI framework. As shown in Table 5.2, specific affordances strongly aligned with teaching presence included: videos, page comments, discussion forums and course overview pages. In regards to cognitive presence, strongly aligned affordances were the following: quizzes, assignments, discussion forums and file management.

Table 5.2 MOOC's Platform affordances and CoI Alignment: Coursera

ALIGNMENT	ELEMENTS	CATEGORIES	AFFORDANCES
STRONG	Teaching Presence (M=4.3, SD=1.2)	Design & Organization	Course overview pages Panel or Blogs Calendars Videos
		Facilitation	Discussion Forums Course Comments Videos
		Direct Instruction	Discussion Forums Course Comments Videos
SOMEWHAT	Social Presence (M=3.0,SD=1.0)	Affective Expression	Discussion Forums Course Comments
		Open Communication	Discussion Forums Course Comments
		Group Cohesion	Peer Evaluation Upvote/Downvote posts
STRONG	Cognitive Presence (M=4.8,SD=0.5)	Triggering Event	Quizzes Assignments
		Exploration	Discussion Forums File management Assignments Quizzes
		Integration	File management Discussion Forums
		Resolution	Assignments

5.1.2 MOOC's platform: Edx

The mean scores obtained for teaching, social and cognitive presences were 4.7, 4.0 and 3.8 respectively. Hence, all three elements of the CoI framework were strongly aligned with the affordances provided by Edx. As shown in Table 5.3, specific affordances strongly aligned with teaching presence included: videos, page comments, discussion forums, calendars and course overview pages. The strongly aligned affordances for the social presence were the following: Face-to-Face meetups, discussion forums, customized profiles and course comments. In regards to cognitive presence, strongly aligned affordances were the following: quizzes, assignments, discussion forums and file management.

Table 5.3. MOOC's Platform affordances and CoI Alignment: Edx

ALIGNMENT	ELEMENTS	CATEGORIES	AFFORDANCES
STRONG	Teaching Presence (M=4.7, SD=0.6)	Design & Organization	Course overview pages Videos Calendars Discussion Forums
		Facilitation	Discussion Forums Course Comments
		Direct Instruction	Course Comments Videos
STRONG	Social Presence (M=4.0, SD=0.0)	Affective Expression	Discussion Forums Chat rooms Face-to-Face Meetup Customized Profile Course Comments
		Open Communication	Discussion Forums Course Comments
		Group Cohesion	Course Comments
STRONG	Cognitive Presence (M=3.8, SD=0.5)	Triggering Event	Quizzes Assignments Course Comments
		Exploration	Assignments Quizzes File management Discussion Forums
		Integration	File management Discussion Forums
		Resolution	Assignments

5.1.3 MOOC's platform: Udacity

The mean scores obtained for teaching, social and cognitive presences were the same 4.0. Hence, all three elements of the CoI framework were strongly aligned with the affordances provided by Udacity. As shown in Table 5.4, specific affordances strongly aligned with teaching presence included: videos, page comments, discussion forums and course overview pages. The strongly aligned affordances for the social presence were the following: Face-to-Face meetups, discussion forums, customized profiles and course comments. In regards to cognitive presence, strongly aligned affordances were the following: quizzes, assignments, discussion forums and file management.

Table 5.4. MOOC's Platform affordances and CoI Alignment: Udacity

ALIGNMENT	ELEMENTS	CATEGORIES	AFFORDANCES
STRONG	Teaching Presence (M=4.0, SD=1.7)	Design & Organization	Videos Course overview pages
		Facilitation	Discussion Forums Quizzes Course Comments
		Direct Instruction	Course Comments Videos
STRONG	Social Presence (M=4.0, SD=0.0)	Affective Expression	Discussion Forums Profile (Gravatars) Course Comments
		Open Communication	Discussion Forums Course Comments
		Group Cohesion	Study Group (Hangout) Upvoted and downvote Icons Course Comments
STRONG	Cognitive Presence (M=4.0, SD=0.0)	Triggering Event	Videos Quizzes Assignments
		Exploration	Discussion Forums wiki Quizzes
		Integration	Coaches Online office hours Discussion Forums
		Resolution	Assignments

5.1.4 MOOC's platform: Udemy

The mean scores obtained for teaching, social and cognitive presences were 3.3, 2.3 and 1.8. Hence, all three elements of the CoI framework were somewhat or poorly aligned with the affordances provided by Udemy. As shown in Table 5.5, videos and discussion forums were not enough to leverage an alignment between affordances and CoI framework elements.

Table 5.5. MOOC's Platform affordances and CoI Alignment: Udemy

ALIGNMENT	ELEMENTS	CATEGORIES	AFFORDANCES
SOMEWHAT	Teaching Presence (M=3.3, SD=1.5)	Design & Organization	Videos Course overview pages
		Facilitation	Course Comments
		Direct Instruction	Announcements Course Comments
POORLY	Social Presence (M=2.3, SD=0.6)	Affective Expression	Discussion Forums Course Comments
		Open Communication	Course Comments
		Group Cohesion	Course Comments
POORLY	Cognitive Presence (M=1.8, SD=0.5)	Triggering Event	Videos
		Exploration	Course Comments
		Integration	Course Comments
		Resolution	

5.1.5 MOOC's platform: Alison

The mean scores obtained for teaching, social and cognitive presences were 3.0, 2.7 and 2.8. Hence, all three elements of the CoI framework were somewhat aligned with the affordances provided by Alison. As shown in Table 5.6, videos and discussion forums were not enough to leverage an alignment between affordances and CoI framework elements.

Table 5.6. MOOC's Platform affordances and CoI Alignment: Alison

ALIGNMENT	ELEMENTS	CATEGORIES	AFFORDANCES
SOMEWHAT	Teaching Presence (M=3.0, SD=1.0)	Design & Organization	Videos Course overview pages
		Facilitation	Videos Course Comments Discussion Forums
		Direct Instruction	Course Comments Discussion Forums
SOMEWHAT	Social Presence (M=2.7, SD=0.6)	Affective Expression	Course Comments
		Open Communication	Course Comments
		Group Cohesion	Discussion Forums Course Comments
SOMEWHAT	Cognitive Presence (M=2.8, SD=0.5)	Triggering Event	Videos
		Exploration	Course overview pages
		Integration	Discussion Forums
		Resolution	

5.1.6 MOOC's platform: OpenHPI

Mean scores obtained for teaching (M=3.7) and cognitive (M=4.0) presence were higher than social (M=3.0) presence of the CoI framework in OpenHPI. This means that the affordances used by this platform to support social presence in basic programming skill courses were only somewhat aligned to the categories within this element of the CoI framework. As show in Table 5.7, specific affordances strongly aligned with teaching presence included: videos, page comments, discussion forums and course overview pages. In regards to cognitive presence, strongly aligned affordances were the following: quizzes, assignments, discussion forums and file management.

Table 5.7. MOOC's Platform affordances and CoI Alignment: OpenHPI

ALIGNMENT	ELEMENTS	CATEGORIES	AFFORDANCES
STRONG	Teaching Presence (M=3.7, SD=0.6)	Design & Organization	Course overview pages Discussion Forums Calendar Videos
		Facilitation	Discussion Forums Videos Course Comments
		Direct Instruction	Quizzes Discussion Forums Videos
SOMEWHAT	Social Presence (M=3.0, SD=0.0)	Affective Expression	Discussion Forums Course Comments
		Open Communication	Discussion Forums Course Comments
		Group Cohesion	Discussion Forums Course Comments
STRONG	Cognitive Presence (M=4.0, SD=1.2)	Triggering Event	Quizzes Assignments
		Exploration	Course Comments File management Quizzes
		Integration	File management Discussion Forums
		Resolution	Assignments

5.1.7 MOOC's platform: Stanford OpenEdx

The mean scores obtained for teaching, social and cognitive presences were 4.3, 4.0 and 3.8 respectively. Hence, all three elements of the CoI framework were strongly aligned with the affordances provided by Standford OpenEdx. As shown in Table 5.8, specific affordances strongly aligned with teaching presence included: videos, page comments, discussion forums, calendars and course overview pages. The strongly aligned affordances for the social presence were the following: discussion forums, customized profiles and course comments. In regards to cognitive presence, strongly aligned affordances were the following: quizzes, assignments, discussion forums and file management.

Table 5.8. MOOC's Platform affordances and CoI Alignment: Stanford Openedx

ALIGNMENT	ELEMENTS	CATEGORIES	AFFORDANCES
STRONG	Teaching Presence (M=4.3, SD=0.6)	Design & Organization	Course overview pages Videos
		Facilitation	Discussion Forums Videos Course Comments
		Direct Instruction	Emails Course Comments Videos
STRONG	Social Presence (M=4.0, SD=0.0)	Affective Expression	Discussion Forums Chat rooms Customized Profile Course Comments
		Open Communication	Discussion Forums Emails Course Comments
		Group Cohesion	Course Comments
STRONG	Cognitive Presence (M=3.8, SD=0.5)	Triggering Event	Quizzes Assignments
		Exploration	Assignments Quizzes
		Integration	File management Discussion Forums
		Resolution	Assignments

5.1.8 MOOC's platform: CourseSites

Mean scores obtained for social and cognitive presences were 4.0, which were slightly higher than the teaching presence (M=3.3) of the CoI framework in CourseSites. This means that the affordances used by this platform to support teaching presence in basic programming skill courses were only somewhat aligned to the categories within this element of the CoI framework. As shown in Table 5.9, specific affordances strongly aligned with social presence included: discussion forums, profiles, course comments, emails, and course overview pages. In regards to cognitive presence, strongly aligned affordances were the following: quizzes, assignments, BBC Learn, discussion forums, and file management.

