

Interrelation between Pedagogical Design and Learning Interaction Patterns in different Virtual Learning Environments

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Abstract. Different virtual learning environments offer different affordances and pedagogical design for learning interactions which results in difference learning interaction patterns. With the emergence of a new era in VLE (virtual learning environments) a new set of affordances is needed to support the appropriate learning interactions. We argue that there is a strong interrelation between the pedagogical design and learning interaction patterns in a given VLE which is influenced by the affordances of that VLE. In order to create a set of affordances that support learning interactions within the DLE, there is a need of analysis of already existing learning interaction affordances across different platforms.

1 Introduction

Different virtual learning environments offer different affordances and pedagogical design for learning interactions, which results in difference learning interaction patterns. With the emergence of a new era in VLE (virtual learning environments) a new set of affordances is needed to support the appropriate learning interactions. We argue that there is a strong interrelation between the pedagogical design and learning interaction patterns in a given VLE, which is influenced by the affordances of that VLE. In order to create a set of affordances that support learning interactions within the DLE, there is a need of analysis of already existing learning interaction affordances across different platforms.

In this paper we examine the pedagogical designs and learning interaction patterns in VLEs like EduFeedr, Massive Open Online Courses platforms Coursera, Udacity, traditional LMSs and explore their interrelation patterns with pedagogical design of each course. The typology of the pedagogical design and interaction patterns will be based on the Communities of Inquiry [1,2,3,4].

Teaching is a design profession, today more than before. We define pedagogical design in line with Romizowski [5] as systematic choice and use of procedures, methods, prescriptions, and devices in order to bring about effective, efficient, and productive learning. In addition to European tradition of didactic design based on heuristic guidelines, there exist several formalised and prescriptive instructional design models (e.g. [26,27,28]). As we are interested in actual pedagogical design models implemented by teachers who do not have any training or guidelines in the

domain of instructional design, we use IMS Learning Design for representing differences of pedagogical designs in online courses.

2 Interaction Patterns

According to Wagner's definition interaction is "Reciprocal events that require at least two objects and two actions. Interactions occur when these objects and events mutually influence each other" [6]. Interaction has a specific function and value in education for it creates a big portion of the learning ambience.

Holmberg [7] introduced the notion of "guided didactic discussion", where the student-teacher interaction is mainly text-based and a teacher is guiding the student through the learning process with the help of didactic discussion. This notion is very much related to the Moore's Theory of Transactional distance [8] - transactional distance is where he differentiates between a dialogue and interaction "dialogue" being loaded with the sense of meaningful interaction. As Anderson notes, interactions are too many including human and inanimate [3]. Distance education theorists have broken the concept down to mainly based on the roles of the human and inanimate actors.

Moore's theory of Three Types of Interaction [9] includes learner-content, learner-instructor, learner-content and is the first systematic approach to defining the typologies of interactions in distance education. For Moore the first type of interaction - learner-content is connected to the Holmberg's notion of *internal didactic conversation* and is the defining characteristic for the education, while the learner-instructor is a four-stage support of the learner 1. Designing the content including maintaining motivation, self-direction 2. Making presentations - from students or teachers themselves. 3. Practice and apply acquired competences. 4. Counseling and encouragement of learners according their levels of progress. The third type of interaction – learner-learner for Moore was a new dimension in the distance education and he indicates on its importance but also stresses its dependence on circumstances – like age of the, experience and the level of "inner autonomy".

One part of "indirect" impacts of the interactions is covered by Sutton [10] that introduced the notion of vicarious interaction defined as what "takes place when a student actively processes both sides of a direct interaction between two other students or between another student and the instructor".

Anderson has expanded Moore's three dyads of interaction - learner-content, learner-teacher and learner-learner to include content-teacher, content-content and teacher-teacher interactions [4]. Anderson's model is learning-centred and also takes into account material resources. The main idea of the Equivalency theorem is that in order the learning to take place, one of the interactions shall be at a high level. Other dyads of interaction can add value and increase the quality of learning but it must also estimate the costs of resources for these types of interactions.

