

CONTEXT OF ARGUMENTATION WITH A ROLE-PLAYING BOARD GAME - AN ACTIVITY THEORY PERSPECTIVE

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The study of technology-supported argumentation has foregrounded its epistemic aspect in terms of processes of reasoning. We report a qualitative case study that takes a different line of inquiry, centered on the question: How might the context of argumentation be characterized from the perspective of Activity Theory? We posit Activity Theory (AT) as a potential interpretive framework, and use it to characterize the context of argumentation mediated by a role-playing board-game. Emergent findings suggest that argumentation was situated in a dialogic, participatory, collaborative, problem-solving activity. These findings are further synthesized and discussed to propose that the context of argumentation may be characterized as a game-based problem-solving context. This conceptualization is based on these preliminary claims: [1] Problems were created through the design of the game or arose due to cultural factors that influenced how players responded to the game. [2] There were three modes of problem-solving: collaboration, dialogic argumentation and role-playing. For the former two especially, distinct patterns are observed that suggest that they constitute cultural practices. [3] Emergent selves in terms of role-identities has three aspects: agency, social and ideology. These role-identities potentially constitute epistemic frames for argumentation. In conclusion, this paper suggests an alternative view of the interactions implicated in argumentation as practice inflected in praxis.

Keywords: Activity Theory; collaboration; argumentation; game-based learning.

1. Introduction

Educational reform has become a key concern among nations eager to maintain their competitive edge in a global economy that is increasingly driven by innovation and knowledge production. To this end, a key challenge is how education might be reformed to develop people capable of new literacy skills (diSessa, 2000; New London Group,

1996) characterized by higher-order thinking skills (such as inquiry skills) and social skills (that are required in communication and collaboration). An important higher-order thinking skill for 21st century learning is argumentation (Jan, 2009).

Game-based learning approaches have been put forward as having the potential to transform learning (Gee, 2004; Shaffer, Squire, Halverson, & Gee 2005; Squire, 2005). Many commercial games are able to engage players in complex thinking tasks, and guide them into specific ways of thinking (Gee, 2003, 2004). Based on studies of Massively Multi-player Role-Playing Games (MMORPGs), it has been argued that such multi-player games potentially engage players in the learning of scientific literacy practices, especially the practice of argumentation (Steinkuehler & Duncan, 2008).

This paper reports a qualitative case study of argumentation enabled by a role-playing board-game that is designed for dialogic argumentation. First, we consider how argumentation has been studied in research on technology-supported dialogic argumentation. Based on this review, we suggest the potential of studying the context of argumentation using Activity Theory (AT) (Leont'ev, 1978; Engeström, 1987). Thereafter, we utilize AT as a framework to interpret and characterize the game-based activity context in which our participants' argumentation was situated. The key research question that guides our inquiry is: How might the context of argumentation be characterized from the perspective of Activity Theory?

2. Literature Review

2.1. Studies in technology-supported argumentation

“Argumentation” is a term with several meanings (Nussbaum, 2008). Nussbaum notes that O’Keefe (1982) distinguishes between two senses of the term “argument”. The first conception is argument as a product, which consists of propositions in which a conclusion is inferred from premises. In our view, this conception also foregrounds argument as a product of reasoning. The second conception is argument as a process, referring to the social processes by which individuals make and critique arguments in dialogue with each other. In our view, argumentation also needs to be considered as goal-directed activity as people seldom argue for its own sake but they do so with certain aims in mind. This view concurs with a third sense - the functional sense - that is prominent in argumentation theory. For instance, the leading figures of pragma-dialectics, Frans van Eemeren and Rob Grootendorst (2004), see the elimination or resolution of a difference of opinion as the aim of argumentation.

“Dialogic argumentation” has also been proposed to encapsulate these epistemic, social and functional aspects of argumentation. Stressing a dialogic perspective, Driver, Newton, and Osborne (2000) view dialogic argumentation as a process whereby “different perspectives are being examined and the purpose is to reach agreement on acceptable claims or course of actions” (p.291). Similarly, but taking a specifically problem-solving perspective, Clark and Sampson (2008) view dialogic argumentation as

“a process of proposing, supporting, evaluating, and refining ideas in an effort to make sense of a complex or ill-defined problem” (p.296).

In education, there has been considerable research in digital technology-mediated argumentation. These tools and technologies include online learning environments (Clark, Sampson, Weinberger, & Erkens, 2007) with instructional features specially developed to support dialogic argumentation. These instructional features include scripts and awareness heightening tools to scaffold argumentation (Cho & Jonassen, 2002; Oh & Jonassen, 2007). Another emerging research trend concerns how digital technology may support game-based learning approaches to the learning of argumentation. Inspired by video-games and virtual worlds, Beach and Doerr-Stevens (2009) argue that online role-playing over discussion forums in social networking sites can support the learning of argumentation practices. Other innovative tools and technologies with affordances for game-based learning of argumentation include augmented reality and networked mobile devices (Squire & Jan, 2007; Matthews, Holden, Jan, & Martin 2008; Jan, 2009). Among these digital game-based learning approaches, a common feature is role-playing. For instance, in Beach and Doerr-Stevens’s study, the role-play focused on the issue of online privacy, with participants playing roles such as lawyer and members of the Internet community.

However, learning through role-playing certainly predates digital technologies and digital games. Digital role-playing games, such as MMORPGs, that are said to make for learning (Childress & Bresswell, 2006; Steinkeuler, 2004, 2006) and argumentation (Steinkuehler & Duncan, 2008) have a lineage that can be traced to non-digital forebears (Hitchens & Drachen, 2008; Indvik, 2012). It has also been found that digital and non-digital role-playing games share common features. For instance, both forms of role-playing games are typically set in imaginary worlds that evolve through how the players play their character roles (Hitchens & Drachen, 2008). Moreover, non-digital role-playing games, such as Table-top Role-Playing Games (TRPG), possibly offer advantages that digital forms may not. For instance, the game worlds of TRPGs tend to be less predefined and less structured than MMORPGs, with predesigned back-stories and level missions featuring more prominently in the latter. Hence, players in TRPGs have greater agency to create their game worlds and game trajectories so that their decisions and actions are more meaningfully situated. Despite the close similarities between digital and non-digital role-playing games and even possible advantages of the latter, there is a paucity of research on the affordances of the latter for learning in general, and with regard to our interest, argumentation in particular.

Besides a lack of research in how argumentation can be supported by non-digital games, another potential gap concerns a key aspect of argumentation that is usually neglected in studies of it. A common central concern of studies of argumentation supported by digital technologies and digital games is the question, “What makes good argumentation?” This question has been motivated by various concerns. With the goal of developing a design framework for dialogic argumentation, Jan (2009) considered good argumentation in terms of the levels of epistemological understanding (Kuhn, Cheney, &

Weinstock, 2000) that it reflects, its argumentation structure according to Toulmin's Argumentation Pattern (Toulmin, 1958), and how well theory is coordinated with evidence (Kuhn, 1989, 2005). With respect to assessing dialogic argumentation in online learning environments, Clark and Sampson (2008) has identified five categories of analytic frameworks that respectively evaluate dialogic argumentation in terms of (1) formal argumentation structure, (2) conceptual quality, (3) nature and function of contributions within the dialogue, (4) epistemic nature of reasoning, and (5) argumentation sequences and interaction patterns.

However, what seems to be generally lacking is a consideration of the contextual aspects of argumentation. An important conclusion of Jan's (2009) study of his design framework for dialogic argumentation is that there is a need to go beyond the grammatical approach of identifying good arguments, such as drawing on Toulmin's Argumentation Pattern (TAP) as a template to map learners' arguments. He maintained that the epistemological, social, and material aspects of argumentation are vital in understanding argumentation as a social / cultural product and process. For instance, what may seem like poor argumentation in terms of the lack of counter-arguments might in fact be a strategic, reconciliatory stance adopted by the interlocutor(s) to repair imminent breakdown in communication. Such argumentation patterns might also reflect a certain culture of communication that values harmony and non-confrontational communication (Watanabe, 1993). In these contexts, for argumentation to successfully achieve its goal (e.g. solving a problem collaboratively), communicative and social goals have to be skillfully managed in culturally appropriate ways as well, which may in turn influence how the interlocutors engage in argumentation in the epistemic sense.