Table 5.9. MOOC's Platform affordances and CoI Alignment: CourseSites

ALIGNMENT	ELEMENTS	CATEGORIES	AFFORDANCES
SOMEWHAT	Teaching Presence (M=3.3, SD=0.5)	Design & Organization	Course overview pages Discussion Forums Calendars
		Facilitation	Course Comments Videos
		Direct Instruction	Videos Audio
STRONG	Social Presence (M=4.0, SD=1.0)	Affective Expression	Discussion Forums Profiles Course Comments
		Open Communication	Discussion Forums Course Comments
		Group Cohesion	Discussion Forums Course Comments Emails
STRONG	Cognitive Presence (M=4.0, SD=0.0)	Triggering Event	Quizzes Assignments
		Exploration	Course Comments NBC Learn Quizzes
		Integration	File management Discussion Forums
		Resolution	Assignments

5.1.9 MOOC's platform: Iversity

Mean scores obtained for teaching and social presences were 4.0 and 3.7 respectively, which were slightly higher than the cognitive presence (M=3.5) of the CoI framework in Iversity. This means that the affordances used by this platform to support cognitive presence in basic programming skill courses were only somewhat aligned to the categories within this element of the CoI framework. As shown in Table 5.10, specific affordances strongly aligned with teaching presence included: discussion forums, profiles, course comments, emails, and course overview pages. In regards to cognitive presence, strongly aligned affordances were the following: quizzes, assignments, BBC Learn, discussion forums, and file management.

Table 5.10. MOOC's Platform affordances and CoI Alignment: Iversity

ALIGNMENT	ELEMENTS	CATEGORIES	AFFORDANCES
STRONG	Teaching Presence (M=4.0, SD=0.0)	Design & Organization	Discussion Forums Course overview pages Videos
		Facilitation	Discussion Forums Course Comments
		Direct Instruction	Quizzes Discussion Forums Videos
STRONG	Social Presence (M=3.7, SD=0.6)	Affective Expression	Discussion Forums Profiles Course Comments
		Open Communication	Discussion Forums Meetups Course Comments
		Group Cohesion	Meetups Discussion Forums Course Comments
SOMEWHAT	Cognitive Presence (M=3.5, SD=1.0)	Triggering Event	Quizzes Course Comments
		Exploration	Course Comments Quizzes
		Integration	File managements Discussion Forums
		Resolution	

5.1.10 MOOC's platform: Futurelearn

The mean scores obtained for teaching, social and cognitive presences were 3.3, 2.7 and 2.0. Hence, all three elements of the CoI framework were somewhat and poorly aligned with the affordances provided by Futurelearn. As shown in Table 5.11, videos and discussion forums were not enough to leverage an alignment between affordances and CoI framework elements.

Table 5.11. MOOC's Platform affordances and CoI Alignment: Futurelearn

ALIGNMENT	ELEMENTS	CATEGORIES	AFFORDANCES
SOMEWHAT	Teaching Presence (M=3.3, SD=1.5)	Design & Organization	Videos Course overview pages
		Facilitation	Videos
		Direct Instruction	Discussion Forums Videos
SOMEWHAT	Social Presence (M=2.7, SD=0.6)	Affective Expression	Discussion Forums
		Open Communication	Discussion Forums
		Group Cohesion	Discussion Forums
POORLY	Cognitive Presence (M=2.0, SD=0.8)	Triggering Event	Videos
		Exploration	Course overview pages
		Integration	Discussion Forums
		Resolution	

5.1.11 MOOC's platform: Canvas.net

The mean scores obtained for teaching, social and cognitive presences were 3.3, 2.7 and 3.0. Hence, all three elements of the CoI framework were somewhat aligned with the affordances provided by Canvas.net. As shown in Table 5.12, videos and discussion forums were not enough to leverage an alignment between affordances and CoI framework elements.

Table 5.12. MOOC's Platform affordances and CoI Alignment: Canvas.net

ALIGNMENT	ELEMENTS	CATEGORIES	AFFORDANCES
SOMEWHAT	Teaching Presence (M=3.3, SD=1.5)	Design & Organization	Discussion Forums Calendar Video Course overview pages
		Facilitation	Course Comments Video
		Direct Instruction	Video
SOMEWHAT	Social Presence (M=2.7, SD=0.6)	Affective Expression	Emails Profile Discussion Forums Course Comments
		Open Communication	Discussion Forums Chat rooms
		Group Cohesion	Discussion Forums Course Comments
SOMEWHAT	Cognitive Presence (M=3.0, SD=0.8)	Triggering Event	Quizzes
		Exploration	Discussion Forums File management
		Integration	Chat rooms Discussion Forums
		Resolution	

5.1.12 MOOC's platform: Janux

The mean scores obtained for teaching, social and cognitive presences were 3.3, 3.3 and 3.0. Hence, all three elements of the CoI framework were somewhat and poorly aligned with the affordances provided by Janux. As shown in Table 5.13, videos and discussion forums were not enough to leverage an alignment between affordances and CoI framework elements.

Table 5.13. MOOC's Platform affordances and CoI Alignment: Janux

ALIGNMENT	ELEMENTS	CATEGORIES	AFFORDANCES
SOMEWHAT	Teaching Presence (M=3.3, SD=1.5)	Design & Organization	Video Course overview pages
		Facilitation	Discussion Forums Email
		Direct Instruction	Discussion Forums Email
SOMEWHAT	Social Presence (M=3.3, SD=0.6)	Affective Expression	Discussion Forums Course Comments
		Open Communication	Discussion Forums
		Group Cohesion	Discussion Forums Course Comments
SOMEWHAT	Cognitive Presence (M=3.0, SD=0.8)	Triggering Event	Video Assignments
		Exploration	Video
		Integration	Discussion Forums
		Resolution	Assignments

5.1.13 MOOC's platform: Openlearning

The mean score obtained for teaching presence was 3.7, which was slightly higher than the social (M=3.3) and cognitive presence (M=3.0) of the CoI framework in Openlearning. This means that the affordances used by this platform to support social and cognitive presence in basic programming skill courses were only somewhat aligned to the categories within this element of the CoI framework. As shown in Table 5.14, specific affordances strongly aligned with teaching presence included: video, course overview pages, course comments and chat rooms.

Table 5.14. MOOC's Platform affordances and CoI Alignment: Openlearning

ALIGNMENT	ELEMENTS	CATEGORIES	AFFORDANCES
STRONG	Teaching Presence (M=3.7, SD=1.2)	Design & Organization	Videos Course overview pages
		Facilitation	Videos Course Comments Chat Rooms
		Direct Instruction	Course Comments Chat Rooms
SOMEWHAT	Social Presence (M=3.3, SD=0.6)	Affective Expression	Course Comments Chat Rooms
		Open Communication	Course Comments Chat Rooms
		Group Cohesion	Chat Rooms Course Comments
SOMEWHAT	Cognitive Presence (M=3.0, SD=0.8)	Triggering Event	Videos Course Comments
		Exploration	File management
		Integration	Course Comments
		Resolution	Assignments

5.1.14 MOOC's platform: Open2Study

The mean score obtained for teaching presence was 3.7, which was slightly higher than the social (M=2.7) and cognitive presence (M=3.5) of the CoI framework in Open2Study. This means that the affordances used by this platform to support social and cognitive presence in basic programming skill courses were only somewhat aligned to the categories within this element of the CoI framework. As shown in Table 5.15, specific affordances strongly aligned with teaching presence included: course overview pages, video, course comments and emails.

Table 5.15. MOOC's Platform affordances and CoI Alignment: Open2Study

ALIGNMENT	ELEMENTS	CATEGORIES	AFFORDANCES
STRONG	Teaching Presence (M=3.7, SD=1.2)	Design & Organization	Course overview pages Videos
		Facilitation	Videos Course Comments Emails
		Direct Instruction	Course Comments Emails
SOMEWHAT	Social Presence (M=2.7, SD=0.6)	Affective Expression	Course Comments Emails
		Open Communication	Course Comments
		Group Cohesion	Course Comments
SOMEWHAT	Cognitive Presence (M=3.5, SD=1.0)	Triggering Event	Videos Course Comments
		Exploration	File management
		Integration	Chat Rooms Course Comments
		Resolution	Assignments

5.1.15 MOOC's platform: NovoED

The mean scores obtained for teaching, social and cognitive presences were 3.0, 3.3 and 3.0. Hence, all three elements of the CoI framework were somewhat and poorly aligned with the affordances provided by NovoED. As shown in Table 5.16, videos and discussion forums were not enough to leverage an alignment between affordances and CoI framework elements.

Table 5.16. MOOC's Platform affordances and CoI Alignment: NovoED

ALIGNMENT	ELEMENTS	CATEGORIES	AFFORDANCES
POORLY	Teaching Presence (M=3.0, SD=0.0)	Design & Organization	Course overview pages Videos
		Facilitation	Course Comments Discussion Forums
		Direct Instruction	Course Comments Discussion Forums
SOMEWHAT	Social Presence (M=3.3, SD=0.6)	Affective Expression	Course Comments Discussion Forums
		Open Communication	Course Comments
		Group Cohesion	Discussion Forums Course Comments
SOMEWHAT	Cognitive Presence (M=3.0, SD=0.0)	Triggering Event	Videos Assignments
		Exploration	Video lectures Description Pages Reading materials
		Integration	Discussion Forums Students Area
		Resolution	Assignments

5.2 Phase II: CoI-based Evaluation

The purpose of this section is to address the second question of this study; which asks how CoI framework-based instructional strategies are currently used in a set of six basic programming skills MOOCs using Python. The top three MOOC's platforms identified in the first phase of this study, edX, Coursera and Udacity, served as the sources to select these six MOOCs (Two MOOCs per platform). As stated in the methodology chapter, the additional criteria used to select these MOOCs consisted in number of enrolled students, target audience (novice), and frequency of course availability (see Table 4.1). The CoI-based instructional strategies for each MOOC were documented using an ethnographic-like approach. Each MOOC description was organized around the three components of the CoI framework: teaching, social and cognitive presence.

5.2.1 Edx Courses

Edx is one of the top MOOC providers and online learning platform in United States. Edx was founded in May 2012 by the Massachusetts Institute of Technology and Harvard University ("edX," 2015). Different from other renowned MOOC providers, Edx is a non-for-profit organization with more than 300 courses and approximately 3 million of students around the world ("edX," 2015). Beyond that, Edx has expanded its partnership list by including other elite learning institutions around the globe such as Caltech, Dartmouth, Columbia, Berkeley, University of Queensland, Cornell, Rice, and University of Chicago, among others. In the area of

computer science Edx is currently offering more than 50 courses only for the first quarter of 2015. These characteristics and the fact that it was the MOOC's platform with the highest total mean score among the platforms evaluated in the first phase of this study makes Edx the perfect candidate.

