The Game Object Model and expansive learning: Creation, instantiation, expansion, and re-representation

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In this paper, the collaborative development, instantiation, expansion and re-representation as research instrument of the Game Object Model (GOM) are explored from a Cultural Historical Activity Theory perspective. The aim of the paper is to develop insights into the design, integration, evaluation and use of video games in learning and teaching. The first part of the research deductively analyses the historical development of the GOM over the past 12 years against the expansive learning cycle. Thereafter the open-ended reflections of participants who attended a workshop to re-represent the GOM as an instrument to evaluate computer games for the classroom were analyzed using both interpretive and deductive qualitative approaches. The development of the GOM and associated models showed that the prime unit of analysis was collective, tool-mediated and object-oriented activity. Findings show that, during each expansive learning cycle, the model functioned first as object and then as tool. Analyses of the activity associated with the development of the GOM instrument to evaluate computer video games fostered individual understanding of the role of games in education and transformed world views in all non-positivist participants. The development of the GOM and associated models supported multiple points of view in which activity system and individual contradictions drove expansive learning cycles and individual transformations. Future research should investigate the efficacy of the GOM-based game evaluation instrument developed as a product of this research.

Keywords: Game Object Model, Game Achievement Model, expansive learning, Cultural Historical Activity Theory, tool mediation, computer video games, transformation, non-positivist participants

Introduction

While the use of computer video games in the classroom is advocated as an artefact to support contemporary learning practices, there are insufficient insights into the learning processes associated with the design of educational games and their use in the classroom. Our narrative makes use of a decade of research from a single research group and Cultural Historical Activity Theory (CHAT) as a heuristic to explore the notion of collaborative tool building and individual transformations. The paper is divided into a number of sections. First, a brief introduction to CHAT (Engeström, 2000, 2001; Roth & Lee, 2007) is provided, then the collaborative production and use of the Game Object Model (GOM) version II (Amory, 2007) is analysed using published research (development, instantiation and expansion) and new research which employs the GOM as a model to develop an instrument to evaluate computer games for classroom use (re-representation). Finally, the implications of these analyses are discussed. This paper is a detailed exploration not of the GOM II and associated models but rather of the use of these models to investigate tool-mediated collaborative knowledge construction. Our exploration begins with CHAT concepts applicable to this paper.

Conceptual framework

Cultural Historical Activity Theory concepts

Vygotsky (1933/1978) proposed the actor-object-tool triad to argue that investigation of any object by actors is always mediated through tools (language, signs and tools). Today the principles of CHAT, as briefly discussed below, are an extension of the Vygotskian triad, and include (1) activity that encompasses action, operation-motive and goals; (2) the concept that human beings live in an object-oriented reality; and (3) tool-mediated learning and development (Engeström, 2000, 2001; Roth & Lee, 2007; Stetsenko, 2004, 2005). The Activity Theory framework therefore considers how subjects, or actors, use *tools* to interact with *objects* to realize *outcomes*. Such activity is governed by *rules* that mediate between the *community* and the *actors*, and includes the *division of labour* that mediates activity between the *community* and the *object* (Fig. 1) (Engeström, 2000, 2001).

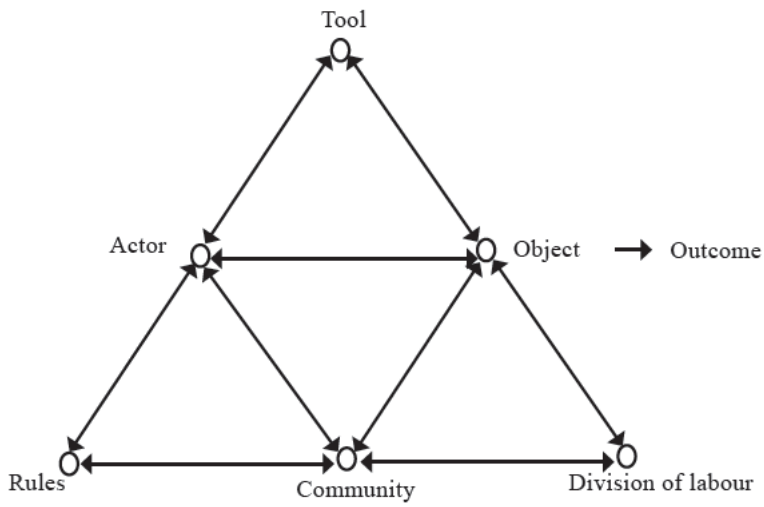

Figure 1: Activity system diagram (from Engeström, 1987)