2.2. Activity Theory as a potential framework for studying context of argumentation

AT has been demonstrated to be useful not just as a theoretical lens for characterizing and analyzing the participatory unit (Barab, Evans, & Baek, 2004; Barab, Schatz, & Scheckler, 2004) but also in informing the design of learning environments (Jonassen & Rohrer-Murphy, 1999). There also exists a small but promising body of work that investigates the relationship between discourse and activity (Engeström, 1995; Engeström, 1999; Goodwin, 1997, 2000; Steinkeuhler, 2006). Many excellent reviews (e.g. Barab, Evans, & Baek, 2004; Nardi, 1996a, 1996b; Roth & Lee, 2007) have been written on AT and the reader is encouraged to turn to them for a fuller treatment.

In this section, we will provide a brief overview of AT, focusing on the second generation AT developed by Engeström (1987), to explicate how AT may be a potentially productive analytic framework for understanding the context of argumentation. We will also illustrate AT with academic review as an example. This is intentional for at least two reasons. One, we believe it is an illustration that the general reader of this paper should be able to identify with. Two, an academic review is arguably a form of argumentation that entails taking a position with regard to the merit of a paper, and providing reasons and evidence to support the reviewer's position. The illustration draws upon our own personal

experience, and applying AT to reflect on our own experience suggests its potential to reveal how even argumentation at the situational level could constitute sociocultural practices. This distinction between the situational level and the larger sociocultural level is consistent with the different perspectives of context considered by Nardi (1996b). With regard to “persistent structures” (p.41) such as institutions and cultural values, Nardi notes that these are the central focus of Activity Theory but are not that of situated models that usually focus on the emergent, contingent nature of human activity. Nevertheless, research coming from the latter perspective has begun to acknowledge and account for regularities in behavior even at the situational level. As we shall see, an outcome of this study using Activity Theory is to suggest how persistent structures such as sociocultural practices could be inflected in the game-play activity of our participants.

Building on the work of Vygotsky (1978, 1987) and Leont’ev (1978, 1981), Engeström further contextualized the unit of activity to reveal the social and cultural resources that are salient in activity. He also provided a triangular schematic (Figure 1) that is widely used to depict the activity system.

The top-most triangle encapsulates the basic idea of Vygotsky who, in asserting that all psychological activity is mediated, started the process of moving the locus of cognition and knowing outside of the individual mind. This triangle depicts the most basic relations that entail a *subject* (individual or group) oriented to transforming an *object* mediated by a *tool* (material or psychological). Roth and Lee (2007) highlight that the object of activity exists twice (Hegel, 1807/1977; Leont’ev, 1978): first, materially and second, conceptually. For instance, in reading this paper, the object of the reader is the content of this paper, which may be embodied in physical or digital form. However, how the content of this paper is conceived depends on the activity of which it is the

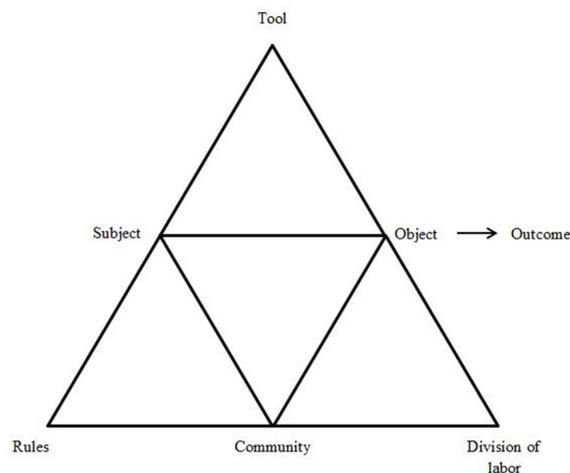


Figure 1. A basic schematic of an activity system (Engeström, 1987).

object. If the activity is academic review, then it becomes more than something to be read (e.g. for reference in academic writing) - it becomes something to be reviewed. In the activity of academic review, the object (content of the paper) is transformed by the subject (the reviewer) into an *outcome* (an argument of its merit for publication, supported by reasons and evidence). However, the reviewer does not do so without tools. These tools may be conceptual, and may reflect something about the *subject's* academic orientation, for instance the reviewer's own conception of what constitutes an appropriate genre of academic writing. These tools may also be techno-material, such as the template provided by the editors to produce the review according to certain representations or format. These tools may also be embedded within the object (e.g. the organization of the text, tables etc.) that the reviewer uses to interpret the text of this paper.

Completing the schematic, following from Engeström's contributions, are the components of *community* (the group or organization), *division of labor* and *rules*. More specifically, it depicts division of labor mediating how the community engages with the object, and rules mediating how the subject and community relate to each other. For instance, although the activity of reviewing an academic article is typically an individual activity, it takes place as part of a larger community that comprises other members such as other reviewers and the editorial committee. From the subject's perspective, the division of labor mediates her work in terms of defining her scope of responsibility with regard to this paper, which in turn defines her as a subject in terms of her role in relation to other roles with other sets of responsibilities (e.g. a reviewer and not an editor). Furthermore, the community may deem certain rules necessary to expedite the collaboration. From the subject's perspective, rules mediate her work in terms of guiding how she works with other members of the community (e.g. prompt submission of review to the editorial committee), which in turn mediate how she engages with the object (e.g. as something to be reviewed according to a certain time frame). These rules may also constitute the terms by which she herself or others see her as a certain kind of subject (e.g. as a responsible reviewer who can be entrusted to submit her reviews on time).

Another important concept in AT is *contradiction*. All activity systems harbor inner contradictions. Crucially, when these inner contradictions become salient, they set the conditions for activity systems to change (Roth & Lee, 2007). For instance, the historical development of how learning is studied may be characterized by a shift from behavioral, to cognitive to sociocultural perspectives. The community is increasingly represented by experts in the fields, not just of psychology, but also of sociology and anthropology as well. Members of these fields have their respective epistemological commitments that conventionally translate into quantitative and qualitative methods of inquiry. For reviewers of the latter persuasion, to be provided with a template (a tool) to produce an academic review in terms of representing their evaluation in the form of a cardinal measurement could be problematic. (This tool may be a legacy of earlier communities.) It might seem fundamentally problematic to transform one's (subjective) evaluation of the merit of a paper into any (objective) measurement. Hypothetically, if the problem is shared by enough reviewers so that its scale extends beyond a few individuals to the

larger community, tools for reviewing may evolve in ways that foreground a more qualitative approach. This illustrates what Engeström (1987) identifies as a *secondary contradiction*, i.e. between constituent nodes in an activity system (e.g. between the tool and the subject / community in our illustration), and how contradictions could drive changes in activity systems.

Hence, it seems to us that AT is potentially useful for analyzing the context of argumentation, even at the situational level, to reveal how its sociocultural aspects may be inflected. In the following sections, we further explore this possibility of using AT, using it as a framework to analyze a game-based activity context of argumentation.

3. Studying Context of Argumentation Mediated by Mad City Mystery-Lite (MCM-Lite)

3.1. *The game-based design of MCM-Lite*

We designed and enacted the game, MCM-Lite, a role-playing board-game to study how participants of different age groups worked together and engaged in dialogic argumentation with the game.

MCM-Lite is a role-playing, board-game designed based on Mad City Mystery (MCM) (Squire & Jan, 2007), a place-based augmented reality game (Klopfer & Squire, 2008). MCM was played at the University of Wisconsin-Madison campus near Lake Mendota. It was designed as a multi-player game and the activity was mediated using mobile device and GPS-enabled location-sensitive technologies. MCM-Lite is a paper-based version based on the original MCM and has been redesigned using A4-size paper cards and A3-size maps. MCM-Lite also retains the multi-player participant structure of MCM. However, in the case of the former, players were co-located in an office space within the research lab, while in the latter, players moved in groups around the University of Wisconsin campus near the south shore of Lake Mendota.