5.2.1.1 COURSE 1: 6.00.1x Introduction to computer science and programming using Python

The MOOC 6.00.1x is the first part of two introductory courses in the computer science field offered by Edx in coordination with the Massachusetts Institute of Technology (MIT). In words of the authors, the course was designed with the cardinal goal to help people with no prior programming knowledge to think computationally and apply these new acquired skills to solve real-world analytical problems. Throughout the course of this MOOC, learners were exposed to basic topics of computation such as the Python programming language, some simple algorithms, testing and debugging, and informal introduction to algorithmic complexity. Although this MOOC is intended for people with little or no background in computer science, there are some minor recommended prerequisites for learners who want to succeed in this course such as high school algebra and a reasonable aptitude for mathematics. It is important to point out that the documentation for this particular MOOC contains a lot of relevant information regarding the logistic of the course. However, the documentation did not make any reference whatsoever to the instructional design principles employed during the development of this MOOC.

5.2.1.1.1 Teaching Presence

Design and organization: This Edx course follows the same structure as other Edx courses and provided a section called “Updates & News” where students were informed about the important topics such as course overview, evaluation process, due dates, and explanations on how to submit exercises and assignments. The course also contained a calendar section that could help students to identify important dates. Another interesting section was called “Tips for Success” where participants were taught how to use the affordances of the course more efficiently. In regards to grading, the section also conveyed sufficient information about this process. The instructors were very diligent in notifying students about new dates and changes through emails and discussion forums.

Facilitation**:** The instructors, through video lectures, repeatedly emphasized areas of importance on a specific topic that could help to cement the understanding of such topic. In this regard, online office hours, broadcasted through Google hangout, provided a synchronous opportunity for participants to further understand course topics and get questions answered. Additionally, the video lectures contained small in-quizzes that could promote engagement and reinforce learning at the same time. In the same vain, the instructor recommended additional reading to help participants to expand their knowledge and explore new concepts. Through weekly announcements, course description pages, and emails, the instructor encouraged participants to get involved in discussions, which could have reinforced the development of a sense of community.

Direct Instruction: Participants received instant feedback after submitting their coding assignments and exercises, because the assignments were programmatically graded. Similarly, thanks to the collaboration of the team of TAs, the participants received assignments feedback in a timely manner.

5.2.1.1.2 Social Presence

Affective expression**:** The course leverages the forums to facilitate open communication among participants. In addition, participants were encouraged to use Facebook as the social media system for this particular class. Other social media systems such as Twitter and Google plus were also made available to participants through the "Updates & News" section.

Open communication**:** There was active participation from participants in discussion forums related to course topics. Participants had the chance to create a new post, follow post for updates, focus on specific topics, upvote posts and good response, and reply to other participant's comments.

Group cohesion**:** As it was mentioned before, the discussion forums and the online office hours leveraged participants to inquire about course topics and provide their own perspective about the topic being discussed.

5.2.1.1.3 Cognitive Presence

Triggering event**:** During the video lecture and announcements, the instructors normally posed a couple problems and asked the students to solve them

using computational thinking and python. The instructor also provided in-quizzes during and at the end of each lesson, with only one purpose: help students to explore and inquire their own understanding of a recently discussed topic. Additionally, participants had to complete problem sets on a weekly basis. Different from the in-quizzes and problems presented within each lesson, participants could not discuss end-of-the-week assignments in forums and course comments. Beyond that students were able to interchange notes, ask questions, and help other students using the discussion forums, course comments, and broadcast events (online office hours).

Exploration**:** In some of the course lessons, the instructor recommended to the participants to reach out some additional educational resources that could enhance their understanding of the topic being discussed. The course comments allowed participants to discuss their findings with other participants.

Integration**:** Occasionally, during the video lectures, the instructor addressed a topic that required some additional knowledge, for which the instructor referred the participants to the additional learning materials. The in-quizzes provided a good opportunity for participants to test their recently acquired knowledge. At the end of each weekly assignment the participants were asked to submit a survey regarding the difficulty level of each lesson and assignment. As a means to support the learning activities, the instructor also recommended to use external tools that leverage students to have a deeper understanding of how a piece of code worked.

Resolution**:** At the end of each week participants had to complete a problem set that consisted in multiple choice questions, code evaluations and writing small functions. At the end of the first half of the course, students were asked to submit a project (Quiz), which consisted in multiple choice questions, exercises and the development of a more complex application applying the knowledge acquired in previous lessons.

5.2.1.1.4 Course Summary

The following table (Table 5.19) summarizes the CoI instructional strategies found in the *6.00.1x Introduction to Computer Science and Programming Using Python* MOOC based on the CoI survey elements.

Table 5.17 CoI Survey and instructional strategies Edx – Course 1

Teaching Presence	***Present?***
Design & Organization	
1. The instructor clearly communicated important course topics.	Yes
2. The instructor clearly communicated important course goals.	Yes
3. The instructor provided clear instructions on how to participate in course learning activities.	Yes
4. The instructor clearly communicated important due dates/time frames for learning activities.	Yes
Facilitation	
5. The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.	Yes
6. The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.	Yes
7. The instructor helped to keep course participants engaged and participating in productive dialogue.	Yes
8. The instructor helped keep the course participants on task in a way that helped me to learn.	Yes
9. The instructor encouraged course participants to explore new concepts in this course.	Yes
10. Instructor actions reinforced the development of a sense of community among course participants.	Yes
Direct Instruction	
11. The instructor helped to focus discussion on relevant issues in a way that helped me to learn.	Yes
12. The instructor provided feedback that helped me understand my strengths and weaknesses.	Yes
13. The instructor provided feedback in a timely fashion.	Yes
Social Presence	
Affective expression	
14. Getting to know other course participants gave me a sense of belonging in the course.	No
15. I was able to form distinct impressions of some course participants.	No
16. Online or web-based communication is an excellent medium for social interaction.	Yes

Table 5.17 CoI Survey and instructional strategies Edx – Course 1 (continued)

Teaching Presence	***Present?***
Open communication	
17. I felt comfortable conversing through the online medium.	Yes
18. I felt comfortable participating in the course discussions.	Yes
19. I felt comfortable interacting with other course participants.	Yes
Group cohesion	
20. I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.	Yes
21. I felt that my point of view was acknowledged by other course participants.	Yes
22. Online discussions help me to develop a sense of collaboration.	Yes
Cognitive Presence	
Triggering event	
23. Problems posed increased my interest in course issues.	Yes
24. Course activities piqued my curiosity.	Yes
25. I felt motivated to explore content related questions.	Yes
Exploration	
26. I utilized a variety of information sources to explore problems posed in this course.	Yes
27. Brainstorming and finding relevant information helped me resolve content related questions.	Yes
28. Online discussions were valuable in helping me appreciate different perspectives.	No
Integration	
29. Combining new information helped me answer questions raised in course activities.	Yes
30. Learning activities helped me construct explanations/solutions.	Yes
31. Reflection on course content and discussions helped me understand fundamental concepts in this class.	Yes
Resolution	
32. I can describe ways to test and apply the knowledge created in this course.	Yes
33. I have developed solutions to course problems that can be applied in practice.	Yes
34. I can apply the knowledge created in this course to my work or other non-class related activities.	Yes

5.2.1.2 COURSE 2: 6.00.2x Introduction to computational thinking and data science

The MOOC 6.00.2x is the second part of two introductory courses in the computer science field offered by Edx in coordination with the Massachusetts Institute of Technology (MIT). Although this course requires some knowledge in the field of programming with Python, it is still recommended for beginners, since the level of programming employed in this course is basic. The author explained that the main goal is to teach students the concept of computational thinking without getting too deep into the convoluted world of programming. The course was offered during a period of nine weeks. It was opened on October 21st, 2014 and finished on December 24th, 2014.

5.2.1.2.1 Teaching Presence

Design and organization: This Edx course follows the same structure as other Edx courses and provided a section called “Updates & News” where students were informed about the important topics such as course overview, evaluation process, due dates, and explanations on how to submit exercises and assignments. The course also contained a calendar section that could help students to identify important dates. Another interesting section was called “Tips for Success” where participants were taught how to use the affordances of the course more efficiently. In regards to grading, the section also conveyed enough information about this process. The instructors were very diligent in notifying students about new dates and changes through emails and discussion forums.

Facilitation**:** Similar to other MOOCs, the instructor used pre-recorded video lectures to emphasized important topics that could help students to build a better understanding of the entire course. The instructor used the discussion forums as the pivotal tool to provide feedback and communicate important messages to participants. Additionally, at the end of each video lectures the instructor provided one or two quizzes related to the topic that was being taught that could reinforce learning. In the same way, the instructor recommended additional reading to help participant to expand their knowledge and explore new concepts. Through weekly announcements, course description page and emails the instructor encouraged participants to get involved in the discussions; which could have reinforced the development of a sense of community.

Direct Instruction**:** Participants received instant feedback after submitting their coding assignments and exercises, since the assignments were programmatically graded. In the case of the weekly assignments the students had to wait a period of at least a week to get feedback from the team of graders. The instructor occasionally used the comment area to share some thoughts about a particular problem posed in the class, and to answer some questions.

5.2.1.2.2 Social Presence

Affective expression**:** The course leverages the forums to facilitate open communication among participants.

Open communication**:** There was active participation from participants in discussion forums related to course topics. Participants had the chance to create a new post, follow post for updates, focus on specific topics, upvote posts and good responses, and reply to other participant's comments.

Group cohesion**:** The discussion forums leveraged students to collaborate with each other. Additionally, this tool allowed students to interchange ideas about any course issue.