Stetsenko (2005:74) argued that the foundation of human development includes the "material production of tools, the social exchanges among people, and the individual mechanisms regulating this production and these exchanges". However, Stetsenko (2005:75) posited that object-relatedness is "disconnected from the broader dialectical Marxist premises of Activity Theory, [and] does not fully overcome the dichotomies of internal-external and collective-individual forms of activity". To address such dichotomies, or uncertainties, Stetsenko suggested that a cultural-historical object is not only a product of communal social practice, but also comes into sharp focus when acted upon by individuals, resulting in their transformation and development. To explore the contradictions associated with any activity system (including contradictions associated with the object and within expansive learning as described below) it is necessary to first briefly discuss tool mediation.

Tool mediation

Tool mediation is core to human development, or transformation, and the freedom to improve the human condition (Stetsenko, 2004). Wertsch (2007) categorized Vygotsky's formulation of mediation as either extrinsic or intrinsic. Extrinsic mediation is when an individual "overtly and intentionally introduces a 'stimulus means' into an ongoing stream of activity" (Wertsch, 2007:180) that is obvious and non-transitory. Intrinsic mediation, on the other hand, is less obvious and difficult to detect, but "it involves signs, especially natural language, whose primary function is communication" (Wertsch, 2007:181).

Whether mediation operates through direct intervention or through language and signs, individual transformation includes both extrinsic and intrinsic modes of mediation. Also, Edwards (2008) argued that mediation is hierarchical, with the tools ranging from simple and material to the sophisticated (for example, technological systems and ideologies), and that tools help humans to master their world and thereby transform themselves.

The object of the activity

Kaptelinin (2005) explained that the Russian *objekt* and *predmet* both translate to "object" in English. While an *objekt* refers to actual items that exist in the real world and are independent of the mind, *predmet* refers to the target, or content, associated with a thought. Kaptelinin (2005:8) supposed that

> *the reader should rely on the context, taking into account that 'object' is likely to have the meaning of predmet if emphasis is placed on intentional, social, meaningful, and integrated qualities. Running the risk of oversimplification, one can say that predmet is more 'subjective,' and objekt is more 'objective' ... In the expression 'the object of activity' and related uses, 'object' has the meaning of predmet ... In the 'subject–object' distinction and related uses, 'object' has the meaning of object.*

Expansive learning and activity

Contradictions are an integral part of any learning system. Engeström (2004) argued that learning takes place along two dimensions: emergence of a new object through activity on one axis, and exploration for new knowledge and the exploitation of existing knowledge along the other axis. Incremental exploration is concerned with experimentation and expansive learning is therefore connected to new knowledge production associated with emerging activities. Thus, expansive learning includes a cyclic sequence of learning activities: (1) questioning: primary contradiction; (2) analyzing historical contradictions: secondary contradictions; (3) modelling a new solution; (4) examining the model; (5) implementing the new model: tertiary contradictions; (6) reflecting on the process: quaternary contradictions; and (7) consolidating the new practice (Engeström, 1999, 2004). Contradictions (conflicts, dilemmas, disturbances and local innovations) "become the actual driving forces of expansive learning when they are dealt with in such a way that an emerging new object is identified and turned into a motive" (Engeström & Sannino, 2010:7). In addition, these authors posited that expansive learning results in an enlarged pattern of activity associated with a new theoretical concept, and a new type of work.