This study uses a paper-based version of MCM-Lite for at least two reasons. First, one of the challenges that the augmented reality version faced was that players were often too dispersed by the unconstrained physical space to be engaged in sufficient dialogic interaction. Playing the game around a paper map leverages on the physical constraint for moving freely as an affordance for dialogic interaction. Second, paper-prototyping is a common practice even in digital game design. Studying a paper-based version of MCM-Lite potentially informs its possible redesign as a digital game.

The game begins with the revelation of the mysterious death of the protagonist, Ivan. The challenge for the players to investigate the case as a group is:

Ivan Illycih is dead.

Police claimed that he drowned while fishing by the south shore of Lake Mendota.

Between January and the time of his death, Ivan put on 25 pounds and started drinking heavily. His health condition had deteriorated considerably.

As one of his friends, your task is to investigate the case with two of your best friends. It is your duty to present a clear picture about the causes and effects of these to the public.

Following the game challenge, players may freely choose one of the three roles—Medical Doctor, Environmental Scientist and Government Official - as their character role in the investigation. Each role has his or her unique ability to access certain data set, and all roles share similar degrees of agency and power in the game. For example, the Government Official is the only player who has access to secret documents, that are essential for the Medical Doctor and Environmental Scientist when they interpret the data exclusive to them, such as the medical history of Ivan (which is exclusive to the Medical Doctor) or fish samples (which are exclusive to the Environmental Scientist) in the game. In other words, each player can only have access to a subset of all the data necessary for understanding the mystery case. Hence, with respect to the design, the degree of agency and power that one has as a Medical Doctor is similar to the one playing the role of Environmental Scientist and Government Official. We purposefully distribute the power evenly among the character roles so that they do not steer any player toward assuming a team leader, a follower, or other social roles. Successful game play would require the players to understand their unique role affordances through play and as a group, identify for themselves ways of working together to be successful in solving Ivan’s mystery.

From here, players progressively encounter non-player characters (NPC) and game objects in the form of case cards that they collect in a predetermined sequence. These virtual characters and game objects offer or direct players to personal or official information that are contained in these case cards. To offer players a sense of place to the case, the players also have access to several maps of the Lake Mendota area made with Google Earth and Google map, which function as another source of data. After collecting all the case cards in the game, players are required to propose what the probable causes of Ivan’s death are and what might the possible effects on the public be.

A key design feature of MCM-Lite is its openness. This is similar to types of games that are open-ended (Squire, 2007) and that harness collective intelligence for collaborative, search and analysis game-play (McGonigal, 2007). First, the goal of MCM-Lite is open-ended. The information that players receive are designed to suggest a variety of factors—environmental, societal, medical—that act in combination to cause Ivan’s death. The aim is to engage players to think about multi-factorial causal relations so as to promote systems-thinking, a key affordance of good games (Gee, 2007). Hence, the game is designed to allow players to arrive at different resolutions, whose merit is based on how well-supported they are, rather than any “right” or “wrong” answer.

Second, the rules of MCM-Lite are also open-ended. MCM-Lite is like the *I Love Bees* game (McGonigal, 2007) that,

(does) not articulate a specific goal, a win condition, rules, or any of the other formal guidelines traditionally associated with games. Instead, the (players have) only a call

to action, a very complex data set, a few seemingly random threads of story—and the freedom to respond to them however they (want). (p.203)

The only rule is for players to encounter the virtual characters and objects in a predetermined sequence, in order to situate players in social settings that are more familiar to begin with (e.g. family) and less so (e.g. scientific practice) as the game progresses. This is to scaffold knowledge-building by allowing players, especially younger ones, to engage with familiar experiences in the earlier stages. This is meant to help them make greater personal meaning of information in the earlier stages as a base for constructing their hypotheses or arguments later on.

3.2. Research methodology

3.2.1. The research project

This study is part of a comprehensive study that investigates how players of different age groups and educational backgrounds engage in argumentation when they play MCM-Lite. In this comprehensive study, we recruit participants who (1) share similar educational backgrounds and age and (2) have established social relationship to form player teams. Specifically, we identify four ranges of age groups and educational backgrounds. They are primary school students (11 - 12 years old), secondary school students (14 - 15 years old), junior college students (17 - 18 years old) and adults with a diploma (20 years old and above). Each player team, comprising three players of the same age, plays MCM-Lite as part of a three-step procedure: (1) briefing, (2) game play, and (3) debriefing and interviews. The procedure will be identical for all player teams, regardless of their age and educational background. The research design enables us to understand how argumentation patterns may emerge from playing the same game due to age and educational differences. Our findings will also provide an in-depth understanding of what to scaffold in terms of the cognitive, social and material aspects of argumentation.

3.2.2. Case study and the selection of the case in this study

While the comprehensive study will cover multiple age groups, the study described in this paper constitutes only one of the four age groups: adults (20 years old and above) with a diploma. We identify the study of each age group as a single case within a multiple-case design framework (Stake, 2006; Yin, 2003). Although a comparison across all four different age groups is our ultimate goal, each single case can be considered an independent and in-depth case study when not being compared and contrasted with the other cases.

Within a qualitative case study approach (Stake, 1995), we structured data collection around emerging phenomena that were deemed important for describing the case in terms of the research question - How might the context of argumentation be characterized from the perspective of Activity Theory? The case is bounded by the play that occurred among the three adult players, which include how the players worked together and engaged in

argumentation. A qualitative case study is an appropriate approach for our research question as we aim to construct a deep understanding of the interactions and argumentation that emerged during game play. Eventually, when we collect and analyze the data from all age groups, we will be able to understand how players at different age groups engage in argumentation similarly and differently.

3.2.3. *Procedure*

The study took place in a room that could comfortably accommodate six to eight people. The room was usually used for social purposes - tea break and conversations. We were involved in the study as facilitators and observers. The study was divided into three stages: briefing, game play and debriefing with interviews. During the briefing, we introduced MCM-Lite to the three participants with basic information regarding role-playing, rules, and the game materials. The goal of the briefing was to provide only the essential information to initiate the game play. During the game play, we tried to minimize playing the facilitator role so that the players could have a greater sense that we were not involved in the game play. We observed the game session and took brief field-notes while a research assistant video-recorded the game-play. After the game session, the participants reported their findings to us and we interviewed them for about 30 minutes as a group to elicit their perspectives of their game experience. The whole procedure took about two-and-a-half hours.

3.2.4. *Participants*

The three participants in this case of adults with at least a diploma were David (age 28), Eddy (age 27) and Geoff (age 28) (all pseudonyms). The participants are proficient in communicating in English language, which is the medium of instruction in Singapore schools. They are also our colleagues in the research lab. David and Eddy are both digital game programmers and Geoff is a digital game designer. Between 2009 and 2011, they had been working together as part of a research team developing digital games for learning at the lab. We were also part of the team for the entire duration when the participants had been working together and have thus observed, first-hand, their culture of working together.

The three participants' work on the research projects was distributed based on a division of labor consistent with their various roles. However, they would also develop shared understanding of each other's work and roles, which would be required given the very complex nature of the projects. For instance, David and Eddy would need to understand Geoff's design to guide their programming work, while Geoff would need to understand David's and Eddy's programming constraints to produce a feasible game design. They would also participate in the project team's regular meetings during which they would not only report on their respective work, but would also discuss the problems that the team faced with other members. Where views differed during these discussions, the three participants would typically avoid conflicts with each other and other team

members. Instead, they would rather focus on resolving the problems at hand. Seldom would any of our three participants dominate team discussions.

Besides being colleagues, the participants are also avid players of digital games, including MMORPGs. In fact, the participants would take part in a game session with other members of the research team at least once a week at the lab.

3.3. *Data analysis*

3.3.1. *Data preparation*

After the game session, the first author transcribed speech and major gestures but did not attempt to capture nuances in voice or full gestures. A fuller range of affective content might have been communicated through these nuances but these are not of primary relevance in addressing our research question. The entire transcript consisted of 472 turns of speech. In the transcripts, the players, David, Eddy and Geoff, are denoted as “D”, “E” and “G” respectively, corresponding to their respective roles as Medical Doctor, Environmental Scientist and Government Official.