5.2.1.2.3 Cognitive Presence

Triggering event**:** During the video lecture, the instructor occasionally asked students to complete a task using the python integrated development environment (IDE). The instructor also provided in-quizzes at the end of each lesson, with only one purpose: help students to explore and inquire their own understanding of a recently discussed topic. Additionally, participants had to complete problem sets on a weekly basis. Different from the in-quizzes and problems presented within each lessons, participants could not discuss end-of-the-week assignments in forums and course comments. Beyond that students were able to interchange notes, ask questions and help other students using the discussion forums and course comments.

Exploration**:** In some of the course lessons, the instructor recommended to the participants to reach out for additional educational resources that could enhance their understanding of the topic being discussed. The course comments allowed participants to discuss their findings with other participants.

Integration**:** Occasionally, during the video lectures, the instructor addressed a topic that required some additional knowledge, for which the instructor referred participants to the additional learning materials. At the end of the midterm quiz, participants were also asked to complete a survey which provided formative evaluation about the course.

Resolution**:** At the end of each week, participants had to complete a problem set that consisted in multiple-choice questions, code evaluations and writing a small piece of code. At the end of the first half of the course, students were asked to submit a project (Quiz), which consisted in multiple-choice questions, exercises and the development of a more complex application applying the knowledge acquired in previous lessons.

5.2.1.2.4 Course Summary

The table 5.20 summarizes the CoI instructional strategies found in the *6.00.2x Introduction to Computational Thinking and Data Science* MOOC based on the CoI survey elements.

Table 5.18 CoI Survey and instructional strategies Edx – Course 2

Teaching Presence	***Present?***
Design & Organization	
1. The instructor clearly communicated important course topics.	Yes
2. The instructor clearly communicated important course goals.	Yes
3. The instructor provided clear instructions on how to participate in course learning activities.	Yes
4. The instructor clearly communicated important due dates/time frames for learning activities.	Yes
Facilitation	
5. The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.	Yes
6. The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.	Yes
7. The instructor helped to keep course participants engaged and participating in productive dialogue.	No
8. The instructor helped keep the course participants on task in a way that helped me to learn.	No
9. The instructor encouraged course participants to explore new concepts in this course.	Yes
10. Instructor actions reinforced the development of a sense of community among course participants.	No
Direct Instruction	
11. The instructor helped to focus discussion on relevant issues in a way that helped me to learn.	Yes
12. The instructor provided feedback that helped me understand my strengths and weaknesses.	Yes
13. The instructor provided feedback in a timely fashion.	Yes
Social Presence	
Affective expression	
14. Getting to know other course participants gave me a sense of belonging in the course.	No
15. I was able to form distinct impressions of some course participants.	No
16. Online or web-based communication is an excellent medium for social interaction.	Yes

Table 5.18 CoI Survey and instructional strategies Edx – Course 2 (continued)

Social Presence	***Present?***
Open communication	
17. I felt comfortable conversing through the online medium.	Yes
18. I felt comfortable participating in the course discussions.	Yes
19. I felt comfortable interacting with other course participants.	Yes
Group cohesion	
20. I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.	Yes
21. I felt that my point of view was acknowledged by other course participants.	Yes
22. Online discussions help me to develop a sense of collaboration.	Yes
Cognitive Presence	
Triggering event	
23. Problems posed increased my interest in course issues.	Yes
24. Course activities piqued my curiosity.	Yes
25. I felt motivated to explore content related questions.	Yes
Exploration	
26. I utilized a variety of information sources to explore problems posed in this course.	Yes
27. Brainstorming and finding relevant information helped me resolve content related questions.	Yes
28. Online discussions were valuable in helping me appreciate different perspectives.	No
Integration	
29. Combining new information helped me answer questions raised in course activities.	Yes
30. Learning activities helped me construct explanations/solutions.	Yes
31. Reflection on course content and discussions helped me understand fundamental concepts in this class.	Yes
Resolution	
32. I can describe ways to test and apply the knowledge created in this course.	Yes
33. I have developed solutions to course problems that can be applied in practice.	Yes
34. I can apply the knowledge created in this course to my work or other non-class related activities.	Yes

5.2.2 Coursera Courses

Coursera is the most popular MOOC provider in United States with more than 22 million enrolled students worldwide. It is the 777th most popular website according to Alexa.com ranking ("Coursera," 2015). As of October 2014, it had 839 courses from more than 100 different institutions. This for-profit organization was founded in 2012 by two Stanford professors Daphne Koller and Andrew Ng ("Massive open online course," 2015).

5.2.2.1 COURSE 1: Learn to program – the fundamentals

According to the course's creators, Jennifer Campbell and Paul Gries, the course was designed mainly for students worldwide with a moderate computer experience that wanted to further their knowledge in computer programming using Python. In addition, through the accomplishment of this course, students would have a better understanding of how computer applications work, which enable them to apply computational thinking to solve real-world problems. The course was introduced in August 2013 by one of the top MOOC's platforms (Coursera) in partnership with the University of Toronto. During a period of seven weeks, learners were exposed to common fundamental concepts of computer programming languages. The Python programming language was used to demonstrate these concepts due to its simplicity and ease of learning.

5.2.2.1.1 Teaching Presence

Design and organization: The course provided a section called “course logistics” where students were informed about the important topics such as course overview, evaluation processes, due dates and weights, and an explanation on how to submit exercises and assignments. In regards to grading, the section also conveyed sufficient information about this process. The instructors were very diligent in notifying students about new dates and changes through emails and discussion forums. On the left side of the screen, the course displayed multiple sections that could provide participants with relevant information about the course structure such as resources, exercises, assignments, a syllabus, video lectures, discussion forums, etc.

Facilitation**:** The instructors, through video lectures, repeatedly emphasized areas of importance of a specific topic that could help to cement the understanding of such topic. The instructors also used the discussion forums to deliver feedback and answered some of the questions that participants had regarding the course and concepts being facilitated. Additionally, the video lectures contained small in-quizzes that could be seen as a means to promote engagement and reinforcement of key concepts. In a similar way, the instructor recommended additional reading to help participants to expand their knowledge and explore new concepts. The instructors encouraged the participants to use the discussion forums to schedule or organize group meetings and study groups; which could have fostered the development of a sense of community among participants.

Direct Instruction**:** Participants received instant feedback after submitting their assignments and exercises. The evaluation of these assignments were done automatically by the assessment system incorporated in Coursera. In the same way, although the number of students that completed the course was staggering (8,600 students), the feedback from instructors and teacher assistants (TAs) were also delivered in a timely manner. The instructors used pre-recorded video lectures to facilitate the class.

5.2.2.1.2 Social Presence

Affective expression**:** The course leverages the forums to facilitate open communication among participants. The forum section were divided in subsection to identify different areas of interest like lectures, study groups, exercise and assignments, etc. In addition, participants could create their own social profile which could help or promote a distinct impressions of course' participants.

Open communication**:** There was active participation from participants in discussion forums related to course topics. Participants had the chance to create new posts, attach pictures as well as math code using LaTeX. Among other features, the forums allowed participants to freely like or dislike comments from other participants.

Group cohesion**:** As it was mentioned before the discussion forums were very active. Using these same forums participants were able to inquire about course topics and provide their own perspective about the topic being discussed. The

forums also had sub-forums titled study groups where participants from a specific location around the world organized meetings.

5.2.2.1.3 Cognitive Presence

Triggering event**:** While exercises and video lectures were purely based on nurturing learning through accessing computer programming concepts, the assignments took a more empirical approach. In other words, participants learned by doing; more specifically by developing applications in Python. The instructors presented the computational thinking concepts in an engaging fashion. As an example, the first assignment in the second week asked students to provide a solution to coordinating universal time (UTC). Each zone of the UTC standard has a number that indicates the number of hours and minutes they are away from UTC+00:00. To provide a more accurate result the students were asked to display the same results, but in seconds. The instructions for each assignment were clear, but more importantly students were able to receive support from other students, TAs and instructors, in the discussion forums.

Exploration**:** In some of the course lessons, the instructor recommended to participants to reach out for some additional educational resources that could enhance their understanding of the topic being discussed. The discussion forums allowed participants to discuss their findings with other participants. The course also offered a section called resources where participants could find additional documentation and tools necessary to complete the programming assignments.

Integration**:** Occasionally, during the video lectures, the instructor addressed a topic that required some additional knowledge, for which the instructor referred the participants to the additional learning materials. The course also offered a resource section. The in-quizzes provided a good opportunity for participants to test their recently acquired knowledge.

Resolution**:** During each week, participants had to turn in an exercise, which consisted in developing an application using Python. The assignments were more complex, thus they were biweekly assigned and consisted in a large project.

5.2.2.1.4 Course Summary

The Table 5.21 summarizes the CoI instructional strategies found in the *Learn to Program – The Fundamentals* MOOC based on the CoI survey elements.