Theoretical frames

Social interactions, tool mediations and contradictions associated with the meaning of the *object* are used to frame our analyses of the GOM and GOM-based tools. The main objective of these analyses and their results is to develop insights into the developments of complex learning systems and tools to support the design, integration, evaluation and use of video games in learning and teaching. Expansive learning cycles associated with each of the creation, instantiation, expansion, and re-representation (new research) aspects of the GOM are explored in the following sections.

Analysis

Creation of the GOM – Expansive Learning Cycle 1

The development of computer games during the early 1990s evoked a debate as to how such artefacts could be used as educational tools (primary contradiction). A research project was therefore initiated to (1) identify types of computer games that, according to students, might be useful in teaching and learning; (2) evaluate student opinions related to computer games; (3) develop a game based on student opinions; and (4) assess the impact of computer video games on teaching and learning. Amory, Naicker, Vincent and Adams (1999) reported that students preferred adventure and strategy games and identified a number

of useful design criteria for educational games. These criteria were used to develop an adventure game to help students understand human evolution. Evaluations of game-play and associated learning found that students enjoyed game-play and developed an understanding of the concepts embedded in the game. These experiences and findings resulted in the development of the GOM (Fig. 2).

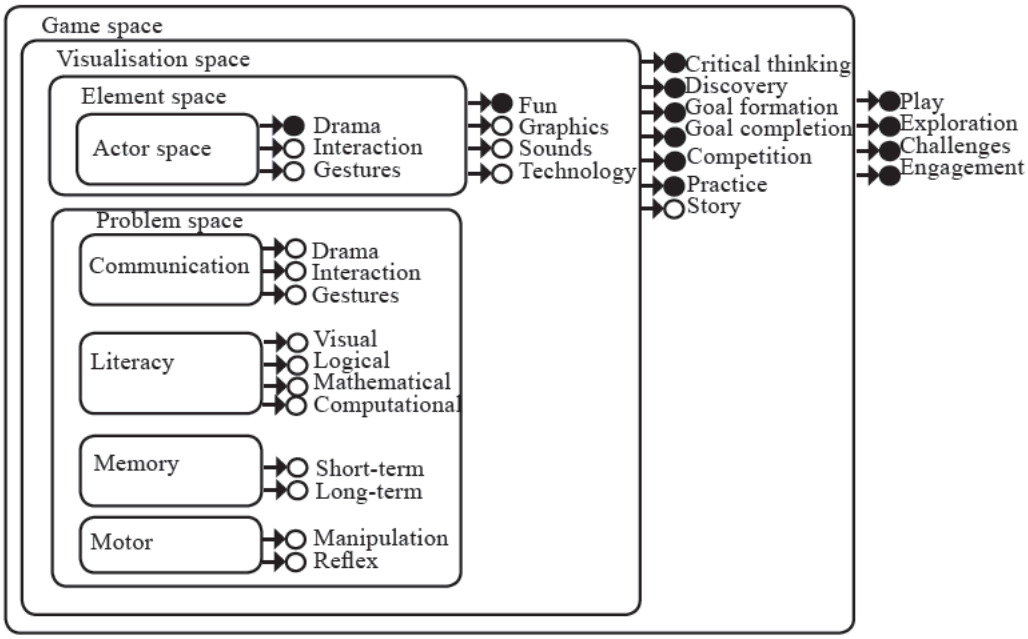

Figure 2: The Game Object Model (redrawn from Amory & Seagram, 2003)

The GOM consists of a number of entities, each described through abstract and concrete attributes represented by open and closed circles respectively. Abstract attributes refer to pedagogical and theoretical ideas and are useful in the conceptualization of an educational game, whereas concrete attributes are the design elements used to construct the game. Educational game designers make use of the abstract attributes in the conceptualization phase of game design, while game developers realize these pedagogical aspects of an educational game by incorporating the concrete attributes into the game software. Therefore, during the first expansive cycle a new form of activity, associated with the GOM, came to the fore. However, the use of the GOM as a tool in the design and development of educational games proved more complex than initially anticipated (the primary contradiction of the expansive learning cycle associated with the instantiation of the GOM).