3.3.2. *Interpretive framework*

AT in the form of Engeström’s (1987) model provided the interpretive lens with which we characterized the activity with MCM-Lite. Before we present our analysis proper, we would like to clarify two things. The first is about our treatment of the subject. Barab, Evans, and Baek (2004) offer a general heuristic for analysis and design. Our approach reflects this heuristic that includes the tactic of mining our transcripts to see which data relates to which particular component to come up with a “bucket” (p.207) list for each component. However, we apply this approach to the subject as well, resulting in a composite individual that is constituted by any of our players. Although AT theoretically concerns a single individual or single group’s perspective, the analytical tactic of homogenizing the subject is not new (see Feldman & Weiss, 2010; Jaworski & Potari, 2009).

The second clarification pertains to what the subject and community denote in our case. While it is typical to depict the subject as an individual or a group in an activity system, the latter is usually denoted as the subject when the activity is carried out as a group working with other members of the larger community. In our case, the activity was primarily carried out among the three players. Therefore, the subject refers to the composite individual while the community primarily refers to the group of game players.

3.3.3. *Trustworthiness*

In lieu of the epistemological and ontological differences between qualitative and quantitative research, qualitative researchers (e.g. Creswell, 2007; Lincoln & Guba, 1985; Maxwell, 2005; Wolcott, 1994) argue that the two research paradigms deal with different validity threats. Quantitative research, coming from a positivist paradigm, generally

attempts to ensure validity through research methods such as establishing control groups, statistical control, randomized sampling and other means. Qualitative research, however, does not ensure its validity the same ways as commonly established in quantitative research (Maxwell, 2005). To address the ontological and epistemological differences, some researchers (e.g. Eisner, 1991; Lincoln & Cuba, 1985; Walcott, 1994) suggest using different terms, such as trustworthiness (Creswell, 2007) or credibility (Lincoln & Cuba, 1985) as alternative terms for “validity” in quantitative research.

Maxwell (2005) maintains that researchers may establish the trustworthiness of a qualitative research by articulating how the interpretation can be supported by evidences so that alternative hypotheses can be made implausible. In this research, our interpretation is shaped and warranted not only by providing direct evidence of our participants’ game-play, but also our in-depth and situated understanding of the participants as colleagues. Besides the above, the researchers, as the major instrument of the study, reached consensus on the interpretation together. This approach is similar, but not equivalent to the inter-rater reliability approach commonly used in quantitative research.

4. Analysis and Findings

4.1. *Game play as a problem-solving activity in five distinct phases*

In characterizing the activity, we first considered a central notion of AT i.e. activities are intentional (Engeström, 2004; Nardi, 1996), constituted by motives and goals (Barab, Evans, & Baek, 2004). In particular, we tried to identify what the motives and goals were in terms of the various challenges and problems that the players were addressing. After the briefing, the players embarked on the game play activity that unfolded in five distinct phases that cross-cut at some points. These phases were distinguished by particular sets of problems or challenges. We denote these phases of problem-solving during game play as “making the game”, “making the plot”, “moving the plot and making the story”, “solving the mystery” and “resolving the mystery” (Table 1).

We denote the first phase of activity as “making the game”, during which the players attempted to construct the rules of the game. Although the second author informed the players that they could decide their own rules, the players turned to him to clarify the rules (Extract 1). Clearly, the players saw him as the designer of the game and expected some degree of clarity of the rules before they felt ready to carry out the activity. Although the second author avoided making the rules, the players continued to turn to him to supply them (Extract 4). This first phase appears to be the shortest, but episodes of rule-construction were also present during the second and third phase.

Table 1. Instances of game play as a problem-solving activity in five distinct phases.

Turn	Phase	Extract
6 - 15	Making the game	[1] Second author (SA): I'll leave the game to you. You decide how you want to play it. David (D): So we can discuss it among ourselves?
16 - 58	Making the plot	[2] Geoff (G): So what role are you? D: I'm doctor. [growling] [Both D and G laugh] [3] G: [Uses a pencil to point to a location at the center of the map] So we will start with this guy, then we will move to this guy? D: The nearest one [Reads aloud introduction page of the doctor] "Ivan Illich is dead (...) dead as a doornail." So should we go to the south shore, the place where he was found? [4] G: [At SA] Do we have to follow this route?
59 - 357	Advancing the plot and making the story	[5] G: Who is Eve? He says to talk to Eve. He says she likes catfish. So catfish might be what. (...) maybe it has poison. No, catfish are not normally poisonous. But then again, if it is in the fish, other people should get it. [6] D: So the next one is (...) we go and find Doctor Zhivago. G: OK, Ivan's doctor. Oh! He does not say anything to (...) [reads aloud] "I don't discuss my patients unless I am talking with a doctor." [looks at D and laughs]
358 - 385	Solving the mystery	[7] D: [At Eddy (E)] You've got anything to say about all these? E: I think the pollution plays a part. And just nice [sic] because of Ivan's living lifestyle - he worked in the factory, and he drank a lot, he went fishing and he ate the fish.
386 - 472	Resolving the mystery	[8] D: So let's do a conclusion. Shall we do a conclusion? So most likely it's the (...) TCE? [9] G: I think that's the main factor leading to his death because D: He was exposed to it. E: More than other people G: Ya E: Other people had the symptoms. The wife, baby, the friend-whoever were rained on [sic] in the season all had minor symptoms. But as for this guy, he worked there, he drank to make himself have a lesser-worse body condition [sic], then he ate fish also, and was exposed to the rain more. D: [Smiling] He had everything.

The second phase of the activity was "making the plot". As a narrative, the investigative genre typically distinguishes between the story and the plot (Jenkins, 2004). The former refers to the subject's reconstruction of the events that led to the incident under investigation. The latter refers to the investigation itself. The second phase consisted of two kinds of plot-related actions. Firstly, the players proceeded to take on their respective character-roles (Extract 2). Secondly, the players proceeded to use the map to plan the route to take for the investigation (Extract 3).

The third phase of the activity - “advancing the plot and making the story” - was by far the longest and constituted the investigation proper. In this phase, the players proceeded to interview the NPCs one after another and, in so doing, advance the plot and construct the story. They would get to know each NPC and their relations to each other (Extract 5). They would also have a sense of their own character role from the perspective of the NPCs (Extract 6). It is also in this phase that the players would start to provide tentative solutions to the mystery (Extract 5). In such instances, the emergent story mediated argumentation, for instance, by being evaluated for its relevance as evidence and supporting deduction.

These tentative attempts reached its consolidation in the fourth phase - “solving the mystery” - after the players had visited all the NPCs. Here, the players focused on the factors that could have contributed to Ivan’s demise. As Extract 7 exemplifies, the players would demonstrate systems-thinking (Gee, 2007), considering the factors in combination. This phase is short relative to the last phase, “resolving the mystery”. It is in this phase where argumentation was most intense, driven on by Eddy in particular. Here, the players proceeded to differentiate the factors and non-factors. They also tried to establish the relative significance of each factor in order to establish what the main and secondary factors were (Extracts 8 & 9).

What we also find interesting is why the activity would exhibit such distinct phases. Activity Theory could offer a plausible reason. In a subsequent interview with the players, they reported to us that they were more familiar with games whose design in terms of rules and plot were more well-defined. This concurred with the observations that we had earlier mentioned about the kinds of games that they would usually play together. Therefore, it seems plausible that this secondary contradiction (between the open design of the game (the tool) and the gaming cultures of the players (the community)) presented such a problem to the players that they felt the need to clarify what the rules and plot were *before* actually proceeding with the investigation. In Figure 2.1, this contradiction is depicted as a fractured double-directional arrow between the community and the tool.