Table 5.19 CoI Survey and instructional strategies Coursera – Course 1

Teaching Presence	***Present?***
Design & Organization	
1. The instructor clearly communicated important course topics.	Yes
2. The instructor clearly communicated important course goals.	Yes
3. The instructor provided clear instructions on how to participate in course learning activities.	Yes
4. The instructor clearly communicated important due dates/time frames for learning activities.	Yes
Facilitation	
5. The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.	Yes
6. The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.	Yes
7. The instructor helped to keep course participants engaged and participating in productive dialogue.	Yes
8. The instructor helped keep the course participants on task in a way that helped me to learn.	Yes
9. The instructor encouraged course participants to explore new concepts in this course.	Yes
10. Instructor actions reinforced the development of a sense of community among course participants.	Yes
Direct Instruction	
11. The instructor helped to focus discussion on relevant issues in a way that helped me to learn.	Yes
12. The instructor provided feedback that helped me understand my strengths and weaknesses.	Yes
13. The instructor provided feedback in a timely fashion.	Yes
Social Presence	
Affective expression	
14. Getting to know other course participants gave me a sense of belonging in the course.	No
15. I was able to form distinct impressions of some course participants.	No
16. Online or web-based communication is an excellent medium for social interaction.	Yes

Table 5.19 CoI Survey and instructional strategies Coursera – Course 1 (continued)

Social Presence	***Present?***
Open communication	
17. I felt comfortable conversing through the online medium.	Yes
18. I felt comfortable participating in the course discussions.	Yes
19. I felt comfortable interacting with other course participants.	Yes
Group cohesion	
20. I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.	Yes
21. I felt that my point of view was acknowledged by other course participants.	Yes
22. Online discussions help me to develop a sense of collaboration.	No
Cognitive Presence	
Triggering event	
23. Problems posed increased my interest in course issues.	Yes
24. Course activities piqued my curiosity.	Yes
25. I felt motivated to explore content related questions.	Yes
Exploration	
26. I utilized a variety of information sources to explore problems posed in this course.	Yes
27. Brainstorming and finding relevant information helped me resolve content related questions.	Yes
28. Online discussions were valuable in helping me appreciate different perspectives.	No
Integration	
29. Combining new information helped me answer questions raised in course activities.	Yes
30. Learning activities helped me construct explanations/solutions.	Yes
31. Reflection on course content and discussions helped me understand fundamental concepts in this class.	Yes
Resolution	
32. I can describe ways to test and apply the knowledge created in this course.	Yes
33. I have developed solutions to course problems that can be applied in practice.	Yes
34. I can apply the knowledge created in this course to my work or other non-class related activities.	Yes

5.2.2.2 COURSE 2: An introduction to interactive programming in Python

This is an introductory programming course designed especially for people with little or no background in computer programming. The main goal of this course was to teach students how to build interactive applications. The language of choice was Python, due to the simplicity of its syntax and its ever-growing popularity. The course was taught by four professors of Rice University in September 2014 for a period of nine weeks. At the end of the course, in words of the instructors, the students should be able to build simple interactive games such as Pong, Blackjack and Asteroids. It is important to mention that this is one of the oldest courses being offered at Coursera. It was firstly introduced in 2012.

5.2.2.2.1 Teaching Presence

Design and organization: Similar to other Coursera courses this course offered a section called "Administrivia" where students were informed about the important topics such as course overview, evaluation process, due dates and weights, and an explanation on how to submit exercises and assignments. Participants also had access to additional learning materials located in the main menu of the course, such as tools, practice and help, concepts and examples, etc. Nevertheless, the instructors provided sufficient information about the logistics of the course through the introductory video. The instructors were very diligent in notifying students about new dates and changes through emails and discussion forums.

Facilitation**:** The instructors, through video lectures, repeatedly emphasized areas of importance on a specific topic that could help to improve the understanding of such topic. The instructors also used the discussion forums to deliver feedback and answered some of the questions that participants had regarding the course and concepts being facilitated. The instructors also relied on TAs to provide feedback in a timely manner. The assignments were evaluated using a peer evaluation approach. The video lectures contained small in-quizzes that could be seen as a means to promote engagement and reinforcement of key concepts. The instructors recommended additional reading material to help participants to expand their knowledge and explore new concepts. The instructors encouraged the participants to use the discussion forums to schedule or organize group meetings and study groups; which could have fostered the development of a sense of community among participants. The instructors periodically informed participants about the learning advantages of using the discussion forums.

Direct Instruction**:** The assignments and exercise feedbacks were delivered to students in a fair amount of time by peer evaluators. Although the assignments were evaluated using a peer-evaluation approach, the in-quizzes were evaluated programmatically using the assessment system incorporated in Coursera. The instructors and TAs used the discussion forums to interact with students and answer their questions regarding course topics or concepts. The instructors used pre-recorded video lectures as the main tool to facilitate the class.

5.2.2.2.2 Social Presence

Affective expression**:** The course leverages the forums to facilitate open communication among participants. The forum section were divided in subsection to identify different areas of interest like lectures, study groups, exercise and assignments, python questions, etc. In addition, participants could create their own social profile which could help or promote a distinct impression on other course participants.

Open communication**:** There was active participation from participants in discussion forums related to course topics. Participants had the chance to create new posts, attach pictures as well as math code using LaTeX. Among other features, the forums allowed participants to freely like or dislike comments from other participants. However, when participants dislike a comment, the application will send a message recommending to provide feedback.

Group cohesion**:** As it was mentioned before, the discussion forums were very active. Using these same forums participants were able to inquire about course topics and provide their own perspective about the topic being discussed. The forums also had sub-forums titled study groups where participants from a specific location around the world organized meetings.

5.2.2.2.3 Cognitive Presence

Triggering event**:** While exercises and video lectures were purely based on nurturing learning through accessing computer programming concepts, the assignments took a more empirical approach. In other words, participants learned by doing, more specifically by developing applications in Python. The instructors presented the computational thinking concepts in an engaging fashion. Instructors provided an application called "CodeSkulptor" that allowed students to dive directly into the software development part of the course, which was the essential goal of this MOOC. The mini-projects were assigned on a weekly basis. The instructions for each mini-project were clear, but more importantly students were able to receive support from other students, TAs and instructors, in the discussion forums.

Exploration**:** In some of the course lessons, the instructor recommended to the participants to reach out for some additional educational resources that could enhance their understanding of the topic being discussed. The discussion forums allowed participants to discuss their findings with other participants. The course also offered a section called resources where participants could find additional documentation and tools necessary to complete the programming assignments.

Integration**:** Occasionally, during the video lectures, the instructor addressed a topic that required some additional knowledge, for which the instructor referred the participants to the additional learning materials. The course also offered a resource section. The in-quizzes provided a good opportunity for participants to test

their recently acquired knowledge. The forums offered an opportunity to participants to collaborate with other participants.

Resolution**:** During each week, participants had to turn in an exercise that consisted in developing an application using Python. There were also mini-projects that were related to real-world problems. Due to the complexity of the mini-projects, the participants had a period of seven days to turn in the assignment without any penalty.

5.2.2.2.4 Course Summary

The following table summarizes the CoI instructional strategies found in the *An Introduction to Interactive Programming in Python* MOOC based on the CoI survey elements.

Table 5.20 CoI Survey and instructional strategies Coursera – Course 2

Teaching Presence	***Present?***
Design & Organization	
1. The instructor clearly communicated important course topics.	Yes
2. The instructor clearly communicated important course goals.	Yes
3. The instructor provided clear instructions on how to participate in course learning activities.	Yes
4. The instructor clearly communicated important due dates/time frames for learning activities.	Yes
Facilitation	
5. The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.	Yes
6. The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.	Yes
7. The instructor helped to keep course participants engaged and participating in productive dialogue.	Yes
8. The instructor helped keep the course participants on task in a way that helped me to learn.	Yes
9. The instructor encouraged course participants to explore new concepts in this course.	Yes
10. Instructor actions reinforced the development of a sense of community among course participants.	Yes
Direct Instruction	
11. The instructor helped to focus discussion on relevant issues in a way that helped me to learn.	Yes
12. The instructor provided feedback that helped me understand my strengths and weaknesses.	Yes
13. The instructor provided feedback in a timely fashion.	Yes
Social Presence	
Affective expression	
14. Getting to know other course participants gave me a sense of belonging in the course.	No
15. I was able to form distinct impressions of some course participants.	Yes
16. Online or web-based communication is an excellent medium for social interaction.	Yes

Table 5.20 CoI Survey and instructional strategies Coursera – Course 2 (continued)

Social Presence	***Present?***
Open communication	
17. I felt comfortable conversing through the online medium.	Yes
18. I felt comfortable participating in the course discussions.	Yes
19. I felt comfortable interacting with other course participants.	Yes
Group cohesion	
20. I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.	Yes
21. I felt that my point of view was acknowledged by other course participants.	Yes
22. Online discussions help me to develop a sense of collaboration.	Yes
Cognitive Presence	
Triggering event	
23. Problems posed increased my interest in course issues.	Yes
24. Course activities piqued my curiosity.	Yes
25. I felt motivated to explore content related questions.	Yes
Exploration	
26. I utilized a variety of information sources to explore problems posed in this course.	Yes
27. Brainstorming and finding relevant information helped me resolve content related questions.	Yes
28. Online discussions were valuable in helping me appreciate different perspectives.	No
Integration	
29. Combining new information helped me answer questions raised in course activities.	Yes
30. Learning activities helped me construct explanations/solutions.	Yes
31. Reflection on course content and discussions helped me understand fundamental concepts in this class.	Yes
Resolution	
32. I can describe ways to test and apply the knowledge created in this course.	Yes
33. I have developed solutions to course problems that can be applied in practice.	Yes
34. I can apply the knowledge created in this course to my work or other non-class related activities.	Yes

5.2.3 Udacity Courses

Udacity is for-profit educational organization founded as the result of successful free computer science classes offered by the University of Stanford in the summer of 2011 ("Udacity," 2015). The first two courses launched by Udacity were in the realm of computer science. In 2013, Udacity announced the first entirely MOOC-based Master's Degree in collaboration with other educational organizations ("Massive open online course," 2015). By 2014 Udacity had more than 1.6 million enrolled students and was offering more than 100 courses. Udacity has also grown its partnership portfolio by including renowned organizations like Google, AT&T, cloudera, Facebook, mongoDB, etc ("Udacity," 2015).

5.2.3.1 COURSE 1: Programming foundations with Python

This introductory programming class was designed for people that did not have any prior knowledge in computer programming and were willing to learn computational thinking concepts. The programming language used in this class was Python. In words of the author, the course was intended to teach students the concepts of Object-Oriented programming by learning actively with mini projects. Although the course is not free, it offered an audited version, which was free. However, participants enrolled in the audited version of the course did not have access to coaches or instructors' feedback. Certificates were not a part of this type of courses. The course was self-paced and had approximately 70,000 enrolled students. The course lasted a period six of weeks.

5.2.3.1.1 Teaching Presence

Design and organization: The course provided a section called "Course Summary" that provided students with valid information about the course's logistics. For example, students were able to find important dates, the course syllabus, and information about the instructor. The instructor also used the introductory video to inform participants about the learning objectives of the course as well as how and when to submit assignments. The video lectures were interactive. In other words, the instructor will ask the students to answer questions during the video lectures. Then students will use the same video to provide the answers.