Instantiation of the GOM – Expansive Learning Cycle 2

Research group members, game designers and software programmers found it difficult to understand the GOM and to exploit its concrete attributes (primary contradiction). In order to make use of the GOM as a *tool*, members needed to understand it first. Therefore, to develop insights, the GOM had to act as the *object* of an activity first. In addition, Amory (2001) suggested that educational game design should be divided into three phases: research, resource creation and software development. The research phase included learning problems identification, puzzle design to overcome the identified learning problems, and game narrative construction. Digital resources used to realize the narrative and puzzles form part of the resource creation phase. Software development included the creation of the game and playback engines to support the narrative and puzzles. However, this relationship between the GOM and research, resources and software development did not overcome the GOM-implementation contradictions, so Amory and Seagram (2003) designed the Game Achievement Model (GAM) in an attempt to do so. The GAM considered all

the concrete attributes of the GOM and envisaged an educational game as a three-act narrative play with embedded puzzles that were to be the stratagem for attaining learning outcomes. Each act includes any number of scenes that bring to fruition its aims and narratives, but the acts are not arranged linearly. It was argued that such a reductionist model would not only simplify these conceptualizations of educational computer video games but also explicate game and puzzle designs. However, the use of the GOM and GAM with large development teams (Amory & Seagram, 2003; Seagram & Amory, 2004) and small ones (Baxter & Amory, 2004, 2006) brought forth a number of other contradictions:

- Puzzle design through reduction was more complex than envisaged by the GAM (Baxter & Amory, 2004).
- Writing a non-linear narrative was complex and difficult, especially when professional scriptwriters attempted to argue their linear storytelling positions (Amory & Seagram, 2003).
- Dialectical tensions existed between the narrative, puzzles and individual belief systems (Baxter & Amory, 2006).

To address these contradictions and to include recent advances it was necessary to expand the GOM.

Expansion of the GOM – Expansive Learning Cycle 3

Amory (2007) extended the GOM (Fig. 3, below) so that educational computer games were conceived to:

- be relevant, explorative, emotive and engaging, and include complex challenges
- support authentic learning activities that are designed as narrative social spaces in which learners are transformed through exploration of multiple representation, and reflection
- be gender inclusive, include non-confrontational outcomes, and provide appropriate role models
- develop democracy and social capital through dialogue that is supported by means of computer-mediated communication tools
- include challenges, puzzles or quests, which form the core of the learning process, and provide access to explicit knowledge, conversations, and reflection, resulting in the construction of tacit knowledge.

