cogent education

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Teaching to emerge: Toward a bottom-up pedagogy

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Abstract: This paper focuses on the conceptual model of an academic course inspired by complexity theory. In the proposed conceptual model, the aim of teaching is to form a learning organization: a knowledge community with emergent properties that cannot be reduced to any linear combination of the properties of its parts. In this approach, the learning of the participants depends not so much on their individual action, as on being the coevolving parts of a self-organized whole. In this design, the role of the educator is to catalyze emergence and to facilitate bottom-up knowledge production. To achieve this, we present a systematic way to orchestrate in-class face-to-face activities in small groups while utilizing common web technologies to facilitate online collective action.

1. Introduction

The present case study describes a complexity based approach to collaborative learning that incorporates face-to-face small group work, individual reflective blogs, a facilitated meta-narrative on a cloud document, and subsequent collective editing. The overall process is based on the principles of

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PUBLIC INTEREST STATEMENT

Today we are faced with an unprecedented set of challenges that cannot be addressed by any of us individually. Climate change, the overexploitation of environmental resources, financial crises, war, violence, poverty, and affronts to basic human rights and needs raise calls to action. How does a bottom-up pedagogy based on group work and inspired by complexity theory connect with these callings? These challenges not only defy individual action; they defy even actions attempted by linearly summing our forces. They demand complex collective action within an organized whole that is greater than the sum of its parts. We have implemented such a systemic stance in the context of the classroom as a step in this direction. In an inherently complex universe, continuing to impose linear educational interventions no longer serves society. We propose group work within a complexity theory framework as a new model for educating the next generation of global citizens.

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complexity theory: "a way of thinking about the world which is founded on an ontological understanding of much of that world as being composed of interacting and dynamic complex systems" (Byrne, 2014, p. 40). The proposed pedagogical model was developed for a senior level course on *Internet Cultures* offered at the authors' university (Psychology Department, Panteion University; Athens, Greece) during the spring semester of the 2014–2015 academic years. The class was comprised of 25 actively engaged students. The lecture component of this course was substantially reduced in length from the onset and eventually was replaced entirely by intensive face-to-face small group work sessions. Following small group transaction, students were asked to reflect on their experience and post their reflections to their own online blogs. Each individual reflection was automatically pulled and aggregated on a hub site to initiate the "groupsourcing" creation of the course notes in the form of a digital document stored in the cloud. The technical design and implementation of this system are described in detail in Brailas, Koskinas, and Alexias (2016). Here, we present the theoretical underpinnings, and a method to organize and structure such a course mode.

To articulate a pedagogical model based on systematic in-class group work that is compatible with the principles of complex living systems, we brought together insights from complex systems pedagogy along with group work techniques developed in group psychotherapy practice. This is a group-as-a-whole pedagogical approach in the sense that the learning of the individuals depends not so much on their own "heroism" but on being part of a successful learning group (Agazarian & Gantt, 2000). In this model, the role of the teacher is to provide a structure for the learning organization that will permit it to thrive as a whole, to delegate responsibility to the participants, to be clear about the educational goals, to give clear guidelines, and, most of all, to be an active "guide on the side," as described by King, in contrast to the traditional "sage on the stage" (1993). Thus, the role of the teacher can be better described as the initiator, the facilitator, and the catalyzer of a complex group process. After providing the initial structure for the group process, the facilitator steps to the side (Owen, 2008) and lets the process evolve over time, intervening whenever required. In this conception of teaching, the teacher tries not to control the learning group in an authoritative manner, as "an autopoietic system cannot easily be directed from the outside" (Ricca, 2012, p. 35). Instead of seeking authoritative control, the teacher tries to catalyze the learning process by establishing at every moment a short "predictability horizon" (Katerelos & Koulouris, 2004; Weichhart, 2013) to work within. The course design based on this complexity approach can be summarized in the following points:

- The class as a whole group is presented with a high-interest artifact that is relevant to a substantive topic of the course curriculum, and this is quickly followed by small group discussions structured and facilitated by the educator in the role of "guide on the side."
- Following the small group discussions, the participants contribute personal reflective posts on their own blogs (retaining the ownership of their posts).
- The educator acts as a model of the ideal connected-learner in a networked era; "Listen deeply and tell one story" was the slogan we used in the group's mashup site—a web aggregator hub of the participants' blog feeds.
- The educator facilitates creation of a meta-narrative essay, in the form of a synthesis of participants' reflective blogs, which is subsequently uploaded to a cloud service (such as Google docs) for further collective editing.
- The group members' reflective posts act as an *information filter* on the abundance of information that exists about their substantive topic of interest.

The overall course design is graphically represented in Figure 1. The innovation in the proposed design lies in the combination of face-to-face small group sessions of intensive collaborative inquiry with the online reflective practice in students' blogs and the subsequent collective production of a meta-narrative artifact. The group's face-to-face transaction is functionally extended and continued online by utilizing participatory web media: personal, student-owned blogs, and collectively created and shared web documents.