Learning interactions have been regarded in the context of Technology-Enhanced Learning as an important unit of analysis and they have been studied by the community of educational researchers from various perspectives [4, 11]. Most of the research is based on the data collected through learner-reported surveys [11,12, 13] educational data mining techniques [14,15], qualitative text analysis [16] or social network analysis [17]. In our study, we will use content analysis technique and count

interaction pattern frequencies and map them to Conole's *Learning Activity Taxonomy* [18]. Conole's taxonomy contains six types of tasks:

- **assimilative tasks**, e.g. reading, viewing or listening;
- **information handling**, e.g. gathering and classifying resources from the Web or manipulating data;
- **adaptive**, e.g. engaging learners in using modelling or simulation software;
- **communicative**, e.g. engaging learners in debate or group discussions;
- **productive**, e.g. actively constructing an artefact such as a written essay, production of a new piece of software or creation of a video clip;
- **experiential**, e.g. practicing skills in a particular real-life context, engaging in live role-play or undertaking an investigation offline.

3 Beyond Counting the Frequencies of Interactions

Within the model of the communities of inquiry different types of interactions are crucial for the learning [1,9,19]. But still interaction is different from presence, interaction does not guarantee the presence itself, these interactions are the building blocks towards the presences in the communities of inquiry. Interaction alone is not enough for the purposes of inquiry and cognitive presence. Therefore the model of the community of inquiry consists of the three core elements that go beyond the social exchanges [3] Understanding the interaction nature of interaction is not simple - though interaction does not always lead to social presence [20] it is the interaction that mostly affects social and cognitive engagement of the students in an online course.

The model of this Community of Inquiry assumes that learning occurs within the Community through the interaction of three core elements [1] CoI model core elements are three presences: Cognitive presence, Social presence and Teacher presence and each of the presences contain hierarchies.

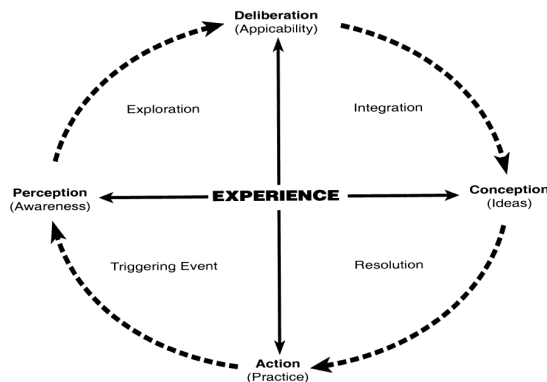


Fig. 1. From Garisson et al [1]

Cognitive presence is the basic element for success of educational experience [1]. It had been conceptualized as “practical inquiry” and has four stages of development:

1. Triggering event – experience resulting in a feeling of unease puzzlement.
2. Exploration - search for information, knowledge alternatives that might help to make sense of the situation or problem
3. Integration – this phase integrates information and knowledge into a coherent idea
4. Resolution – resolution of a problem or issue

Practical inquiry is the variation of *Cognitive Presence* and it’s presented as a holistic, phased model that starts with *triggering event* that is later followed by: *exploration, integration* and *resolution* phases. For the authors of the framework, cognitive presence is not a stand-alone process internalized in one’s mind only and it is an interaction of personal and shared worlds.

The second core element of CoI is *Social Presence*, which again represents a phased process:

1. Emotional expression – establishment of emotional ambience with the help of emoticons, symbols, humor or self-disclosure
2. Open communication – exchange, mutual awareness, and recognition between the messages that facilitate the process of shaping the learning activities of each participant.
3. Group cohesion - group commitment, sense of togetherness, belonging.

Social presence creates a supportive context for building understanding and ease of communication, thus maintaining the educational community.

Teacher presence is the connecting element of the CoI model [1]. For the authors of the CoI model both – cognitive and teaching presence depend on the presence of the teacher, especially in the VLE. If the educational experience fails, then it is the lack of teacher presence is to blame. Teacher presence can be assessed based/through on the instructional design. Teacher presence consists of:

1. Instructional management – is about setting curriculum, designing methods and assessment means, effective use of the medium.
2. Building understanding – it aims at the construction of collaborative community and academic integrity through sharing meaning, seeking understanding.
3. Direct instruction - it’s the ultimate teaching responsibility through the presentation of content, questions and proactively guiding and summarizing the discussion.