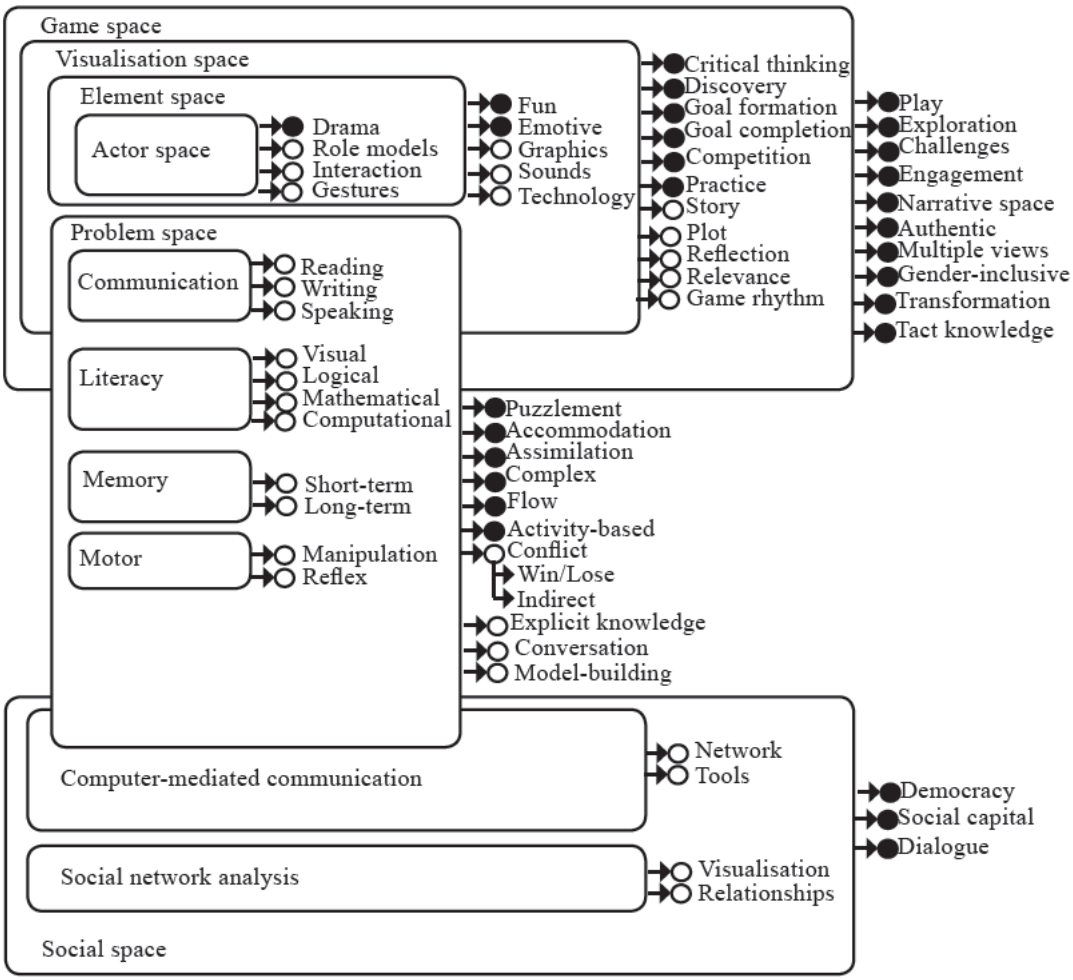

Figure 3: The Game Object Model version II (redrawn from Amory, 2007)

Amory (2007) has suggested that, while the GOM version II was designed to support development of educational computer video games, the model could also be used as a game evaluation framework, the development and use of which is discussed in the next section.

Re-representation of the GOM as instrument – Expansive Learning Cycle 4

To address the concern related to the integration of computer video games into the curriculum, de Freitas and Oliver (2006) introduced and evaluated a four-dimensional framework, which included the context of the learning activity, learner specification, pedagogic considerations, and the mode of representation, or tools, for use. They found that the framework was flexible and able to support reflective practices in the use of games in the classroom. Becker (2007) suggested that teachers could only successfully integrate games into teaching and learning if they themselves were encouraged to play them. Game-play should allow teachers to become critical in appraising the educational value of computer video games. While playing games might develop teacher experience, the selection of appropriate computer video games for use in the classroom is complex. Therefore, the design of a specific game evaluation instrument could assist teachers in making appropriate choices.

The re-representation of the GOM version II model as an evaluation instrument could solve the problem of computer video game selection for teaching and learning. The design of such an instrument was socially constructed during a workshop attended by a group of researchers and postgraduate students. The workshop included two primary activities: development of the instruments based on the GOM version II, and playing a number of computer video games. The workshop was designed from a social constructivist position from which dialogue and consensus seeking were used to develop the instrument (reported in this paper) and to explore a number of commercial and educational games.

Methodology

In conducting the research we followed a qualitative interpretive approach. The data set consisted of reflections written by the six participants after the completion of the workshop. First, we incorporated the reflection data into an integrated dataset on *Atlas.ti*™, a computer-assisted qualitative data analysis system. Second, we used the concepts of the GOM version II as theoretical codes and deductively coded and categorized the data set. This analysis allowed for the development of an initial understanding of participants' perceptions of and contributions to the workshop. Third, we combined codes closely related to each other in order to build a better understanding of the activity associated with the workshop (selective coding). However, some of the meanings embedded in the data were not yet sufficiently categorized; therefore, during the final phase a grounded-theory approach with inductive reasoning was applied for a conceptual analysis of the data set. This resulted in eleven categorized conceptual codes revealing the dynamics of and individual positions articulated during the workshop activity.