Figure 1. A collective reflective learning model in a blended (face-to-face plus online) activity space. The group's transaction, in the form of a focused discussion about their substantive subject of study, takes place face-to-face in small groups, while personal blogging, post aggregation and collective narrative essay writing take place online (Brailas et al., 2016).
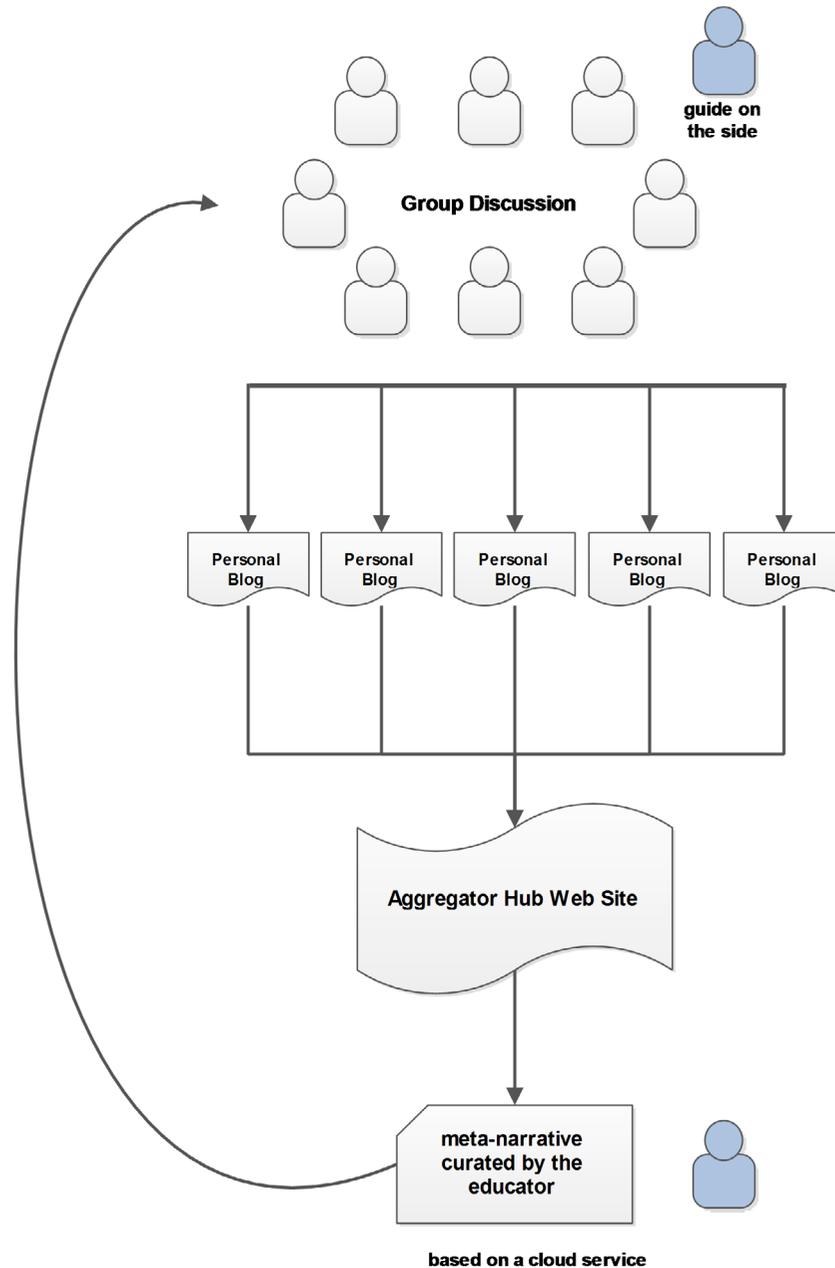
Teacher facilitated face-to-face collaborative inquiry in small groups has significant implications for the teacher's authority in the classroom. This approach to teaching constitutes a paradigm shift that is not easy to implement. The educator has to step out of her traditional role and to move beyond being the group's center to being the group's facilitator: "Even when our traditions are flawed, at least they are comfortable flaws. Change invites fear of what follows" (Gergen, 2009, p. xxv).

The paradigm shift from the "sage on the stage" to the "guide on the side" model in an educational environment (King, 1993) transforms the teaching and learning experiences of the participants. However, simply moving to the side of a group process is not a sufficient condition to ensure that the group will form a learning organization (Senge, 2006) and thrive as a whole (Weichhart,

2013). Stepping down from the "stage" does not automatically result in transforming students into active learners who are willing to get involved in meaningful transactions, especially in an educational culture in which many students have been conditioned to passive rule-following and rote memorization of course notes. Self-organization requires members to be attuned as the parts of a greater whole, as the constituent parts of a complex formation. In this conception, the word *guide* is critical. In this paper, we present a systematic way for the facilitator to organize group work inside and outside the classroom and to be an active guide on the side of the group's process. We show how the facilitator can nurture an effective learning organization in the context of a complexity-inspired educational culture.

2. Theoretical background

The learning organization (Senge, 2006) is a complex formation, a living social system with emergent properties (Capra & Luisi, 2014). As an inseparable part of this learning organization, the teacher has the unique opportunity to learn along with all the other members/students. While acting as a facilitator, as a guide on the side, the teacher cannot avoid personal development, growth, and learning as a "side-effect" of her coevolution with the individual participants, and also through her coevolution with the group-as-a-whole. Teacher and students constitute a complex organization, a self-organized learning entity in the way that Kauffman (1996) describes living coevolving systems:

> In coevolving systems, each partner clambers up its fitness landscape toward fitness peaks, even as that landscape is constantly deformed by the adaptive moves of its coevolutionary partners. [...] As if by an invisible hand, each adapting species acts according to its own selfish advantage, yet the entire system appears magically to evolve to a poised state where, on average, each does as best as can be expected. (p. 24)

According to Kauffman (1996), between the biological systems and other social systems there appears to be an isomorphy similar to that between economic and the technological evolution. A learning organization holds emergent properties (Weichhart, 2013) that do not exist in any of its parts alone—emergent properties that come as the product of the group's transactions and its members' synergies. Therefore, a learning organization can be conceived of as a living system with emergent properties that cannot be reduced to any linear combination of the participants' properties:

> Life, in this view, is not to be located in its parts, but in the collective emergent properties of the whole they create. Although life as an emergent phenomenon may be profound, its fundamental holism and emergence are not at all mysterious. A set of molecules either does or does not have the property that it is able to catalyze its own formation and reproduction from some simple food molecules. No vital force or extra substance is present in the emergent, self-reproducing whole. But the collective system does possess a stunning property not possessed by any of its parts. It is able to reproduce itself and to evolve. The collective system is alive. Its parts are just chemicals. (Kauffman, 1996, p. 24)

The familiar saying is, "*The whole is greater than the sum of its parts*." However, emergence does not imply a kind of superiority; emergence implies differentiation, something that can be realized only at the group-as-a-whole level. As Lewin suggests, "The statement should be: The whole is *different from* the sum of its parts." (1951, p. 146). A living system is always situated in a hierarchical context of isomorphic systems with emergent properties that are energy-organizing, goal-directed, and self-correcting (Agazarian, 1992). From a complex perspective, there is a need to treat the teacher, the students, and the teaching process as the complex constituent parts of a complex greater whole with emergent properties: what Ricca (2008) defines as the enframing of situations.

Today's participatory web tools can facilitate collective and cooperative online action (Tsekeris & Katerelos, 2012); there are many ways to collectively produce innovative digital artifacts, and brand new ways are being devised and proposed almost daily (Brailas et al., 2016). However, putting complexity based pedagogy as a preliminary step to the use of participatory web tools is absolutely

necessary to make the difference in learning. Otherwise, the networked class will simply replicate the same systemic problems that existed long before the advent of modern web technologies.

The critical questions to answer before proposing a complexity inspired group-based pedagogy are: "Why should we work collaboratively in the first place?; What is the objective?; and, How will this objective be better served by asking students to work in groups and post their individual reflections on blogs?" Learning, according to Robinson and Aronica, "is the process of acquiring new knowledge and skills. Human beings are highly curious learning organisms" (2015, p. xi). Although we agree with this definition of learning when we refer to individuals, we also think of learning as a property of the group-as-a-whole. We contend that there is a kind of knowledge that is situated at the group level, at least in the sense that there are some challenges that can be addressed only by the concerted collective action of all group members. This knowledge can be realized as the emergent property of the group-as-a-whole; it is the byproduct of members' synergies. From this perspective, learning is a social phenomenon situated in the group level; learning is a pattern of students' purposeful interaction.

If learning is about knowledge and co-action, education is about organized programs of this kind: "The assumption of formal education is that young people need to know, understand, and be able to do things that they wouldn't if left to their own devices" (Robinson & Aronica, 2015, p. xii). Traditional education can be better understood as a planned enculturation process (Osberg, 2005), aiming to drive students from a known starting point to a known final one:

> Educational environments are designed specifically to move a person—intellectually—from point A to point B. To do this we must know what the starting point is and what the finishing point is. For example to produce "creative" people, or "politically responsible" people we must first of all know the nature of the human subjects we are dealing with. Second, we must know what it means to be "creative" or "politically responsible." Then we must have a plan or method to move A to B. (Osberg, 2005, p. 81)

Therefore, before answering the critical question, *Why a group-based pedagogy?*, we should answer the even more fundamental question, *What is the finishing point we are looking for?* What are those things that young people need to know, understand, and be able to do? What are the specific skills that are required by individuals to be functional and competent members of a modern society? *Training* is a type of education that is focused especially on learning those specific skills (Robinson & Aronica, 2015). Training activities should be part of a modern schools' curriculum and incorporated into academic courses to provide young people with all the required fundamental knowledge and professional skills. However, "From a complexivist perspective, the problem with this conception of education—as planned enculturation—is that it is based on the notion of linear progression and determinism" (Osberg, 2005, p. 82). The world was never a deterministic automaton; life is only possible far away from the equilibrium (Prigogine & Stengers, 1997). Today, maybe more than ever before, we are facing complex challenges—challenges we have yet to invent ways to tackle: "the population of the world has doubled from less than three billion to more than seven billion. We are the largest population of human beings ever to be on Earth at the same time, and the numbers are rising precipitously" (Robinson & Aronica, 2015, p. xv). Such challenges are so complex that collective action is required to address them. If we want education to provide young people with the necessary affordances for collective action, if we want education to be a planned enculturation process to a point that cannot be envisioned yet, "we have to get away from linear and deterministic logic without giving up the idea that education is about purposely shaping human subjectivity" (Osberg, 2005, p. 82).

We think a combination of face-to-face and online interactions can be an effective way to engage students in meaningful complex transactions. Interacting in a group, negotiating a common purpose, and doing things together are the prerequisite essentials to fostering a complex learning system. However, it is crucial to organize and plan student's group work carefully; otherwise, it can be a

source of frustration for students and teacher alike, and, in the end, it can feel like a waste of time (Konza, Grainger, & Bradshaw, 2001). A common complaint of educators when they try to engage students in group work is that usually only a few students do all the work, and the rest of the students are just benefiting from those charismatic few. That is why we propose that group work should take place during a face-to-face session, in the *here and now* of a lesson's space and time, with the educator present in the role of the group facilitator.