Facilitation**:** The instructors used the interactive video lectures as the focal learning tool for this class. The instructor explained each topic using analogies which could be helpful for students to understand convoluted concepts. Only for the paid version of this class, the students had the opportunity to use coaches who were very verse in the topic and could provide more insight to the students about a specific concept. The participants could use the discussion forums to interact with other participants. This feature was available in the free version of this course. Additionally, the video lectures contained small in-quizzes that could be seen as mean to promote engagement and reinforcement of key concepts. In a similar way, the instructor recommended additional reading to help participants to expand their knowledge and explore new concepts. The instructors encouraged the participants to use the discussion forums to schedule or organize group meetings and study

groups; which could have fostered the development of a sense of community among participants.

Direct Instruction**:** Participants received instant feedback after submitting their assignments and exercises. However, this only worked for the small quizzes embedded in the video lectures. The evaluation of these quizzes were done automatically by the assessment system incorporated in Udacity. For the paid version, the instructor provided feedback throughout discussion forums periodically.

5.2.3.1.2 Social Presence

Affective expression**:** The course leverages the forums to facilitate open communication among participants.

Open communication**:** There was active participation from participants in discussion forums related to course topics. The participants used the discussion forums to post assignments and ask questions regarding course issues.

Group cohesion**:** As it was mentioned before, the discussion forums were very active. Using these same forums participants were able to inquire about course topics and provide their own perspective about the topic being discussed.

5.2.3.1.3 Cognitive Presence

Triggering event**:** The instructor leveraged project-based learning methodology to teach the class. The video lectures contained small quizzes and

mini-projects that made them highly interactive and engaging. The instructor presented the computational thinking concepts in an engaging fashion. As an example, the first assignment consisted in developing an application that worked as an alarm to take sporadic breaks.

Exploration**:** The instructor constantly referred to the Google search engine to find information regarding a specific question or project posted in the video lectures. The discussion forums allowed participants to discuss their findings with other participants.

Integration**:** Occasionally, during the video lectures, the instructor addressed a topic that required some additional knowledge, for which the instructor referred the participants to use Google to find helping information. The in-quizzes and mini-projects provided a good opportunity for participants to test their recently acquired knowledge.

Resolution**:** Due to the fact that this was a self-paced online course, participants did not have a due date to turn in the mini-projects. However, the mini-projects were designed in a way that they could be easily compared to real-world problems.

5.2.3.1.4 Course Summary

The Table 5.23 summarizes the CoI instructional strategies found in the *Programming foundations with Python* MOOC based on the CoI survey elements.

Table 5.21 CoI Survey and instructional strategies Udacity – Course 1

Teaching Presence	***Present?***
Design & Organization	
1. The instructor clearly communicated important course topics.	Yes
2. The instructor clearly communicated important course goals.	Yes
3. The instructor provided clear instructions on how to participate in course learning activities.	Yes
4. The instructor clearly communicated important due dates/time frames for learning activities.	No
Facilitation	
5. The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.	Yes
6. The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.	Yes
7. The instructor helped to keep course participants engaged and participating in productive dialogue.	Yes
8. The instructor helped keep the course participants on task in a way that helped me to learn.	Yes
9. The instructor encouraged course participants to explore new concepts in this course.	No
10. Instructor actions reinforced the development of a sense of community among course participants.	No
Direct Instruction	
11. The instructor helped to focus discussion on relevant issues in a way that helped me to learn.	Yes
12. The instructor provided feedback that helped me understand my strengths and weaknesses.	Yes
13. The instructor provided feedback in a timely fashion.	Yes
Affective expression	
14. Getting to know other course participants gave me a sense of belonging in the course.	No
15. I was able to form distinct impressions of some course participants.	No
16. Online or web-based communication is an excellent medium for social interaction.	Yes

Table 5.21 CoI Survey and instructional strategies Udacity – Course 1 (continued)

Social Presence	***Present?***
Open communication	
17. I felt comfortable conversing through the online medium.	Yes
18. I felt comfortable participating in the course discussions.	Yes
19. I felt comfortable interacting with other course participants.	Yes
Group cohesion	
20. I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.	No
21. I felt that my point of view was acknowledged by other course participants.	No
22. Online discussions help me to develop a sense of collaboration.	No
Cognitive Presence	
Triggering event	
23. Problems posed increased my interest in course issues.	Yes
24. Course activities piqued my curiosity.	No
25. I felt motivated to explore content related questions.	Yes
Exploration	
26. I utilized a variety of information sources to explore problems posed in this course.	No
27. Brainstorming and finding relevant information helped me resolve content related questions.	Yes
28. Online discussions were valuable in helping me appreciate different perspectives.	No
Integration	
29. Combining new information helped me answer questions raised in course activities.	Yes
30. Learning activities helped me construct explanations/solutions.	Yes
31. Reflection on course content and discussions helped me understand fundamental concepts in this class.	Yes
Resolution	
32. I can describe ways to test and apply the knowledge created in this course.	Yes
33. I have developed solutions to course problems that can be applied in practice.	Yes
34. I can apply the knowledge created in this course to my work or other non-class related activities.	Yes

5.2.3.2 COURSE 2: Intro to computer science

This is an introductory class to computer programming. Hence it was created for people with little knowledge in the computer science field. Participants of this class had the chance to learn computational thinking concepts while learning how to build a web engine using the Python programming language. Similar to other courses offered by Udacity, this course was partially free; which means that the content of the course was available to all students, but the feedback from coaches was available for a monthly payment of US $199.0 dollars. Approximately half million of students were enrolled in this class. It was self-paced class with a length of three months.

5.2.3.2.1 Teaching Presence

Design and organization: The layout of course was very simple. The controls of the menu were located on the left side of the main window. The participants could select multiple options from the main menu, which included a dashboard, classroom, materials, discussions and overview. The overview section of the course contained relevant information about the course's logistics. For example, students were able to find important dates, the course syllabus, and information about the instructor. The instructor also used the introductory video to inform participants about the learning objectives of the course as well as how and when to submit assignments. The video lectures were interactive. In other words, the instructor will

ask the students to answer questions during the video lectures. Then students will use the same video to provide the answers.

Facilitation**:** The instructors used the interactive video lectures as the focal learning tool for this class. However, the instructor occasionally referred students to use the discussion forums to submit answers to a questions asked during the videos. The instructor explained each topic using analogies, which could be helpful for students to understand convoluted concepts of computer programming. In the paid version of the course, students had access to coaches who were well-versed on the topic, thus could provide further insight on the course content. The participants could use the discussion forums to interact with other participants. This feature was available in the free version of this course. Additionally, the video lectures contained small in-quizzes that could be seen as a means to promote engagement and reinforcement of key concepts.

Direct Instruction**:** Participants received instant feedback after submitting their assignments and exercises. However, this only worked for the small quizzes embedded in the video lectures. The evaluation of these quizzes were done automatically by the assessment system incorporated in Udacity. For the paid version, the instructor provided feedback throughout discussion forums periodically.

5.2.3.2.2 Social Presence

Affective expression**:** The course leverages the forums to facilitate open communication among participants. The participants were able to create personal profiles that could allow them to form distinct impression of course participants.

Open communication**:** There was active participation from participants in discussion forums related to course topics. The participants used the discussion forums to post assignments and ask questions regarding course issues.

Group cohesion**:** As it was mentioned before the discussion forums were very active. Using these same forums participants were able to inquire about course topics and provide their own perspective about the topic being discussed.

5.2.3.2.3 Cognitive Presence

Triggering event**:** The instructor leveraged project-based learning methodology to teach the class. The video lectures contained small quizzes that supported active learning. The instructor presented the computational thinking concepts in an engaging fashion. More importantly, students were able to receive support from other students in the discussion forums.

Exploration**:** The instructor provided additional educational material to be used during and after each lessons. The course contained a section called “course-Related Resources”, where student could find further information about different topics and concepts discussed in the class. The online discussions also provided an

additional source of information, since the course topics were being often being discussed.

Integration: The instructor occasionally directed the students to use the examples located in the additional educational resource to resolve some of the assignments posted in the class. The quizzes and small projects provided a good opportunity for participants to test their recently acquired knowledge.

Resolution**:** The fact that this was a self-paced online course, participants did not have a due date to turn in the projects. However, the projects were designed in way that they could be easily compared to real-world problems.

5.2.3.2.4 Course Summary

The Table 5.24 summarizes the CoI instructional strategies found in the *Intro to Computer Science* MOOC based on the CoI survey elements.

Table 5.22 CoI Survey and instructional strategies Udacity – Course 2

Teaching Presence	***Present?***
Design & Organization	
1. The instructor clearly communicated important course topics.	Yes
2. The instructor clearly communicated important course goals.	Yes
3. The instructor provided clear instructions on how to participate in course learning activities.	Yes
4. The instructor clearly communicated important due dates/time frames for learning activities.	No
Facilitation	
5. The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.	Yes
6. The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.	Yes
7. The instructor helped to keep course participants engaged and participating in productive dialogue.	Yes
8. The instructor helped keep the course participants on task in a way that helped me to learn.	Yes
9. The instructor encouraged course participants to explore new concepts in this course.	Yes
10. Instructor actions reinforced the development of a sense of community among course participants.	No
Direct Instruction	
11. The instructor helped to focus discussion on relevant issues in a way that helped me to learn.	Yes
12. The instructor provided feedback that helped me understand my strengths and weaknesses.	Yes
13. The instructor provided feedback in a timely fashion.	Yes
Social Presence	
Affective expression	
14. Getting to know other course participants gave me a sense of belonging in the course.	No
15. I was able to form distinct impressions of some course participants.	No
16. Online or web-based communication is an excellent medium for social interaction.	Yes

Table 5.22 CoI Survey and instructional strategies Udacity – Course 2 (continued)

Social Presence	***Present?***
Open communication	
17. I felt comfortable conversing through the online medium.	Yes
18. I felt comfortable participating in the course discussions.	Yes
19. I felt comfortable interacting with other course participants.	Yes
Group cohesion	
20. I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.	Yes
21. I felt that my point of view was acknowledged by other course participants.	No
22. Online discussions help me to develop a sense of collaboration.	Yes
Cognitive Presence	
Triggering event	
23. Problems posed increased my interest in course issues.	Yes
24. Course activities piqued my curiosity.	Yes
25. I felt motivated to explore content related questions.	Yes
Exploration	
26. I utilized a variety of information sources to explore problems posed in this course.	No
27. Brainstorming and finding relevant information helped me resolve content related questions.	Yes
28. Online discussions were valuable in helping me appreciate different perspectives.	No
Integration	
29. Combining new information helped me answer questions raised in course activities.	Yes
30. Learning activities helped me construct explanations/solutions.	Yes
31. Reflection on course content and discussions helped me understand fundamental concepts in this class.	Yes
Resolution	
32. I can describe ways to test and apply the knowledge created in this course.	Yes
33. I have developed solutions to course problems that can be applied in practice.	Yes
34. I can apply the knowledge created in this course to my work or other non-class related activities.	Yes

CHAPTER 6. DISCUSSION AND CONCLUSION

The first phase of this research study aimed to identify affordances of MOOC's platforms best suited to design/implement basic programming skill courses based on the instructional strategies of the CoI framework. The second phase focused on describing six case studies of how CoI-based instructional strategies are currently used across six basic programming skill MOOCs using Python.