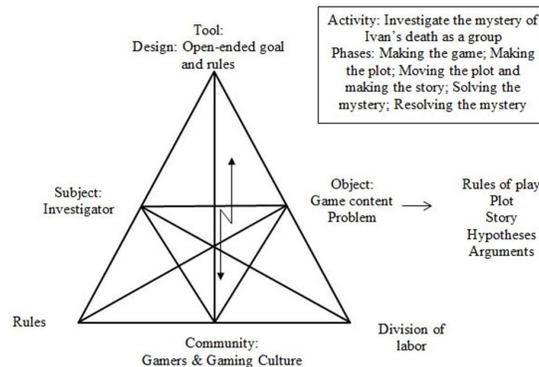


Figure 2.1. Problem-solving with MCM-Lite.

4.2. Collaborative problem-solving activity mediated by division of labor

From this point, we progressively modify the characterization of the activity, further considering the social interactions. In this and the next section, we turn our attention to what was happening when the players worked together, mediated by a certain division of labor and rules.

In this section, we consider the phenomena in the context of how the game, in terms of its design, afforded collaboration. A key design feature of MCM-Lite is how the game content (the object) is distributed. Firstly, the content is distributed across the players' character-roles. For instance, only David, the medical doctor has the medical report of the NPC, Bartleby (Extract 10 in Table 2). Secondly, the content is distributed across the NPCs. The NPCs represent three different levels of in-game fictional community in terms of the degree with which we expect players to identify most closely: family and friend of Ivan (the protagonist), the scientific institutions and the state institutions.

From the perspective of AT, the nature of the game content in relation to the challenge could have presented a contradiction to the players. Although the players had differential access to the content, they had to eventually reach a consensus on the case to present it to the fictional public as a group. The distributed nature of the game content (the object) and the collective nature of the game in terms of its challenge (the tool) presented a contradiction that created a disturbance (Extracts 10 and 11) when each player realized that the information he had would not be sufficient to solve the case. Here, they responded to this disturbance by clarifying what the rules of the activity were by asking if they could share their notes. This instance suggests how a contradiction could create a deep need for the players to interact and to collaborate (Figure 2.2).

Table 2. Instances of collaborative problem-solving activity mediated by division of labor.

Turn	Phase	Extract
62 - 63	Advancing the plot and making the story	[10] D: OK, I got this. Health report. G: About this guy? Oh! [Checks if he also has the health report, then shakes his head] D: I have it. Oh, because I am a doctor so I can see his thing. [11] G: Ya. And I think the government official doesn't get much information. D: [At SA] So can we share our notes?
68 - 70		[12] G: [At D] And medical, you did not get any information about her health, right?

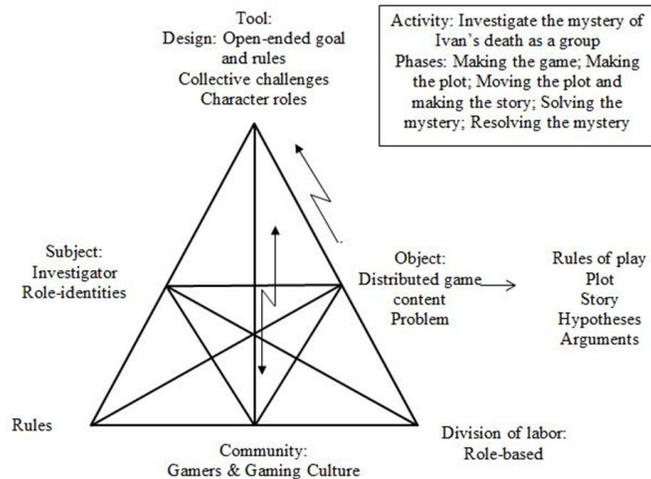


Figure 2.2. Collaborative problem-solving with MCM-Lite.

Furthermore, according to the excellent review of Hogg, Terry, and White (1995), identity theory offers the perspective that it is through interaction with others that people develop “role identities”. First, the way the game content was distributed across their character-roles afforded a division of labor that provided the basis for players to be identified in terms of their character-roles in collaborating with each other. For instance, David, the medical doctor was the only one who could provide medical information to the group (Extract 10), while Geoff, the government official would have access to state documents. This resulted in players taking on different responsibilities for solving the mystery in terms of the different information and perspectives that each player could offer according to their character-roles. Second, it was through reflexive dialogue that the players developed a sense of role-identities. Role-identities are reflexive (Burke & Reitzes, 1981) and this is exemplified by David in Extract 10. Here, David had earlier discovered that he had the NPC, Bartleby’s, medical information. This provided the basis for which he could identify himself as a doctor in terms of the things he could see i.e. medical reports. What is happening here is a slight, but non-trivial, contrast to that of Geoff’s utterance in Extract 11. In this instance, Geoff did not identify himself as a government official but merely reflected that “the government official doesn’t get much information”. Yet, we see how role identities provide meaning for self by distinguishing roles in terms of relevant complementary or counter-roles (Lindesmith & Strauss, 1956). For instance, Extract 11 shows how Geoff, through dialogic interaction with David, came to see the identity of the government official in terms of what he is not (the medical doctor who has more information).

4.3. Participatory, collaborative, problem-solving activity mediated by rules

In this section, we consider how the players collaborated with each other mediated by rules.

During the test session, each player received a set of information that was unique to their role in the form of A4 sheets of paper. Upon realizing that each had differential access to information and that each had the agency and responsibility to bring something to the table, they tried to figure out how they could communicate their respective information. Soon, what became problematic was how limited were the ways in which the players could share their respective information (in contrast to, say, how digital content might be shared on an online platform). Upon clarifying the rule that they could share their notes (Extract 11 in Table 2), they proceeded to go about it in different ways, for instance, by sharing them on the tables. Information sharing was further complicated by the physical constraints of the site. For instance, the tables were too small and they became cluttered very soon. Eventually, they settled on the rule to take turns to read their respective information aloud (Extract 13 in Table 3). What is thereby instantiated is how the material embodiment of the game content interacted with its distributed nature and the physical environment to deepen collaboration by creating a need to create rules to mediate collaboration.

While David's explicitly proposed rule - "maybe we should just individually present" - was agreed upon and constituted what their solution to the problem of communication was, it was rules that were more tacit and emergent that mediated how they enacted the solution to the problem (Figure 2.3).

Table 3. Instances of participatory, collaborative, problem-solving activity mediated by rules (I).

Turn	Phase	Extract
110 - 127	Advancing the plot and making the story	<p>[13] D: [Initiates sharing of notes by reading aloud] "He was my patient. Ivan showed-" Maybe we should just individually present. [G nods his head] D: [Continues to read aloud where he had left off] "Ivan drank 6-8 glasses per evening." G: Whoh, Wow! [Laughs] D: "That could have contributed to his deteriorating health...to verify any of my assumptions here." Ok. That's for me.</p> <p>[14] E: Ya. Same here. So the next person - I think it is the wife. G: Ya [Reads all his information aloud] D: For me, almost everything is the same, except that he added, "Adam does not want anything but breast milk." G: OK. So [pause] E: Mine has lesser things but I have what all of you mentioned. D: So did he mention additional things? E: No, no additional things. D & G: Oh, ok. Good.</p>

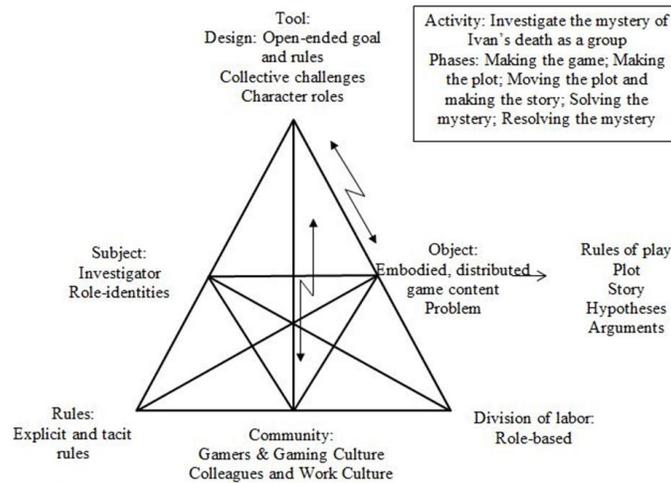


Figure 2.3. Participatory, collaborative problem-solving with MCM-Lite.