In group psychotherapy, the group is the agent of change (Yalom & Leszcz, 2005); we propose an analogous group-based pedagogical model, where the group is the agent of learning. In a small group session, "students are confronted by different interpretations from their peers, and learning proceeds by comparing, contrasting and criticizing these interpretations" (Jackson & Prosser, 1985). Once the student groups are formed, the educator's effort should be directed toward building a group work culture. To accomplish this, there is a need to establish and negotiate a set of rules and behavioral norms, both written and unwritten, that will guide the groups' work and their members' transactions. Establishing a group culture is not an easy process and requires substantial effort and allocation of sufficient time. The educator is responsible for creating and maintaining the space and the time for the group work. This space and time must be as inviolable as possible.

3. Imparting information into the group—the MacGuffin technique

In preparing for small group sessions, there are many practical challenges to be considered. Group work is usually organized around a specific task related to the course content and syllabus (Arthur-Kelly, Lyons, Gordon, & Butterfield, 2006). Viktor Frankl, quoting Nietzsche's work, contends that "He who has a *why* to live for can bear with almost any *how*" (Frankl, 2004, p. 109). Frankl is famous for his approach in psychotherapy called *Logotherapy,* that term originating from the Greek word *Λόγος,* meaning the ultimate purpose, the aim of a living organism. To paraphrase Nietzsche's words, we can say that a group (when treated as a whole, as a living human system) who has a *why* to work for can bear with almost any difficulty, external or internal. The chosen tasks for group work should be relatively easy to cope with, at least at the beginning of the semester, while still challenging enough to provoke students' interest and engagement (Konza et al., 2001).

We proposed and utilized the term *MacGuffin* artifact to describe the group's initial stimulation, the imparting of information, and the schema activation (Manzo & Manzo, 2001) that takes place in every face-to-face session in the proposed pedagogical model. What is a MacGuffin? According to Wikipedia:

> In fiction, a MacGuffin is a plot device in the form of some goal, desired object, or other motivator that the protagonist pursues, often with little or no narrative explanation. The specific nature of a MacGuffin is typically unimportant to the overall plot. Usually the MacGuffin is the central focus of the film in the first act, and thereafter declines in importance. It may re-appear at the climax of the story, but sometimes is actually forgotten by the end of the story. (MacGuffin, 2015)

The reason we exploit the term *MacGuffin* as a metaphor for the artifacts used to ignite the group's *why power* is to emphasize the point that although the stimulus for the small group work should be in some way relevant to the lesson's substantive topic, and should focus the group's work on a specific topic while indirectly imparting information into the group, the ultimate aim of that stimulus is to engage group members in a meaningful, purposeful transaction. The main purpose of the MacGuffin artifact is not only to focus the participants' attention on a specific topic and activate their cognitive schemata (Manzo & Manzo, 2001) but also to serve as an icebreaker—a prompt to facilitate the initiation of a dialog among the small group participants. Thus, a MacGuffin artifact could be a trending YouTube video clip, an inspiring TED talk, a thought provoking web page, a scientific article, a book or any other digital or analog artifact that can be experienced by the participants in the classroom soon after they enter each face-to-face class session. A recent report indicates that nearly half of higher education faculty in the United States already occasionally incorporates YouTube or other

videos in their courses (Eagan et al., 2014). In the proposed model, MacGuffin artifacts are used on a regular basis, in every class session, to initiate the group process and focus members' attention on a topic at hand.

At the beginning of each in-class session, the educator welcomes the students, and the MacGuffin artifact is experienced. There may be no need for an introductory lecture before the MacGuffin artifact is provided. The adoption of a small group teaching approach requires a de-lecturing strategy (Jackson & Prosser, 1985). However, an optional short lecture of introduction to the lesson's topic can be delivered. If that is the case, the purpose of the lecture is to smoothly introduce students into the small group transactions. During the first class meetings, early in the semester, this introductory lecture is probably more necessary. Students may need time to get acquainted with an educational culture in which the teacher is not the sage on the stage. When students encounter this culture for the first time, it may feel strange and unfamiliar, and could raise doubts and concerns. An uncommon course design can cause extreme reactions among students, ranging from stress to panic (Barney & Maughan, 2015; Ricca, 2012). However, the introductory lecture component should gradually be shortened, and eventually dismissed. Given the limit on classroom time, emphasis on group work imposes the reduction of the lecturing component (Jackson & Prosser, 1985). The topic component of a lesson is about the dissemination of knowledge; the personal interaction component is about how this knowledge is generated before being disseminated. Topic and interpersonal communication are interdependent, and vary inversely: "the more the emphasis on the topic, the less the emphasis on the personal component in the communication and vice versa" (Agazarian & Gantt, 2000, p. 48). An optimal mix of lecturing and group work should be selected by the teacher, in accordance with the group's state of preparedness: "The experienced teacher, of course, is intimately familiar with striking the balance between classroom and lesson structures that are too rigid to allow for innovative responses and structures that are too loose to enable coherent activity" (Davis & Sumara, 2006, p. 103).

In this complexity inspired group work, the didactic component should be implicit; the facilitator tries not to offer explicit didactic instruction, and members' transactions are the main vehicle for distilling the information embedded in the MacGuffin artifact, conveying meanings and co-producing knowledge. If necessary, this knowledge can be enriched and supplemented later with homework assignments that incorporate some kind of bibliography research. In this way, the facilitator also acts as the mediator between an external knowledge community and her students (Harasim, 2012). In the proposed pedagogical model, the group based teaching can be easily combined with a flipped classroom approach, where students first experience the lesson content outside the classroom, and then class time is used to practice, apply, and/or interact with peers about the content.