6.1 Affordances of MOOC's platforms

The Table 6.1 and Table 6.2 summarized the results found in the first phase of this study. As shown in the former table, eight out of the fifteen (53%) evaluated MOOC's platforms provided affordances that were strongly aligned with the teaching presence element of the CoI framework. Specific affordances most frequently used across all eight platforms were: videos, comments, course overview pages, forums and calendars. Only 33% of the MOOC's platforms provided affordances that were strongly aligned with social presence with the most frequently supported being: forums, comments and profile pages. The cognitive presence element was strongly aligned with the affordances supported by only 40% of the MOOC's platforms evaluated in this phase.

Table 6.1 Alignment between CoI framework and affordances

TEACHING PRESENCE			SOCIAL PRESENCE			COGNITIVE PRESENCE		
Videos	7	87.5%	Forums	5	100.0%	Quizzes	5	83.3%
Comments	7	87.5%	Comments	4	80.0%	Assignments	5	83.3%
Course pages	7	87.5%	Profiles	3	60.0%	Files	5	83.3%
Forums	5	62.5%	Meetups	2	40.0%	Forums	5	83.3%
Calendars	4	50.0%	Chat Rooms	2	40.0%	Comments	5	83.3%
Emails	2	25.0%	Up/Down votes	1	20.0%	NBC Learn	1	16.7%
Panel or Blogs	1	12.5%	Emails	1	20.0%			
Chat Rooms	1	12.5%						
Quizzes	1	12.5%						
Strongly Aligned Platforms	8			5			6	

Table 6.2 presents the results obtained from calculating the mean scores for all fifteen MOOCs' platforms based on the degree to which their affordances were aligned to the CoI elements. This table served as input for the second phase of this study, which focused on identifying the top three MOOC's platforms with the highest total mean score for all CoI elements. Edx, Coursera, Udacity and Stanford OpenEdx topped the list of platforms, while Alison, FutureLearn and Udemy occupied the bottom.

Table 6.2 MOOC's Platforms vs CoI Elements alignment

	TEACHING			SOCIAL			COGNITIVE			TOTAL	
PLATFORM	M	SD	ALIGNED	M	SD	ALIGNED	M	SD	ALIGNED	M	SD
Edx	4.7	0.6	STA	4.0	0.0	STA	3.8	0.5	STA	4.1	0.3
Coursera	4.3	1.2	STA	3.0	1.0	SWA	4.8	0.5	STA	4.0	0.3
Stanford	4.3	0.6	STA	4.0	0.0	STA	3.8	0.5	STA	4.0	0.3
Udacity	4.0	1.7	STA	4.0	0.0	STA	4.0	0.0	STA	4.0	1.0
Coursesites	3.3	0.6	SWA	4.0	1.0	STA	4.0	0.0	STA	3.8	0.5
Iversity	4.0	0.0	STA	3.7	0.6	STA	3.5	1.0	SWA	3.7	0.5
OpenHPI	3.7	0.6	STA	3.0	0.0	SWA	4.0	1.2	STA	3.6	0.6
OpenLearning	3.7	0.6	STA	3.3	0.6	SWA	3.0	0.8	SWA	3.3	0.1
Open2Study	3.7	1.2	STA	2.7	0.6	SWA	3.5	1.0	SWA	3.3	0.3
Janux	3.3	1.5	SWA	3.3	0.6	SWA	3.0	0.8	SWA	3.2	0.5
NovoED	3.0	0.0	SWA	3.3	0.6	SWA	3.0	0.0	SWA	3.1	0.3
Canvas.net	3.3	1.5	SWA	2.7	0.6	SWA	3.0	0.8	SWA	3.0	0.5
Alison	3.0	1.0	SWA	2.7	0.6	SWA	2.8	0.5	SWA	2.8	0.3
Futurelearn	3.3	1.5	SWA	2.7	0.6	SWA	2.0	0.8	POA	2.7	0.5
Udemy	3.3	1.5	SWA	2.3	0.6	POA	1.8	0.5	POA	2.5	0.6

Strongly Aligned (STA)	Somewhat Aligned (SWA)	Poorly Aligned (POA)
5.0 > X > 3.7	3.6 > X > 2.4	2.3 > X > 1.0
X = Mean		

Results from the first phase suggested that the affordances across all evaluated MOOC's platforms were more strongly aligned with the teaching presence element of the CoI framework; followed by cognitive presence and lastly by social presence. This finding might be due to the fact that the most extensively used affordances of MOOC's are videos, discussion forums and course overview pages focused more on content facilitation and exploration. Both of these aspects were generally mediated by teachers and instructors. For example, students tended to use the forums more frequently and post comments in the course pages as result of teachers' encouragement in the video lectures and course overview pages. According to

Richardson and Swan (2003), affordances that may be associated with teaching presence such as quizzes and assignments are also perceived to support social and cognitive presences. This finding provides further evidence of the overlapping nature among the CoI elements. For instance, results from the first phase showed how the same affordances were present across the three CoI elements. These affordances included: discussion forums, quizzes, course overview pages and page comments.

Findings from the first phase also suggested that even though most MOOC's platforms were composed of similar affordances, there were differences in how they were leveraged to support the CoI elements. This might suggest a lack of effective instructional design and pedagogical practices, which has already been confirmed by prior research (Bali, 2014; Shuchi Grover et al., 2013).

6.2 CoI instructional strategies in programming skill MOOCs

Figure 5.1 provides a summary of the CoI instructional strategies present across the six MOOCs evaluated in the second phase of the study. The percentages represent the number of instructional strategies met by each MOOC across CoI elements. Teaching presence instructional strategies were leveraged the most as compared to the social and cognitive presence. However, social presence instructional strategies were the least used across all six MOOCs.

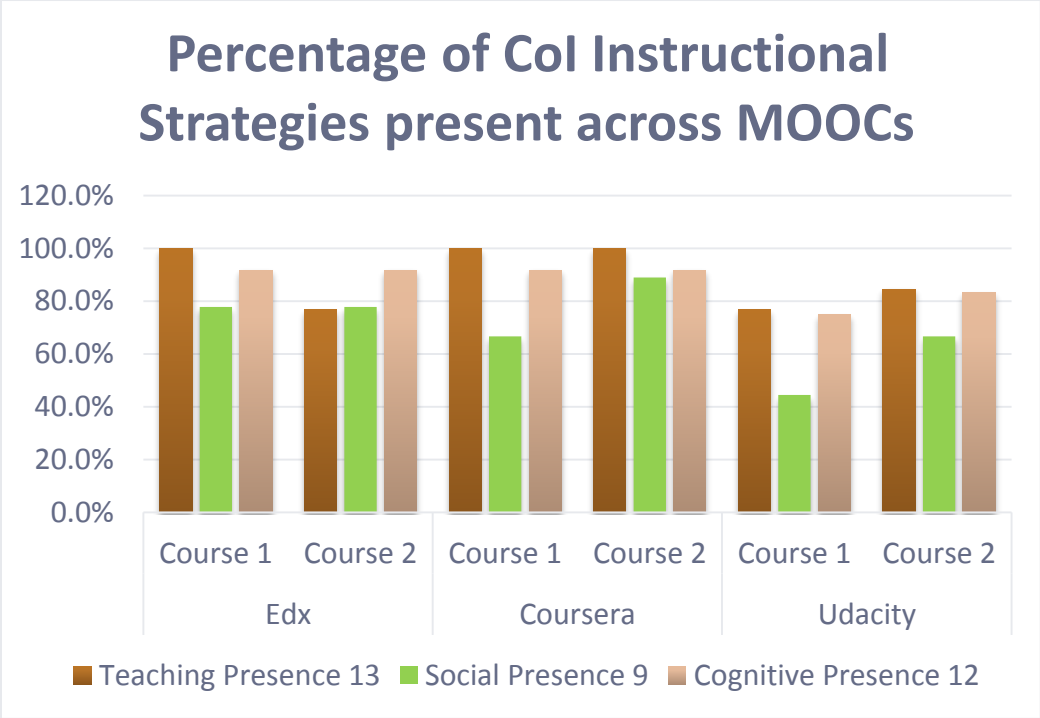

Figure 6.1 CoI Instructional Strategies vs MOOCs

Results from the second phase of this study, corroborated the disconnection between CoI instructional design strategies and MOOC's implementation of courses in basic programming skills. This occurred despite the fact that the six MOOCs were developed in the top three MOOC's platforms identified during the first phase of this study. For instance, from the two selected Udacity courses, Course 2 implemented more instructional strategies from the CoI framework than Course 1.

Nevertheless, instructional strategies associated with teaching presence were leveraged more than instructional strategies for cognitive and social presences across all six MOOCs. Similar to the finding in phase one, this may be due to the fact

that most MOOCs' platform affordances are designed to support aspects of teaching presence. For instance, a strong teaching presence through course design and organization strategies provided enough guidance and key information to encourage participation in course activities and discussions.