In Table 3, we see a high degree of cooperation and coordination among the players. They took a jigsaw-like approach whereby each took turns to supply the information that others lacked until they had verified that they had a full set of information from each NPC. For efficiency, they also made it a point not to read out the information that other members of the group had already offered. These rules were consistently enacted throughout the activity to mediate how they would communicate and share information efficiently.

On the other hand, Table 4 instantiates a different pattern of rule-mediated, turn-based collaboration.

Here, what we see is how the players took turns to advance the plot and to inquire the case in a relay-like manner. In the first instance, Geoff took the lead to get the investigation going (Extract 15). Subsequently, we see David (Extract 17) and then Eddy (Extract 19) taking over the role of advancing the plot. Similarly, Geoff took the lead in kick-starting the inquiry by providing a set of hypothesis and reason (Extract 16). Later on, Eddy began to take on significant epistemic roles in initiating synthesis (Extract 18) and suggesting strategies such as suspending meaning-making until more information was collected (Extract 19). The latter strategy was picked up by David when he subsequently took over the role of advancing the investigation (Extract 20) and the role of initiating inquiry (Table 1, Extract 8). Each player made it a point not to dominate proceedings, even recognizing the roles that each were taking up and inviting each other to play those roles (Table 1, Extract 7).

Table 4. Instances of participatory, collaborative, problem-solving activity mediated by rules (II).

Turn	Phase	Extract
16	Making the plot	[15] G: So we take a look at the NPC together at the same time. [Pointing to AD] So what role are you?
61	Advancing the plot and making the story	[16] G: Who is Eve? He says to talk to Eve. He says she likes catfish. So catfish might be what. (...) maybe it has poison. No, catfish are not normally poisonous. But then again, if it is in the fish, other people should get it.
104		[17] D: So the next one is (...) we go and find Doctor Zhivago.
129		[18] E: Let's think about what we have so far.
158 - 159		[19] G: I wonder what that means. E: Let's move on to the next person.
180 - 182		[20] E: [At G] Does correction (inaudible) use mercury? G: I don't think so, but I don't know. I feel we may have to go back to - I don't know whether we can get more information. D: Maybe later on. Let's go find Santiago.

It is plausible that there are cultural-historical grounds for these patterns of collaboration to emerge. As mentioned, all three participants had been working together at the research lab on common projects. Geoff was a lead designer and shaped the direction of the project team's design and developmental work. Hence, Geoff was regarded as one of the leaders of the project team. Eddy and David were both programmers, thus their roles would also cross-cut in many ways. As mentioned, the projects that they were working on together were complex and required everyone to know each other's work to inform their own. Information sharing was key to their collaboration. This process was facilitated by the fact that they were seated close to each other in their office, which allowed for ready face-to-face dialogue. The three participants would also take part in regular team meetings where each member would give an account of their work. This practice was meant to encourage team members to take personal ownership of their roles and be accountable to the team. In addition, each member would also share the problems he faced and the team would discuss how to solve these problems. This was another important platform for information sharing and collaboration. Moreover, each team member would not just offer solutions to their own problems, but also offer solutions to other team members' problems, which suggests that they would somewhat take on each others' roles. Therefore, it is plausible that the patterns of collaboration that we saw during the test-session reflect the kind of collaborative problem-solving culture that our three participants had developed while working closely with each other and with other project team members at the research lab.

4.4. *Dialogic, participatory, collaborative problem-solving mediated by epistemic frames*

Finally, in this section, we turn our attention to how, in the process of collaboration, the players engaged with each other as subjects through dialogue, in general, and role-playing in particular.

Here, we will focus on the case of David, who was most active in role-playing. At multiple points, we see David identifying himself as medical doctor. He often did so with obvious pleasure (Extracts 21 and 25 in Table 5). Hence, we see how David lent “voice” (Bakhtin, 1982, 1986) to his subjectivity by imbuing his utterances with much affective content. Moreover, he did so in ways that we think reflect voices of prevailing culture. For instance, in Extract 21, David expressed obvious pride at being a medical doctor. While we did not follow up to ask him why, we can reasonably suggest that it probably reflects how certain professions, such as medical doctors, are viewed as having higher social status in the local culture, a perspective often reproduced inter-generationally through parents who communicate such values to their children.

Moreover, we had earlier noted how identities were produced in dialogue, focusing on how the subject reflected upon himself to develop a sense of role-identity. Here, we inquire further into the role of the interlocutor. In Table 5, we see Geoff’s crucial role in producing David’s identity. Firstly, Geoff invited David to consider his role as a medical doctor in relation to his real self - from Geoff’s perspective (Extract 22) and then reflexively (Extract 28). Secondly, Geoff also attempted to produce David’s identity by “hailing” (Althusser, 1971) him in terms of his character - “medical” (Extract 26). Their dialogic interaction with each other was also mediated by their interaction with the NPCs. For instance, Extract 25 instantiates how identities are again produced in dialogic interaction, mediated this time by how an NPC in the activity may interact with one player and not with another.

What is ultimately interesting in these instances is how players’ emergent identity mediated argumentation. David’s utterances instantiate two ways. First, Extract 26 shows David replying Geoff that he did not have the NPC, Eve’s health report. Later (Extract 27), he not only realized that he had it, but more significantly, reflected on his particular role in the activity, that *as* medical doctor, he always has the health report. This is an instance of how players may develop “epistemic frames” (Shaffer, 2006) (Figure 2.4), in terms of identity, through which to know the kinds of data that their professional identity may allow them to draw upon as potential evidence to back up their claims or perspectives.

Table 5. Instances of dialogic, participatory, collaborative problem-solving mediated by epistemic frames.

Turn	Phase	Extract
16 - 17	Making the plot	[21] G: So what role are you? D: I'm doctor. [growling] [G & D laugh]
21 - 23		[22] G: I'm government official D: Doesn't look like [G & D laugh]
67 - 69	Advancing the plot and making the story	[23] G: I don't think I have other documents connected to Bartleby. D: I have it. Oh, because I am a doctor so I can see his thing. G: Ya. And I think the government official doesn't get much information.
78 - 80		[24] D: He doesn't trust doctors. [G laughs] D: Because this part says, "I would prefer not to go doctors. I don't trust them at all." <i>So he may not be telling me some truth.</i>
107 - 108		[25] G: OK, Ivan's doctor. Oh! He does not say anything to (...) "I don't discuss my patients unless I am talking with a doctor." [looks at AD and laughs] D: He's talking to me!
142 - 143		[26] G: [At D] And medical, you did not get any information about her health, right? D: Nope, never say anything about her. So we go to Ahab Captain's.
147		[27] D: Eh, wait. Maybe I have Eve's health. [locates Eve's health report] I always have the health report, sorry.
170		[28] G: Actually I have (...) "Children poisoned by mercury may develop problems. Your doctor can take samples and send them to a testing laboratory." [At AD] Mmm - are you able to do that? D: [Smiles] No, I can't. [Both laugh] OK. I don't have extra information. I only have the health report.

Second, and more significantly with regard to developing an "evaluativist epistemology" (Kuhn et al., 2000), is how epistemic frames may be constituted dialogically and reflexively to mediate players' evaluation of claims or evidence. For instance (as Extract 24 shows), upon reflecting on how Bartleby, the NPC, views members of his profession ("He doesn't trust doctors"), David reflected on how he himself might be viewed by Bartleby and thus, how the claims that Bartleby made to him might not be truthful.