Data analysis

The findings of the qualitative analyses of participants' reflective writing are presented here according to the eleven conceptual codes arranged in descending frequency, namely thinking critically; multiple world view; transformation; inclusivity; empiricist viewpoint; personal world view; social capital; narrative spaces; challenges; authenticity; and exclusion.

Most of the comments related to *thinking critically* were made by two participants, and pertained to the way the workshop supported individual development and how participants built their individual understanding of the GOM:

> *"But for me the most rewarding outcome is that I realized that such processes do lead to transformation and while it might appear that we go round in circles, we in fact are moving ... along a spiral..."*

> *"I knew from previous workshops that involved the GOM how easily participants reinterpret the model from their own perspectives that might be different from mine (different world views) ... We had hardly made any progress during the first day when the group started to articulate their own world views that at time clash with the underlying principles of the model. ...Why do we just go round and round in circles?"*

Participants also commented on the importance of multiple world views:

> *"... that people are coming from varying disciplines ... did not cause any social, cultural, educational, ethnicity, religious, gender, age etc. problems."*

> *"I then came to realize that with many people, there will be many world views."*

Participation in the workshop presented *transformational* opportunities to all the participants, articulated by two with regard to how they had influenced their thinking:

> *"The first port of call for the change of my thought process was the deviation from my tradition or authority of deriving conclusion."*

> *"The design of the experimental questionnaire to deal with factors of motivation such as challenge, curiosity, fantasy, collaboration and cooperation was a great learning outcome for me."*

Participation in the workshop appeared to support individuals (*inclusion*) who were inexperienced in playing modern computer video games:

> *"I was also confronted with how strong others' opinions of female roles, likes and dislikes are and what the perceptions were of what females really are."*

> *"For example, in a computer game, other people would prefer to die and start all over again; while others would feel demoralized by the word 'die'."*

However, a single and very strong voice was associated with an *empiricist* position:

> *"The development of the survey used for the children had a number of positives and some negatives. A theme that should always be remembered and reminded is that this is a gender study in computer games* ***– all other variables should be controlled for and not allowed to influence results*** *... Only through ethnographic research where we expose some children to games and* ***guard another group of children against exposure to games*** *(while controlling all other variables), will we be able to establish the learning benefits of games over time" (our emphasis).*

This empiricist world view aligned with the participants' *personal world views*:

> *"The sample must be carefully chosen or sub-samples established within the sample of those who (i) play games, (ii) those who are able to play games but don't (choice), (iii) those who are unable to play games (lack of income, illiteracy, computer illiteracy, disability, etc.)."*

All of the participants, except the empiricist, made remarks related to social capital, narrative spaces, challenges, authenticity and exclusion. In the following examples these comments are contrasted with the views of the empiricist. With regard to *social capital* participants remarked:

> *"... will not play them on my own, but in the group it was easier for me to accept the aggression."*

> *"To me it seemed that the majority of members involved in the workshop were not very familiar with computer games. Excluding [facilitator] (given his past research experience) and myself (as I have 20+ years of experience dealing [playing, reviewing, and researching] with computer games) ... (NB: playing solitaire or using edutainment doesn't classify as computer gaming). This brings into question the validity/appropriateness of some survey statements agreed by a majority."*

The workshop was seen as a place to explore ideas through stories (a *narrative space*):

> *"Playing games that are challenging, engaging, gender inclusive [and] explorative with multiple views could bring about a huge learning paradigm [change]."*

> *"The questionnaire seemed straightforward to me, but its appropriateness in design will require a trial with children."*

The workshop was *challenging*:

> *"The discussion ... was quite thought provoking where we worked together to resolve our differences in opinion amicably."*

> *"An issue I cannot emphasize enough is the issue of balance. Balance, [I] feel, should be included as an additional dimension. Reading Crawford and Kostikayan will strengthen this claim. It is crucial to creating a game that is immersive."*

Many of the participants, and the empiricist, felt that the workshop included *authentic tasks*:

> *"The selection of the games to be used for the first phase of the experiments was in itself a great challenge as most of them were full experimentation and exploration of ideas, which in turn led to unexpected discoveries and excitement."*

> *"In terms of positives, having a group of (1) people of diverse backgrounds and different specializations provided a fairly (2) rigorous assessment of survey statements and a (3) wide perspective for means of questioning/assessing computer games."*

The code *exclusion* was part of the writings of the empiricist:

*"In terms of playing games in groups with the sample, I don't recommend this to be done with children, unless the **children have a similar profile** in terms of a number of variables (i.e. computer gaming experience, extroversion vs. introversion, etc.)" (our emphasis).*

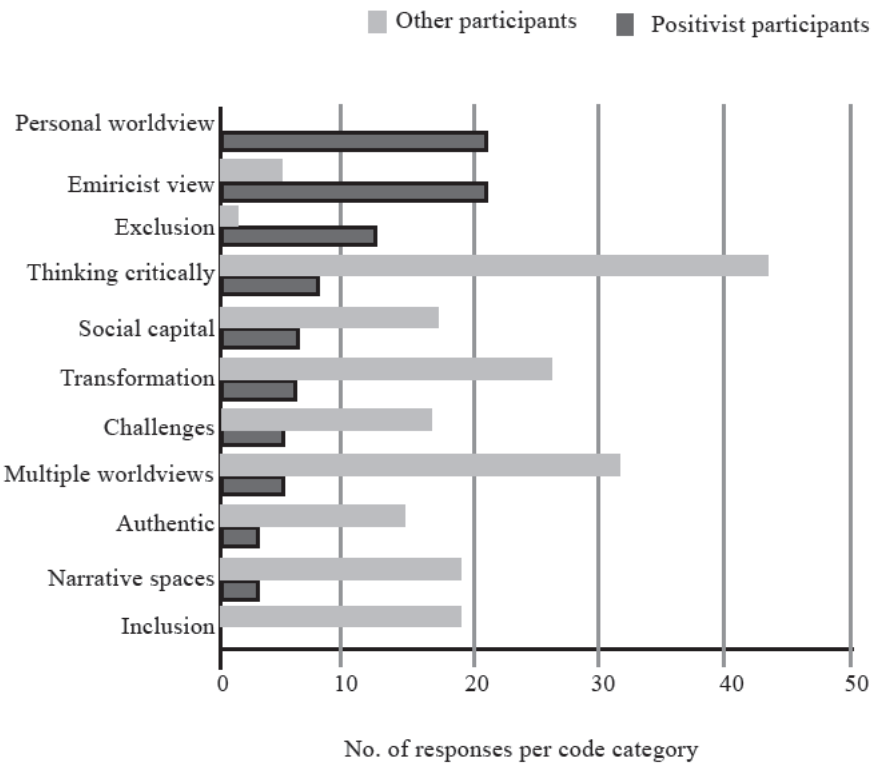

Figure 4: Analysis of the conceptual codes as expressed by the positivist (■) and by other participants (■)

Three important inferences could be drawn from this analysis. First, before the GOM could be used to develop the instrument, participants needed to understand the model. Again, the GOM first acted as the *object* of the activity before it could be used as a *tool* to develop the instrument. Second, the use of social constructivist principles as a means to design the workshop supported learning and development of new insights into the use of video games in education for all but one of the participants. In particular, participation in the workshop supported the transformation of educational practice, especially for two individuals. Third, the participant who strongly supported an empiricist position remained critical of the process and was consistent in maintaining an authoritarian and, at times, condescending position. Presenting the views of this participant in relationship to those expressed by all other participants (Fig. 4) highlights the two opposing world views: the empiricist with a strong personal world view and the social constructivist view expressed by the other participants. On the one side, an individual participant who held a strong empiricist world view and believed in positivist research designs, rejected social constructivism as a way of facilitating consensus building and believed that, in educational research, it is possible to conduct controlled experiments with children. On the other side, two participants wrote about how participation in the workshop changed their world views.