The most important aspect in a group-based pedagogy is members' interactions and their engagement in meaningful transactions. It is the transaction that pushes the group beyond the complexity threshold and allows complex properties to emerge as the byproduct of members' synergies. Thinking of a group as a growing, living system implies that we can try to catalyze, we can facilitate, but we cannot control the outcome of the group's transaction: "Complex systems grow organically; they are not systems assembled piece by piece as a car on an assembly line" (Ricca, 2012, p. 32). If we try to manipulate the group's process, we will deprive the group of its chaotic and unexpected component, and we will fall short of emergence. If information "is controlled through a central hub—that is, if the architecture of the system is Euclidean—then emergent possibility is unlikely" (Davis & Sumara, 2006, p. 105). However, as we have noted above, this paradigm shift is not an easy one: there is a need for a systematic way to orchestrate meaningful group transaction.

4. Engaging students—from the individual to the whole group level

Following presentation of the MacGuffin artifact in a plenary group meeting, it is now time to let students work productively in small groups. A small group can be defined as one sized from three to five members. In the small groups, students must feel free to express their thoughts and ideas, to comment on each other's opinions. Therefore, the main concern of the facilitator is "to suspend

judgment in favor of further exploration of the students' meanings, histories, and cultures. It is this ability to follow a student wherever she leads and do something helpful in response that requires improvisation on the part of the teacher" (Ricca, 2012, p. 45). If the group is meant to develop into a group-as-a-whole learning system, members should be encouraged to interact freely in meaningful ways. Although it is the educator's main responsibility to nurture a group work culture, treating the students as autonomous agents and the group as an emerging entity implies that the participants should be left responsible for negotiating and elaborating their own rules and norms of function through an ongoing process: "teaching must be understood in terms of a sort of emergent choreography in which the teacher's and students' actions are able to specify one another" (Davis & Sumara, 2006, p. 100). Although this could be translated as the educator losing her central control and authority over the class management, this is an inherent characteristic of a living system and should be celebrated instead of feared.

In small group discussions, usually just a few of the members do most of the talking (Jackson & Prosser, 1985). It is also common for shyer students to feel uncomfortable when they are forced to publicly share their thoughts and engage in an active dialog (Crozier, 2005). In the case of a group with passive members who contribute less, it is possible to drive other members to withhold their participation (Meyers, 1997). It is important for the educator to promote active participation for all students. Thus, in classes with uneven participation, one way to facilitate universal engagement is by moving gradually from the individual level to the pair work level, then to the small group level and finally to a plenary, whole group, session. The aim of this brief concluding plenary session is to share the lived experience in the small groups, to make a draft synthesis of the ideas that emerged during group work, and to thank participants for their engagement.

In this sort of gradual transition, students initially work individually, reflecting on their own MacGuffin experience, so there is sufficient space held for personal thoughts and ideas to be self-recognized and internally articulated: "It is only through a process of reflection, whereby one studies one's self studying, that we can integrate the various components of the self. Without such reflection, fragmentation of the person and disconnect from the discipline result" (Ricca, 2012, p. 44). At the following stage, during pair work, personal reflections are expressed, discussed, and enriched by the pair's transaction. Pair work constitutes a kind of learning alliance between the two participating students, allowing for an easier transition to the small group level. The small group constitutes the next vehicle for a smooth transition to the whole group, ensuring that all members' voices will be articulated, enriched, and expressed to a plenary session for further processing. It is crucial to invest in a culture that empowers members to express their thoughts in a productive way. This is the case of *Open Space Technology*, a technique developed by Owen to facilitate grassroots conferences.

"When the unspeakable remains unspoken, important business may be neglected. [...] Everybody has the right and responsibility to place items on the agenda, which allows the unspeakable to be spoken" (Owen, 2008, p. 7). The proposed scheme of a gradual and systematic transition from the personal to the whole group level is graphically depicted in Figure 2. This scheme should be used only to facilitate, not to control (Weichhart, 2013), a group's process, and it should be altered, by-passing some stages where possible, depending on the group's dynamics and on the group's state of development. Effective group facilitation is "a constant process of adjustment, judgment, and responding to the energy and engagement of the students" (Robinson & Aronica, 2015, p. 106).

Another important question that arises regarding the planning of small group work sessions is how to assign individual students to pairs and, subsequently, to small groups. Assignment based on seating proximity or on students' choices are the quickest and may be the more convenient ways, especially in large classrooms with fixed seats. However, the problem with this strategy is that students usually choose their friends or familiar persons to work with, leading to the creation of cliques. This kind of assignment can be dangerous to the cohesion of the whole group in group psychotherapy (Yalom & Leszcz, 2005) and should be avoided when this is practically feasible. One alterative strategy is to simply number off the alphabetized class list by 3's, 4's, or 5's.

Figure 2. A proposed gradual transition scheme for group work: (a) individual, (b) pair work, (c) work in small groups of three to five members, (d) plenary session.