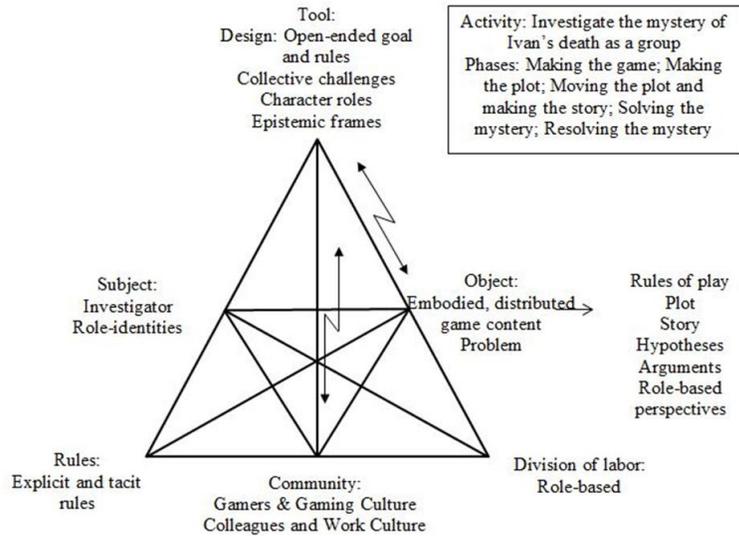


Figure 2.4. Dialogic, participatory, collaborative problem-solving.

5. Discussion

Research question: How might the context of argumentation be characterized from the perspective of Activity Theory?

From our analysis, it should be evident that we have not taken a more conventional approach to studying argumentation. Instances such as Extract 8 and 9 (Table 1) abound throughout the activity, and are typically analyzed with respect to argumentation structure in its epistemic sense. For instance, Extract 8 and 9 would be analyzed in terms of a claim (“TCE is the main factor leading to his death”) supported by evidence (“he worked there”), that is linked to the claim by means of a warrant (“he was exposed to it”) that is qualified (“more than other people”) based on additional evidence (“he drank to make himself have a worse body condition”, “he ate fish”). In terms of argumentation structure in the epistemic sense, this argument reflects rather good argumentation.

Instead, what interests us more are interactions such as the following, which we had earlier analyzed:

- [23]. G: I don’t think I have other documents connected to Bartleby.
- D: I have it. Oh, because I am a doctor so I can see his thing.
- G: Ya. And I think the government official doesn’t get much information.
- And,

[24]. D: He doesn't trust doctors.

[G laughs]

D: Because this part says, "I would prefer not to go doctors. I don't trust them at all." So he may not be telling me some truth.

In this section, we will further discuss and synthesize the findings from our analysis and propose a framework for understanding a game-based activity context of argumentation.

5.1. Role-identity: Agency, social, ideology

In our analysis, we had shown how their role-identities emerged in the context of their collaboration according to a role-based division of labor. In our subsequent analysis of Extract 23 and 24, we suggested how these role-identities could constitute epistemic frames for argumentation. In this discussion section, we will discuss and synthesize our findings from our analysis to suggest three aspects of role identity: agency, social and ideology.

The first aspect of role-identity is agency. At least two senses of agency may be discerned from our data. In our analysis, we had shown how David was developing a sense of personal responsibility for the task as a medical doctor (Extract 27), and how both David and Geoff were developing a sense of their respective roles in terms of the information that each profession could share (Extract 10 - 11 / Extract 23). Hence, the first sense of agency pertains to what one is committed to and able to offer in acting on the problem with others. The second sense of agency is more specifically epistemic in nature. For instance, we had seen in the analysis how the three players alternatively took up the roles of initiating inquiry, offering hypotheses, synthesizing etc. (Extract 17 - 20).

The second aspect of role-identity is the social. Our analysis of (Extract 10 - 11 / Extract 23) suggested what Geoff is getting is a sense of how one's ability to participate in argumentation could depend on the information that one has access to. Hence, the first sense of the social concerns how one sees herself in terms of the extent to which one is denied or privileged with cultural resources to participate in an activity. Our earlier analysis of Extract 24 also suggests another sense of the social. Here, David is beginning to see himself "through the eyes" of the NPC who distrusts doctors in general. Hence, the second sense of the social concerns how one is seen as being inside or outside of a certain community.

The third aspect of role-identity is ideology. Here, we highlight Extracts 7 - 9 from our analysis and discuss them in relation to each other.

[7] D: [At Eddy (E)] You've got anything to say about all these?

E: I think the pollution plays a part. And just nice [sic] because of Ivan's living lifestyle - he worked in the factory, and he drank a lot, he went fishing and he ate the fish.

[8] D: So let's do a conclusion. Shall we do a conclusion? So most likely it's the (...) TCE?

[9] G: I think that's the main factor leading to his death because

D: He was exposed to it.

E: More than other people

G: Ya

E: Other people had the symptoms. The wife, baby, the friend - whoever were rained on [sic] in the season all had minor symptoms. But as for this guy, he worked there, he drank to make himself have a lesser-worse body condition [sic], then he ate fish also, and was exposed to the rain more.

D: [Smiling] He had everything.

As we see in Extracts 8 and 9, while David and Geoff settled on the claim, it was Eddy who pushed it further by offering the evidence, warrant, qualifier and backing. However, he did so not just from a particular perspective (in terms of the environment, which is consistent with his role as an environmental scientist) but consistently so (e.g. Extract 7 through to Extract 9). As a profession, environmental scientists take particular views of socio-scientific problems (e.g. human health) in terms of the relationship between humans and the environment (e.g. how humans contribute to various forms of pollution, which in turn affects human health). In other words, each profession is associated with a particular ideology. Hence, argumentation does not simply constitute assertions, but reflects perspectives and positions (Beach & Doerr-Stevens, 2009) that are ideological.

In summary, our discussion and synthesis here suggest that role-identity has at least three aspects: agency, social and ideology. This is shown as the small middle circle in Figure 3. "Role identity" is placed at the core of the diagram to denote that at the centre of the activity is the subject-in-activity. This is consistent with a core idea of AT that the subject cannot be conceived apart from the activity in which the subject is situated.

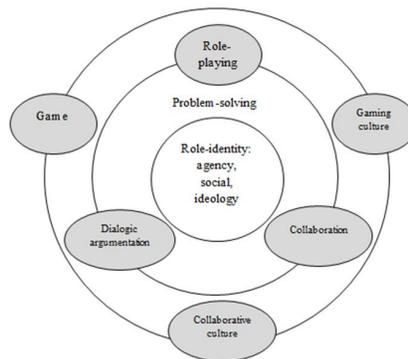


Figure 3. Game-based problem-solving context of argumentation.

5.2. Modes of problem-solving: Dialogic argumentation, collaboration and role-playing

From an AT perspective, our analysis had also suggested that the activity was goal-directed in terms of the problems that our players were trying to address. It was in the process of working together to solve problems that the role-identities emerged. The main problem was the mystery of the protagonist's death. In the process, other problems needed to be addressed, such as creating rules. In this section, we will discuss and synthesize our findings from our analysis of the ways our players engaged in problem-solving. Specifically, we identify three modes of group problem-solving.

The first mode of problem-solving is dialogic argumentation. Although we had noted some instances of argumentation that showed very good reasoning (e.g. Extracts 8 and 9), there were hardly any counter-arguments. (It would not be expected in a debate, for instance, which is a common context of argumentation in schools. Typically, argumentation in a debate would be characterized by counter-claims and rebuttals.) However, what we did see, in Extracts 8 and 9 for instance, were the players working together to extend each other's arguments by offering evidence and warrants. What we had also seen was how they took turns to initiate inquiry, hypothesizing and synthesizing. In other words, what we did not see were patterns of competition that we would normally see in contexts of argumentation such as a debate. What we saw were patterns of a kind of collaborative argumentation (e.g. Nussbaum, 2008; Quignard, 2005) that engaged with each other's arguments in very different ways, for instance, by working with each other to extend each others' arguments rather than rebutting them.

The second mode of problem-solving is collaboration. There are two senses to collaboration. The first is more epistemic in nature and concerns argumentation of the collaborative kind, as we had described in the preceding paragraph. The second sense of collaboration concerns how epistemic objects are circulated in the process of information-sharing. An important epistemic object in the activity is information (e.g. about the protagonist, environment etc.). As a group, they were determined to piece the puzzle together, which they realized depended on having as much information as possible as a group. Hence, they decided to collaborate to share information according to a role-based division of labor and according to certain rules of cooperation and coordination.