4 Three Types of Interaction and CoI model

Swan views Moore's theory of three types of interaction and CoI model as connected concepts, whereas each of the types of interactions correspond to each of the presences.

1. Teaching presence - teacher-learner interaction.
2. Cognitive presence – learner-content
3. Social presence – learner-learner

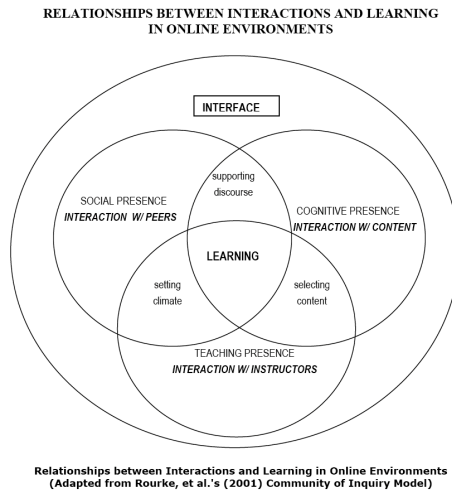


Fig. 2. From Swan [21]

Swan [22] assessed the three types of interaction in the asynchronous online course based on a student-reported survey student satisfaction and perceived learning: her findings for *learner-content* interaction support Moore's theory of interaction and CoI model. "student who reported higher levels of activity in courses also reported higher level of satisfaction and higher levels of learning from them". *Learner-teacher* interactions – her research reports the importance of teacher-student interactions, students with no adequate access to the instructor have less satisfaction and lower perceived learning. *Learner-learner* interactions – are also very important and are in line with Moore and CoI model. Swan's research also tackles the issue of the course design factors and their relation to the interaction patterns – according to the findings, course designers are more influenced by the online environment constraints, than by their affordances. She defines six aspects of course design that affect interactivity in the courses:

1. Frequency of interaction with the instructor
2. Whether there existed any gaps.
3. Frequency of interaction among classmates.
4. Required student participation in course discussions.
5. The authenticity of that discussion
6. Average length of discussion responses.

These factors were correlated to the student perception variables and the findings show that *Learner-content* interaction is influenced by consistency among course modules but no significant correlation was found between course design factors and student perceptions, though Swan also refers to the affordances and constraints of the VLE. No significant results were found for *Learner-teacher* interaction. In *Learner-learner* interaction, strong correlation was found between students' perceptions of their interactions with peers and the actual frequency of interactions between students.

Though the CoI model had been regarded as holistic model for assessing the effectiveness of teaching/learning processes in online communities, much studies concentrate on one of the presences. As we consider that the types of interactions within the CoI model shall be assessed in relation with each other as they are interconnected concepts and necessary for the successful learning. We counted the publications on the official CoI website at coi.athabasca.ca having in mind that the papers listed here are regarded as the most influential: CoI papers – 28, Cognitive presence – 22, Social presence – 10, Teaching presence – 14. Although there is high number of CoI papers listed on the website, altogether much more research is concentrated on assessing single aspect of CoI model (46 publications). We think that, In order to evaluate the existing interaction patterns in different VLEs and get the complete picture, we considered assessing all three core presences in different environments.

5 Methodology

The study used content analysis based on the coding template, which is was validated by several studies [1,2,23,24]. The coding template is directly based on the phased presences in Communities of Inquiry.

Based on the review of several similar studies [1,2,23,24] with the same coding template, we chose the whole message as a unit of analysis. Some of the messages contained two codes from two presences (social and cognitive). Two coders (the authors) coded text consolidated in Coding Analysis Toolkit¹ and coded independently. Coding scheme was developed and discussed. Initial reliability was established. Ethical considerations were followed, the discussion forum messages had been anonymised. In the discussion on results we did not disclose any information about the participants or the names of the sample courses.