(a)

(b)

(c)

(d)
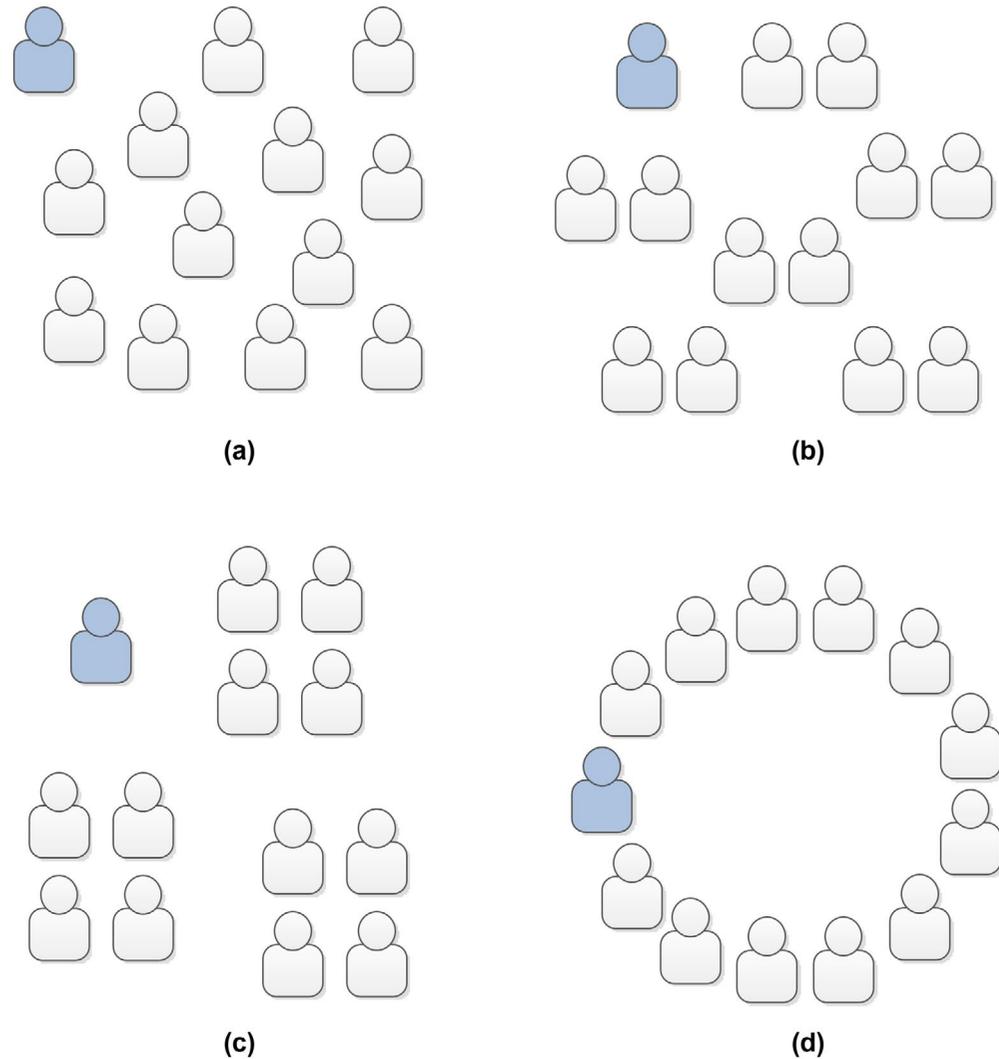
5. Group work continued online: Student sourcing and meta-narrative synthesis

In the proposed complexity teaching model, students are given the responsibility of writing and publishing, in their own blogging spaces, reflective narrative essays about their group-lived experiences during the face-to-face in-class transactions. In this sense, individuals' contributions are group work manifestations. We think of these contributions as the byproduct of members' synergies during the group's encounter. These in-group relational synergies finally become embodied actions (Gergen, 2009) that are manifested in the individuals' blog posts. It is important for the teacher-facilitator to participate in this reflection process (Ricca, 2012) with her own blog post. Subsequently, these narratives are automatically aggregated (using a predefined hashtag) on the group's predefined web hub which acts as the group's "post-it" wall.

In the proposed model, it is the facilitator's role to synthesize students' reflective posts, on a weekly basis, into a coherent meta-narrative. In our case, this collectively produced document was used as the official course book. In this way, the proposed system constitutes a group-based student sourcing model for the creation of the course notes, where the community is the curriculum (Cormier, 2008). During the synthesis stage, the facilitator tries to "listen deeply" to the students' voices and to "tell one story": to tell the group's meta-narrative. The goal of the facilitator is to *enframe* (Ricca, 2008) the individual narratives in the context of a larger picture that makes sense at the group-as-a-whole level (Agazarian & Gantt, 2000). During this weekly process, everything that is manifested

on the individual blog posts becomes part of a collective synthesis, the constituent block of the whole group's narrative. The whole group meta-narrative was loaded on a cloud file service, such as Google Docs or GitHub, to be further edited by all the participants. This proposed group-sourcing approach to content creation is in stark contrast to the traditional individualistic scholarly writing tradition which usually is: "a genre that separates the knowing author from the ignorant reader; it positions the author as the owner of his or her own ideas; it often portrays the author as one whose mind is fully coherent, confident, and conflict free" (Gergen, 2009, p. xxv). In the proposed model, course notes are co-produced by the participants, and the meta-narrative that is synthesized by the facilitator should not be treated as a state-of-the-art product; it is just the current instance of the ongoing group process. Our collectively produced course notes eventually took the form of an edited online volume (https://leanpub.com/culture).

The idea behind the group's meta-narrative, the collectively produced and edited essay, or perhaps some other multimodal digital artifact, is to be a synthesis of the members' work, but not its common dominator. David Bohm (2004) distinguishes between discussion and dialog: discussion is the juxtaposition of arguments, meaning to decide who is right and who is wrong; dialog is not the search for the common dominator, but the quest for the formation of a synthesis, a brand new formation with emergent properties, that cannot be reduced to any linear combination of its constituents. It is the synthesis of differences that produces brand new knowledge: "A difference which makes a difference is an idea. It is a *bit*, a unit of information" (Bateson, 1972, p. 271). It is the transition from the members' individual narratives to the relationships among these, as manifested at the meta-narrative level, which makes the difference. In this way, a group is able to reach a shared conclusion, "one that had not really been suggested by anyone in particular" (Davis & Sumara, 2006, p. 88), and that is the product of its members' complex synergies.

6. Discussion

Why is there an urgent need to put complexity inspired, group-based pedagogy at the center of our teaching practice? Fundamentally, it is due to the facts that "human beings have always lived in groups that have been characterized by intense and persistent relationships among members and that the need to belong is powerful, fundamental, and pervasive motivation" (Yalom & Leszcz, 2005, p. 19). By working together in small groups, members relate to each other. In our course design, we applied group management techniques common in group psychotherapy to the context of an educational institution. Group work requires more effort and time than lecturing. Thus, a critical question we ought to ask is: *How can a teacher implement quality group work without being frustrated at the end of the day?* To address this question and to improve our teaching practice and our enjoyment as educators, we sought insights and inspiration from complexity theory. We treated the group of students as a self-organized entity, as a dissipative structure with emergent properties. In traditional teaching, the emphasis is on the dissemination of information by a sage on the stage. In the proposed model, the students collaboratively produced their course notes "for both individuals and groups, it is how physical events are situated within a web of meaning that matters for what those events are" (Wendt, 2015, p. 194).

6.1. Other concrete examples of how the proposed pedagogy applies

In this paper, we have presented a systematic way to facilitate bottom-up pedagogy, self-organization, and creativity, by orchestrating in-class face-to-face activities in small groups while utilizing common web technologies. Our aim was to nurture a thrivable learning organization in a blended techno-social landscape, with the instructor serving as a "guide on the side" throughout the process, as opposed to a "sage on the stage." The pedagogical model was developed for a senior level course on *Internet Cultures* offered at the authors' university during the spring semester of the 2014–15 academic year. The web blog (and students' aggregator hub) for this project can be found at: https://hub6301.wordpress.com/. Key components of the model included the use of MacGuffin artifacts to initiate the bottom-up learning process, followed by systematic in-class face-to-face pair work sessions, small group work, and concluding plenary meetings. The learning process then continued with

the students' autonomous reflective practice on their blogs (inspired by the in-class process), and the collaborative online editing of a group document.

Other examples of the proposed pedagogy are the *hub2001: An Internet Odyssey* (https://hub2001.wordpress.com/) and the *hub3001: The Networked Dreambody* (https://hub3001.wordpress.com/) projects that continued the tradition of bottom-up learning interventions for the same departmental course during the subsequent two academic years (2015–2016 and 2016–2017) demonstrating sustainability of the project. These two subsequent courses followed the implementation model based on the complexity principles described in this paper, and added the systemic idea of coevolving subsystems: a group of tutor assistants (mainly former students) worked in parallel with the group of enrolled students to create a coevolutionary condition between them. In this way, the sub-group of tutor assistants created a hosting community culture, and students' learning during this course period was realized as an acculturation process (Brailas, Koskinas, Dafermos, & Alexias, 2015). Research data from these application examples have not yet been published and will follow.

A similar intervention was undertaken in a senior level course on *Cyber Research Methods* offered at the authors' university during the winter semester of the 2016–2017 academic year (https://cybermethods.wordpress.com/). In this course, the initiating stimulus (the MacGuffin artifact) was replaced by project-based research assignments and weekly in-class peer supervision sessions. Research data on this application variation have not yet been published and will follow.

In each variation of the proposed bottom-up pedagogy, the unchanged essence is that the whole learning community is treated as a complex living system with emergent properties, and the outcomes can only be anticipated rather than controlled: "A machine can be controlled; a living system, according to the systemic understanding of life, can only be disturbed" (Capra, 2003, p. 98). Interventions initiated from the perspective of learners as dynamic complex systems cannot themselves be static. A complexity inspired bottom-up pedagogy is a complex living system itself; it is constantly in flux, and always adapting to a moving landscape shaped by the co-actions of the many autonomous agents involved (students, teachers, and other contextual players) (Stamovlasis, 2016). Complexity inspired pedagogy should be, itself, an evolving and adapting pedagogy.

6.2. The role of teachers

According to Capra (2003), understanding social organizations, such as classrooms in terms of living systems means understanding them in terms of complex nonlinear networks that "respond autonomously to disturbances from the environment with structural changes, i.e. by rearranging their pattern of connectivity. … the living system not only specifies its structural changes; it also specifies which disturbances from the environment trigger them" (pp. 31–32). To put it in another way, when a group of students is treated as a living system, it maintains its freedom to decide *how* it will be disturbed, and *what* it will notice. In this epistemology, the role of the teacher is to introduce impulses rather than strict instructions, and then step to the side to see what happens, and prepare the next interference. The teacher takes on the job of "creating conditions rather than giving directions, and using the power of authority to empower others" (Capra, 2003, p. 106).

Another job of the teacher in a bottom-up learning organization is to facilitate the creation of meaning: a shared vision to follow. The teacher welcomes the autonomy of the group as a whole, and enables the learning community to go "where no man has gone before": "Facilitating emergence means facilitating creativity" (Capra, 2003, p. 106). An open attitude and a willingness to abandon the traditional power relations in a classroom are essential elements of moving from authoritarian teaching to learning partnerships, and the facilitation of bottom-up knowledge production: "emergence of novelty is a property of open systems, which means that the organization needs to be open to new ideas and new knowledge … a learning culture in which continual questioning is encouraged and innovation is rewarded" (Capra, 2003, p. 107).

Bottom-up pedagogical approaches require a cultural shift in the organization, which involves an inevitable destabilization phase. Students usually are not familiar with the psychological consequences of undertaking the core responsibility for their own learning. A large part of the teacher's role is to inspire the learning group and create a positive climate. Students need to realize their strengths and feel equal to the task, not only as individuals, but also as a group: "collective efficacy is an emergent group-level property, not simply the sum of the efficacy beliefs of individual members. Beliefs of collective efficacy serve functions similar to those of personal efficacy beliefs and operate through similar processes" (Bandura, 2001, p. 14).

6.3. The role of students

In a bottom-up pedagogical process, the students' role is to be active partners in a thrivable learning community. In such a partnership model, the focus is on the process rather than on the outcome (Bryson, 2016). Through their cognitive interactions, all participants actively contribute to a participatory knowledge endeavor in which: "the process of living itself is a process of cognition. … As a living organism goes through its individual pathway of structural changes, each of these changes corresponds to a cognitive act, which means that learning and development are merely two sides of the same coin" (Capra, 2003, p. 32).

In this consideration of knowledge as a process (Bohm, 1980), students essentially have to set questions and, by doing so, to negotiate the context of their scientific exploration. A living learning system is not a machine, an automaton that goes its predefined way, "Instead, what answer we get depends on what question we put, what experiment we arrange, what registering device we choose. We are inescapably involved in bringing about that which appears to be happening" (Wheeler, 1985, p. 365). During this maieutic process, knowledge is not regarded as having a fixed and final form that corresponds to an essentially static reality that is independent of thought (Bohm, 1980). Successful participation in this type of learning community requires a high level of tolerance for ambiguity when entering into those elements of the course which are less structured and which require critical reflective thinking and creativity (DeRoma, Martin, & Kessler, 2003; Weichhart, 2013). As Capra explains, "The experience of the critical instability that precedes the emergence of novelty may involve uncertainty, fear, confusion or self-doubt" (2003, p. 108). Students should anticipate, welcome, and celebrate ambiguity, rather than try to avoid it. This is not an easy task, and meta-cognitive skills are critical to success in coping with ambiguity and uncertainty (Wheeler, 1985).

6.4. Pros and cons of the proposed pedagogy

Conceptualizing a group of students and their teachers as a living learning organization has some important implications. Such an organization cannot be fully directed and controlled without diminishing its creative potential: the ability to think "outside the box." A living learning organization is capable of evolving and producing new knowledge; however, the challenge for the teacher is to nurture this organizational culture within the confines of a predominately mechanistic educational paradigm. The proposed bottom-up pedagogical model creates a learning environment in which the power is distributed among all participants. In this way, students and teachers feel more autonomous, and empowered to achieve their own goals without sacrificing their integrity in order to conform to the norms of a rigid organization.

Another important aspect of the proposed pedagogy is its inherent unpredictability along with its potential for self-organization and for the emergence of order out of Chaos. Ilya Prigogine introduced the concept of dissipative structures to describe open organizational structures that have the ability to self-organize in an entropic universe (Prigogine & Stengers, 1997). Unpredictability is a positive indicator that the learning environment is becoming a true complex learning system; however, it can be a stress factor for participants, and even more so for the teacher, who is officially (in academic settings) in charge not only of the course curriculum but also of the course curriculum within one or more larger accredited academic degree programs.

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6.5. The emergence of a thrivable participatory culture

A living learning community contains both designed end emergent structures (Capra, 2003; Davis, Sumara, & Luce-Kapler, 2015). The designed structures are often the official restrictions and requirements dictated by a given academic institution (curriculum, course syllabus, schedule, place, duration, and prerequisites). The emergent structures are created by the participants' autonomous actions and the synergies of their transactions (Bandura, 2001). The designed structures are necessary to create a supportive learning framework; the emergent structures are necessary to facilitate creativity. Therefore, well designed (but not strictly planned) structures enable emergence: "Complex unities are simultaneously rule-bound (constrained) and capable of flexible, unanticipated possibilities (enabled)" (Davis et al., 2015, p. 219).

Today, in the era of the networked classroom within a networked world, there is such a daunting abundance of instantly available information about almost anything that can be imagined that it literally boggles the mind. To put it mildly, Buffy (2011) has stated that "effective learning is a filtering challenge." A group-as-a-whole pedagogy can be an efficient way to manage this filtering. Therefore, we implemented a concerted group action in the form of collaborative inquiry as an efficient information filter, advancing the ecological validity of this bottom-up knowledge production endeavor. This kind of learning constitutes the group's collectively constructed and collectively narrated reality. Flood (1999) proposes that "Collaborative inquiry encourages people to frame and re-frame reality in successive cycles of learning. Learning here is a process that challenges conventional wisdom and entrenched patterns of living" (p. 120). The proposed model included selected web technologies that allowed for the group process to evolve over time after the face-to-face sessions, and to be extended into a virtual space of facilitated meaningful synergies. In this way, group-based learning and complex systems pedagogy *preceded* individual and interactive uses of web media, and an authentic participatory culture emerged within a blended learning landscape. In the proposed bottom-up pedagogy, the participatory culture was not designed by any of the participants individually, but emerged as a result nonlinear synergies among participants. The questions we asked, the MacGuffin artifact experiences that prompted engagement, our meaningful interactions in small groups, the personal reflections we posted, the online group narrative we wove in a collaborative fashion combined to realize emergent knowledge about the course subject and our community: an emergent knowledge manifested as the product of a transformative learning process.

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