The third mode of problem-solving is role-playing - or more precisely, lack thereof. This is where we would like to add an important caveat to our discussion. The caveat is that instances of role-playing, instantiated by Extracts 23, 24 and just a few others, were the exception rather than the norm. As we had seen in Table 1, most instances of role-playing took place in the first two phases of "making the game" and "making the plot", where the players were orienting themselves to their character roles, back-story and plot. Even when such instances did surface in the subsequent phases of "moving the plot" and "making the story", most instances in this and later phases showed players being oriented toward getting a sense of the problem structure (e.g. the possible causal relations) without reflecting much sense of role-identities. However, those instances that reflected role-

identities (e.g. those analyzed in Section 4.2 and 4.4) point to the interesting possibilities that role-playing presents for collaboration and dialogic argumentation.

In summary, we see role-identity as emerging in the context of problem-solving through the modes of dialogic argumentation, collaboration and role-playing. Diagrammatically in Figure 3, the problem-solving context is depicted by the large middle circle. Along the circumference of this large middle circle are three smaller circles representing the three modes of problem-solving. They are placed along the circumference to denote their inter-relations. As yet, our analysis and synthesis do not suggest much about their relative significance to problem-solving. Hence, they are placed roughly equidistant from each other.

5.3. *Game and culture*

In the preceding section, we suggested how dialogic argumentation, collaboration and role-playing could constitute three modes of problem-solving. In this section, we recall briefly how the game design and its relation to certain cultural factors could create the conditions for problem-solving.

Using AT in the analysis, we had attempted to account for the role of the game design in creating the conditions for the problems to emerge. For instance, in using the concept of contradiction, we argued that the secondary contradiction between the distributed nature of the game content and the collective nature of the game challenge created a need for the players to collaborate with regard to information sharing. This need was accentuated by the fact that the game content was also physically, rather than digitally, embodied and the game was also played in a rather constrained physical space.

More importantly, some of these problems were not generated by the game design alone, but by how it interacted with the culture of the players. For instance, we suggested that it was a secondary contradiction between the open-ended nature of the game and the game culture of the players that not only contributed to the structure of the activity in terms of the five phases, but also made the creation of rules a particular problem. On the other hand, we also suggested how the collaborative culture of the players that they have built up over the years working together at the lab could also have contributed to them being able to successfully solve this problem that was created by the contradiction between the game design and game culture of the players.

On this note on culture, it is probably pertinent to raise the perspective of play as a cultural problem (Van Oers, 2013). From an Activity Theory perspective, Van Oer defines “play” as,

an activity that is accomplished by highly involved actors, who follow some rules (either implicitly or explicitly), and who have some degree of freedom with regard to the interpretation of the rules, and to the choice of other constituents of an activity (like tools, goals, etc.). (p.191)

Although the primary goal of our participants was problem-solving, they clearly went about it playfully, as far as this definition goes. According to Van Oers, the AT perspective views play as taking place in the context of participation in cultural activities. We would add that more specifically, play takes place in the interplay of multiple contexts. In our case of playful problem-solving, so as to speak, it is the inter-play between our game, with its open-ended rules and high degrees of freedom, our participants' culture of gaming and their culture of collaboration.

Diagrammatically, this inter-play of multiple contexts to create the conditions for problem-solving is represented by the largest outermost circle in Figure 3. Specifically, along the circumference of the circle are three smaller circles, representing the "game", "collaborative culture" and "game culture". The three smaller circles are placed along the circumference to represent how they inter-play to create the conditions for problem-solving. Since our analysis and synthesis do not suggest much about their relative significance in constituting the problem-solving context, they are again placed roughly equidistant from each other.

6. Limitations of the Study

In this study, we employ AT as an interpretive framework to understand the context of argumentation with MCM-Lite. In characterizing the subject, we employed a bucket-list approach. We recognize that our bucket-list approach to the subject may result in some loss of fidelity. A much more in-depth approach would be to utilize third-generation Activity Theory (Engeström 2001; Anthony 2012) to analyze the interactions between participants, each representing different activity systems. However, this would be far beyond the scope of this paper. Nevertheless, we feel that in focusing on getting at possible senses of the subject in a single activity system, our approach could offer a big picture, so to speak, that might guide a more in-depth interpretation of the social interactions between individual participants.

The second issue is that without comparing dialogic argumentation across different groups, there are admittedly limitations to the generalizability of our findings. However, we suggest that the problem of generalizability applies even when we compare groups within the same age and education range. In reporting the findings from an adult group that has established social relationship, we do not assume that all adults of similar age and educational background will collaborate and argue in a similar fashion. In fact, social relationship plays a critical role in how our adult team collaborates and argues during the game. Based on such findings, we can conduct another study that focuses on differences in social relationship to inquire the role of social relationship in argumentation.

However, even if there are limitations to the generalizability of our findings, this issue has to be considered from the perspective of our choice of a qualitative case study approach. Whether we want to compare across groups of different age and education range (which is our research design goal) or across groups of similar ones, both kinds of comparison would benefit from an in-depth investigation. We hope that our case study here points to two kinds of benefits from an in-depth qualitative analysis. First, cross-

group understanding cannot be logically derived without applying the same analytic approach across all groups. This study has suggested to us that AT is an interpretive framework that we could use productively for future studies. Second, deep cross-group understanding will be limited without in-depth qualitative case study. For instance, our key findings suggest important sociocultural and situational factors pertinent to dialogic argumentation and problem solving. In fact, we even entertain the possibility that age and education factors may be less important than other sociocultural factors and situational factors based on future cross-group comparisons. Such understanding would not be possible without such in-depth qualitative case studies.

7. Conclusion

Argumentation is indeed an important reasoning skill for 21st century learning. In recognition of this, various tools and technologies have been developed to engage learners in argumentation. Games are also seen as affording more situated experiences of argumentation. Studies of technology-supported dialogic argumentation have typically foregrounded the reasoning process. This is despite the fact that argumentation has also been understood in social and functional senses, and that different patterns of argumentation could be produced in different contexts. Therefore, in our study of argumentation with a role-playing board-game, instead of investigating argumentation as a reasoning process in the first instance, we turned our attention to its context, interpreting the context through the lenses of Activity Theory.

Based on our analysis and discussion directed at our inquiry question (“How might the context of argumentation with MCM-Lite be characterized from the perspective of Activity Theory?”), we propose that the context of argumentation may be characterized as a game-based problem-solving context. This conceptualization is based on these preliminary claims: [1] Problems were created through the design of the game or arose due to cultural factors that influenced how players responded to the game. [2] There were three modes of problem-solving: collaboration, dialogic argumentation and role-playing. For the former two especially, distinct patterns are observed that suggest that they constitute cultural practices. [3] Emergent selves in terms of role-identities has three aspects: agency, social and ideology. These role-identities potentially constitute epistemic frames for argumentation.

In short, we are suggesting that *even* such a relatively brief event may represent “an evolving, complex structure of mediated and collective human agency” (Roth & Lee, 2007, p.198) - as “praxis” that reflects “practice” (ibid). What theoretical implications might alternative conceptions of argumentation have? Conceiving argumentation as praxis would mean theorizing how the situational context, that may include aspects such as communicative goals and contingent problems, are implicated. Seeing argumentation as practice would mean conceiving how the sociocultural context, that may include aspects such as cultural practices of argumentation, may be inflected. Based on these alternative conceptions, a potentially interesting area of research in the study of technology-supported argumentation is the relationship between the technological,

sociocultural, situational and epistemic aspects of argumentation. For instance, in studying argumentation with future designs of MCM-Lite in schools, we are considering the possibility of carrying out an ethnographic study of the practices of argumentation in these schools and compare them to the patterns of argumentation with these future versions of MCM-Lite. Hopefully, this would shed much more light, than what we have attempted in this study, into the various roles that technological, sociocultural and situational factors have in shaping epistemic patterns of argumentation.

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