Discussion – CHAT analysis of the GOM

The relationship between *object* and *tool* appears to be intricate: before complex *tools*, such as models, function to extrinsically mediate activity they need to be understood and thus function as the *object*.

The collaborative design and development of an educational game on evolution, i.e. the *object* of the activity, resulted in the production of *tools*, the educational computer video game itself and a framework to support game development, the GOM. *Actors* subsequently involved in the design and production of other educational games found the GOM difficult to understand and use. Therefore, before the GOM could act as a *tool* to mediate game development, it functioned as an *object* in order to build individual understanding of the model. However, the contradictions associated with the GOM precipitated the development of the GAM. Here, the GOM again functioned as part of the *object* of the activity to support the production of a GAM.

The GAM, in turn, operated both as a *tool* when used to support game design and as an *object* when critiqued. The GAM proved useful as a *tool* to extrinsically mediate educational computer video game production. However, the GAM provided insufficient depth to support puzzle design, non-linear versus linear narratives, and the integration of narrative and puzzles. These dialectical struggles might have been due to individual ideologies and resulted in additional contradictions. In order to extend the GOM, the model functioned as the *object* of activity and the outcome was a more complex model, the GOM version II. The development of an instrument based on the GOM version II to evaluate the educational fit of computer games required the GOM to act as the *object* of the activity first. Therefore, a socially constructed *tool* acted as *object* first and then as a *tool*. The oscillation between *object* and *tool* may be a natural part of the expansive learning cycle, as discussed in the next section.

The expansive learning cycle includes a number of cycles, for example, questioning, analysing, modelling a solution, examination of the model, implementation, reflection and consolidation (Engeström, 1999, 2004). Initial research to produce a game, i.e. the creation phase, led to the production of a game and the development of the GOM. This creation phase included the questioning, analyses and modelling of solution steps of the expansive learning model. An examination and implementation on the GOM and reflection of these two processes brought to the fore a number of contradictions. Therefore, during the instantiation phase it became necessary to develop a production-oriented model, the GAM, to support game design and production. The development of the GAM initiated a second expansive cycle. Within this cycle additional contradictions related to puzzle design, non-linear versus linear narratives and the integration of narrative and puzzles emerged. As a consequence, the GOM was expanded to address the identified contradictions – the third expansive cycle. The GOM version II formed the theoretical substrate for the development of an instrument to evaluate computer video games for classroom use. This instrument is not directly related to the production of educational games, but to their assessment for teaching and learning, and is therefore a part of a different activity system and the start of a new expansive cycle.

Building consensus and understanding collaboratively required resolute effort to work from a social constructivist framework which brought to the fore contradictions related to social constructed meaning making, puzzle design, non-linear narratives and game design. However, the development of the game evaluation instrument highlighted important points pertaining to individual transformation. Many team participants accepted and understood the GOM and were able to use the model as a *tool* to design the evaluation instrument. The participant holding very strong empiricist and positivist views showed little transformation in thinking and attempted to perturb the system. For other individuals the use of social constructivism resulted in a transformation of their belief system related to teaching and learning.

Analyses of the development of the GOM, associated models and educational computer video games support the five principles of Activity Theory (Engeström, 2001), namely:

- The prime unit of analysis was collective, tool mediated (extrinsic and intrinsic) and object oriented.
- Collaboration allowed multiple points of view.
- Current understanding of game design and pedagogy has developed over more than 10 years of activity.
- Numerous expansive learning cycles were driven by system and individual contradictions.

- Collective journeys resulted in expansive transformations in most participants.

In conclusion, the development and use of the GOM illustrates Stetsenko's (2005) argument that "human activity – material, practical, and always, by necessity, social collaborative processes aimed at transforming the world and human beings themselves with the help of collectively created tools – is the basic form of life for people". Extending this idea, the use of computer games in the classroom will only lead to individual transformation, and thus deep learning, when they, the games, function as *tools* that extrinsically and intrinsically *mediate* specific *learning outcomes*. In addition, future research should be undertaken to investigate the efficacy of the GOM-based instrument developed to evaluate the educational value of a games.

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