¹ <http://cat.ucsur.pitt.edu>

Table 1. Coding template based on CoI approach

Element	Category	Indicators
Cognitive Presence	1. Triggering Event	Sense of puzzlement
	2. Exploration	Information exchange
	3. Integration	Connecting ideas
	4. Resolution	Applying new ideas
Social Presence	5. Emotional Expression	Expression of emotions, use of humor, self-disclosure
	6. Open communication	Continuing a thread, quoting from others
	7. Group Cohesion	Encouraging collaboration
Teaching Presence	8. Instructional management	Defining & initiating discussion topics
	9. Building Understanding	Sharing personal meaning
	10. Direct Instruction	Focusing discussion

6 Sampling

We chose 4 different platforms and 1 course from each to analyse. These courses were chosen from a larger set of courses (a convenience sample, accessible for authors), which we considered as typical for four different virtual learning environments: Coursera, eDX, Moodle and EduFeedr. As the whole dataset for these four courses was too large for analysis, we decided to analyse only the learning resources, assignments and interactions from the 4th week of each course. General discussion topics that were not directly connected to the weekly thematic discussion, were also included in the sample based on the timeframe of that week.

Course 1 (MOOC in Coursera): The course was mostly a video-driven. The videos contained in themselves some interactive quizzes. The platform affordances included discussion forums and wikis. Wikis were not used at all and discussion forums were used separately from the instructional design. The discussions were organized according to study weeks and also contained some general discussions, technical forums. Threads emerged on the bases of the learner interest; they were never used as a part of the assignment and never teacher-led. Teacher presence and facilitation was present in almost every thread. The task for week 4 was information handling.

Course 2 (MOOC in EdX): The course affordances include embedded forums within the video lectures, interactive assignments, discussion topic was also given in every thematic unit (study week) and were organized within the thematic unit. The discussion was triggered by the teacher and given particular question to answer to. The instruction never participated in the discussions besides giving the direct assignment. The task for week 4 was adaptive.

Course 3: The platform was one of the mostly used LMS: Moodle. The difficulty we faced was with choosing a course that used discussions (being a part of instructional design or as a stand-alone). The teacher, giving a task to discuss, initiated the discussion. Teacher never participated in the discussion; neither were any continuity in the threads – only one post per participant and no single case of uptake [25] was shown. The task for week 4 was assimilative.

Course 4. A course that made use of blog-based personal learning environments together with aggregator called Edufeedr². Weekly assignments and learning resources were available in the teacher’s blog, each student reflected on his/her learning experiences in a personal blog, which was then commented by teacher. The course was assignment-driven, discussion between students took place rarely. The task for week 4 was combination of assimilative and productive.

7 Results and Discussion

Distribution of interaction events by CoI categories shows significant differences between four courses (see Table 2 below). While in two MOOCs the interactions indicating the social presence were clearly dominating and learners themselves often triggered content-related discussions, Moodle course induced mainly exploration and integration events. EduFeedr course distinguished with strong teacher presence, but also with integration and resolution events. Those differences can be partly attributed to pedagogical design, especially in case of Course 3 and Course 4. Domination of open communication in Coursera and EdX courses occurred in spite (not due to) the pedagogical design. We also strongly believe that differences in interaction patterns was influenced by the number of learners and affordances of virtual learning environment.

Table 2. Comparison of four courses regarding to interaction types

	Coursera	EdX	Moodle	Edufeedr
1. Triggering event	17.24%	10.76%	0%	0%
2. Exploration	7.95%	17.59%	51.16%	1.33%
3. Integration	10.51%	13.12%	34.88%	28%
4. Resolution	6.72%	6.82%	0%	20%
5. Emotional expression	4.52%	5.51%	0%	4%
6. Open communication	38.63%	28.61%	0%	13.33%
7. Group cohesion	.37%	1.84%	0%	0%
8. Instructional management	4.77%	6.82%	9.3%	5.33%
9. Building understanding	4.03%	1.05%	0%	18.67%
10. Direct instruction	4.16%	4.72%	4.65%	9.33%
0. Other	1.1%	3.41%	0%	0%

² <http://www.edufedr.net>

8 Conclusion

While our small sample of courses and focus on the activities of a single week in each course does not allow generalizations, we have demonstrated the method for analyzing interrelations between pedagogical design and learning activity patterns in Web-based learning environments. In order to achieve reliable results, the similar study has to be conducted on a larger scale.

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