On the contrary, social presence instructional strategies were not effectively implemented across MOOCs. This might have been due to the fact that the evaluated MOOCs left up to the participants to cultivate a sense of community. More specifically, the instructors only promoted participation in the forums in relationship to course content. Although this aspect could have allowed to create a stronger learning community, there was a lack of explicit activities or instructions that helped participants feel connected with each other. As a result, there was high reliance on participants to drive a key aspect of learning, which is affective expression.

On a different note, the cognitive instructional strategies more widely adopted across MOOCs were triggering events and exploration. Triggering events such quizzes and assignments were used by instructors across MOOCs that might have ignited participants' curiosity and interest on course issues. In some cases, participants seemed to be eager to collaborate with other students to solve specific course problems and search for additional information. These observations might suggest that participants were able to move successfully from the triggering to the exploration phase of the cognitive presence of CoI. However, the use of integration and resolution strategies were less explicitly implemented across all MOOCs.

Therefore, assumptions were made about my experience evaluating these strategies by solely looking at the cognitive activities provided in each course. In the CoI framework these activities and the participants' experience with integration and resolution strategies also rely on how instructors facilitate them. In this regard, there is enough evidence suggesting that moving to integration and resolution depends on an instructor's ability to challenge the participants and provide appropriate facilitation and direction (Meyer, 2003; Murphy, 2004; Shea & Bidjermo, 2008).

6.3 Implications for Teaching and Learning

Results for this study suggested that the affordances and CoI instructional strategies across all evaluated MOOCs were more strongly aligned with the teaching presence element of the CoI framework; followed by cognitive presence and lastly by social presence. This finding is consistent with other studies, which indicated that online education struggles to move away from content-centered instruction to more constructivist learner-centered models (Bourne, Harris, & Mayadas, 2005). Therefore, one important implication of this research is for MOOC's instructors and course designers to facilitate more learner-centered experiences based on proven pedagogical approaches. Such approaches will need to be selected according to students' prior knowledge and skills, as well as course learning outcomes. In addition, since most MOOCs instructors are subject matter experts with vast experience using lectures as the main instructional strategy, it is critical that they are

provided with professional development opportunities on best practices for online teaching.

6.4 Implications for Instructional Design

Regarding instructional design, one key finding of this study suggested that even though most MOOC's platforms were composed of similar affordances, there were differences in how they were leveraged to support the CoI elements. This might suggest a lack of effective instructional design and pedagogical practices, which has already been confirmed by prior research (Bali, 2014; Shuchi Grover et al., 2013). This gap could be addressed by encouraging MOOCs' designers to leverage proven instructional design principles. For example, the Khan's MOOC Framework describes nine components that need to be present in a well-structured MOOC. These components are: pedagogical, technological, interface design, evaluation, management, resource support, ethical considerations, and institutional. Another example is the CoI framework, which has been further described in chapter 3 of this thesis. Different from the Khan's MOOC Framework, the CoI framework only focuses on three components (Teaching presence, Social presence, and Cognitive presence) to ensure an effective learning environment. In fact, as introduced in this study, the CoI framework serves to guide the design of effective online educational experiences. Course designers could follow the design principles that address each of the presences of this framework.

6.5 Limitations and Suggestions for Future Study

This two-phase research study was conducted by only one researcher who implemented a CoI-based survey to evaluate both MOOC's platforms affordances and MOOCs strategies in basic programming skills. Therefore, the major limitation of this study is associated with the instrumentation and researcher's bias.

Although an expert evaluator revised the survey content, the CoI items in the original instrument were originally written to be completed by students while participating in formal distance learning courses. Indeed, this was the first known time that the survey was adapted for usage as an evaluation tool for MOOC's affordances and courses.

One important source of researcher's bias might have been the discrepancy between the high expertise level of the researcher and the level of expertise required from participants of the introductory programming courses in Python. In addition, the researcher evaluated the courses from the perspective of an observer, rather from an active participant. This might have affected the overall experience with the courses.

Based on the aforementioned, future research needs to be conducted to address these limitations. Primarily, it is recommended that the CoI framework elements and survey instrument be constructed specifically for MOOC's platforms as there are clear differences between this and formal learning distance courses. Additionally, the inclusion of expert evaluators with different level of expertise could enhance the validity of this research.

6.6 Conclusion

The purpose of this descriptive and exploratory study was to characterize existing MOOC's platforms in the current market based on the affordances and instructional strategies aligned with the CoI framework pertaining to MOOCs' platform and courses. This purpose was achieved through two different phases. The first phase-identified affordances of top MOOC's platforms best suited to design/implement basic programming skill courses. The second phase described in six case studies, how CoI-based instructional strategies were implemented across six basic programming skill MOOCs using Python.

Findings for this study provided important evidence on how the elements of the CoI framework are currently being adopted in basic programming skills MOOCs using Python. More specifically, most MOOCs platforms and courses were overly reliant on implementing teaching and cognitive presence strategies, while undermining the social presence strategies of the CoI framework.

In conclusion, based on these findings, important implications of this study for teaching and learning included more constructivist learner-centered pedagogical approaches. Additionally, derived from these findings, the instructional design aspect of MOOCs will need to be strengthened.

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APPENDIX

APPENDIX

Default Question Block

Q17.

Community of Inquiry - Rubric

Instructions: Read the following items and rate the degree to which these are or are not met by the MOOC platform under examination. Provide a comment to explain your rating.

Q19.
Rating scale
1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

Q14. Select the MOOC's platform that will be evaluated
MOOC's platform: ▼

Q47.

Teaching Presence

Q46.
Design & Organization
This aspect of teaching presence entails that the instructor:

- ☐ Clearly communicates important course topics.
- ☐ Clearly communicates important course goals.
- ☐ Provides clear instructions on how to participate in course learning activities.
- ☐ Clearly communicates important due dates/time frames for learning activities.

Q1. Rate level of agreement

	1	2	3	4	5
1. The platform provides affordances that allow the instructor to design and organize a course	○	○	○	○	○

Q25. Comments:

Q48.

Facilitation

This aspect of teaching presence entails that the instructor:

- ☐ Helps in identifying areas of agreement and disagreement on course topics that help participants to learn.
- ☐ Helps in guiding the class towards understanding course topics in a way that help participants clarify their thinking.
- ☐ Helps to keep course participants engaged and participating in productive dialogue.
- ☐ Helps to keep the course participants on task in a way that helps participants to learn.
- ☐ Encourages course participants to explore new concepts in this course.
- ☐ Reinforces the development of a sense of community among course participants.

Q2.

Rate level of agreement

	1	2	3	4	5
2. The platform provides affordances that allow the instructor to facilitate a course	○	○	○	○	○

Q26. Comments:

Q49.

Direct Instruction

This aspect of teaching presence entails that the instructor:

- [ ] Helps to focus discussion on relevant issues in a way that helped me to learn.
- [ ] Provides feedback that helped me understand my strengths and weaknesses.
- [ ] Provides feedback in a timely fashion.

Q3.

Rate level of agreement:

	1	2	3	4	5
3. The platform provides affordances that allow the instructor to deliver direct instruction	○	○	○	○	○

Q28. Comments:

Q50.

Social Presence

Q51.
Affective expression
This aspect of social presence entails that participants:

- ☐ Get to know other course participants, so as to give them a sense of belonging in the course.
- ☐ Are able to form distinct impressions of some course participants.
- ☐ Perceive online or web-based communication is an excellent medium for social interaction.

Q4. Rate level of agreement:

	1	2	3	4	5
4. The platform provides affordances that allow participants to engage in affective expression	○	○	○	○	○

Q30. Comments:

Q31.
Open communication
This aspect of social presence entails that participants:

- ☐ Feel comfortable conversing through the online medium.
- ☐

Feel comfortable participating in the course discussions.

Feel comfortable interacting with other course participants.

Q5. Rate level of agreement:

	1	2	3	4	5
5. The platform provides affordances that allow participants to engage in open communication	○	○	○	○	○

Q33. Comments:

Q55.

Group cohesion

This aspect of social presence entails that participants:

Feel comfortable disagreeing with other course participants while still maintaining a sense of trust.

Feel that their point of view is acknowledged by other course participants.

Feel that online discussions help them to develop a sense of collaboration.

Q6. Rate level of agreement:

	1	2	3	4	5
6. The platform provides affordances that allow participants to develop group cohesion	○	○	○	○	○

Q35. Comments:

Q56.

Cognitive Presence

Q57.

Triggering event

This aspect of cognitive presence entails that:

- ☐ Problems posed increase participants' interest in course issues.
- ☐ Course activities pique participants' curiosity.
- ☐ Participants feel motivated to explore content related questions.

Q7. Rate level of agreement:

	1	2	3	4	5
7. The platform provides affordances that allow designers to embed triggering events	○	○	○	○	○

Q39. Comments:

Q58.
Exploration

This aspect of cognitive presence entails that:

- ☐ Participants utilize a variety of information sources to explore problems posed in a course.
- ☐ Participants resolve content related questions through brainstorming and finding relevant information.
- ☐ Participants find online discussions valuable in helping them appreciate different perspectives.

Q8. Rate level of agreement:

	1	2	3	4	5
8. The platform provides affordances that allow designers to help participants to engage in exploration	○	○	○	○	○

Q41. Comments:

Q59.
Integration

This aspect of cognitive presence entails that:

- ☐ Combined new information helps participants answer questions raised in course activities.
- ☐ Learning activities help participants construct explanations/solutions.
- ☐ Reflection on course content and discussions help participants understand fundamental concepts in this class.

Q9.
Rate level of agreement:

	1	2	3	4	5
9. The platform provides affordances that allow designers to help participants to engage in integration	○	○	○	○	○

Q43. Comments:

Q60.
Resolution

This aspect of cognitive presence entails that:

- ☐ Participants can describe ways to test and apply the knowledge created in this course.
- ☐ Participants can develop solutions to course problems that could be applied in practice.
- ☐ Participants can apply the knowledge created in a course to their work or other non-class related activities.

Q10. Rate level of agreement:

	1	2	3	4	5
10. The platform provides affordances that allow designers to potentially help participants engage in resolution	○	○	○	○	○

Q45. Comments: