

Creativity, Collaboration and Competence: Agency in Online Synchronous Chat Environment

Elizabeth S. Charles, Dawson College, 3040 Sherbrooke W, Montreal, QC H3Z 1A4,
echarles@dawsoncollege.qc.ca
Wesley Shumar, Drexel University 3141 Chestnut Street, Philadelphia, PA 19104,
shumarw@drexel.edu

Abstract: Agency is potentially an important concept for CSCL as researchers think about the effectiveness of online learning environments and the ways they encourage groups to take active control of their learning activities. This paper reports on several sessions of mathematics problem solving in the VMT Chat environment. The VMT Chat is a synchronous chat and whiteboard space for students to collaboratively define and work on problems that are open-ended and that encourage students to define the questions themselves. We draw on the anthropological, psychological and sociological traditions and their concept of agency in order to produce a robust analysis of several segments of student work in the VMT Chat. Our analysis suggests that there are structural features to the VMT Chat environment that encourage “agentic behavior” on the part of students. This has important implications for learning and the structure of pedagogic activities.

Introduction

This paper looks at the mathematics problem-solving behavior of students in the Math Forum’s VMT-Chat environment. The VMT project is a project that is attempting to provide an online synchronous environment for small groups of students to work on math problems together. The project has not only designed a whiteboard/chat environment for students to work in but also does research on various aspects of online collaborative problem-solving.

Computer supported learning comes in many forms and hybrids. There is the notion of computer supported collaborative learning (CSCL), computer-supported community-based learning (CSCBL), and so on. Enactments of such learning opportunities apply to students from primary school to university; they refer to formal and informal learning such as after-school and community centre programs; and to online, face-to-face or to some blend of these. In all cases the one constant is the use of computer tools and artifacts to create activities for intellectual exploration and promotion of social interaction (Stahl, Koschmann & Suthers, in press). These activities are designed to engage students in learning through jointly negotiating and planning how to proceed, generating questions and exploring possible problem solutions together, in the process modeling and scaffolding learning for each other. In short, instruction and learning is viewed as a group initiative and not a teacher lead effort, hence, supporting and sustaining productive interaction is crucial. A major design consideration should be the promotion of students’ *agency* over the processes by which knowledge and ideas are created and improved, sometimes referred to as *epistemic agency* (Scardamalia, 2002). In fact, Scardamalia and Bereiter (1994) describe the release of agency as a guiding principle in the design of their knowledge building communities (KBC). But what do we know about this phenomenon? How do we know that our computer supported learning environments are harnessing (marshalling) the potential of the powerhouse individual and group attribute? What does agency look like when we take a close view of the interactions between individuals? What can we learn from a close examination of this phenomenon that may help design future collaborative environments (both online and face-to-face) or may help promote the development of agency in less agentic groups?

In this paper we use the concept of agency to frame our analysis of some recent data in the VMT-Chat environment. We are interested in thinking about agency as a concept because we would argue that students and groups with a greater sense of competence and self-efficacy will have the potential to make greater progress in their mathematical learning. Agency as a concept helps us understand the relationship between structural (including technological) constraints and human action. This in turn can inform our thinking about the strengths and weaknesses of this kind of online project for a sense of identity, competence and self-efficacy.

1 The Research Setting

2 *Virtual Math Teams* (VMT) is a five-year NSF funded project starting in Fall 2003 designed and run by
3 researchers at Drexel University and *The Math Forum* (<http://mathforum.org>). Its aim is to create an online
4 environment to promote and support the knowledge building and math discourse between groups of individuals who
5 enjoy doing math but do not generally have opportunities to meet and work with like-minded learners. To achieve
6 these goals, VMT researchers designed a software environment called *VMT-Chat*, which provides chat rooms for
7 small groups to meet on the Web to communicate about math and engage in joint problem solving, mediated by a
8 whiteboard, chat logs and associated referencing pointing tools all archived for future referrals. By bringing learners
9 together, the VMT environment and tools challenge participants to engage in collaborative activities that call for
10 jointly negotiating goals, meaning of the shared tasks while constructing problem solutions (e.g., explaining and
11 defending own ideas) and jointly regulating the group's progress.

12 **Structure/Agency**

13 Before we start let us briefly situate agency within the CSCL literature. Most notably, the notion of agency,
14 specifically epistemic agency, has been the focus of work conducted by Marlene Scardamalia and her colleagues
15 (e.g., Scardamalia & Bereiter, 1991; Scardamalia, 2000; 2002). In the course of observing students' use of CSILE
16 and Knowledge Forum, she coined the term epistemic agency to describe the acts of initiative taken by students
17 (very young in some cases) to present their ideas and negotiate a fit between personal knowledge and those of others
18 "using contrasts to spark and sustain knowledge advancement rather than depending on others to chart that course
19 for them." (e.g., Halewood, Reeve, & Scardamalia, 2005, p.2). In taking on the responsibility for aspects of learning,
20 such as, goal setting, motivation, evaluation, and long-range planning, students demonstrate their epistemic agency.
21 As such, Scardamalia (2000) views epistemic agency as one of the two major components of productive
22 engagement. From the collaborative learning perspective, epistemic agency implicates the students' willingness to
23 see themselves as a member of a community, hence their community identity. Which, along with epistemic agency
24 is seen as mutually constituting the students engagement in community discourse (Brett, 2002). We will return to
25 this line of reasoning below.
26

27
28 As a particular case of the larger Western pre-occupation with determinism verses free will, sociology and
29 the social sciences since their inception have tried to think through the relationship between structure and agency.
30 One interesting perspective on the structure/agency binary is the thought of the British sociologist Anthony Giddens.
31 For Giddens structure is a product of the pattern of practices that social actors engage in. Therefore structure is
32 emergent out of human activity. Further there are different levels of structure that emerge out of different forms of
33 human practice, signification, legitimation and domination. Signification has to do with the production of meaning,
34 legitimation the production of moral order through norms and values and domination of course is produced through
35 the exercise of power (Giddens, 1979; 1984).
36

37 These above types of structures are produced by human activity but once they exist they then work to
38 constrain future human action. Therefore the structure produces patterns of activity that, in the French sociologist
39 Pierre Bourdieu's terms, becomes habitual action structured through activity of the past but then used to structure
40 and classify future activity as well as things in the world. This dialectic used by both Bourdieu and Giddens is one
41 way to overcome the primacy of either structure or agency and succeeds in showing how dialectically they are the
42 product of each other. Giddens adds a further dimension to structure and that is that people are conscious of their
43 practices and so they engage with structure in a self-conscious effort to reproduce it or change it. So that there is a
44 reflexive quality to agency. While Bourdieu is also aware of this self-consciousness he is much more interested in
45 the way that most human practice is habitual or semi-conscious. Bourdieu is aware of the fact that social actors
46 often have a "strategy" for "playing the game" of life, but they are also often in his mind "shooting from the hip"
47 (Bourdieu, 1990).
48

49 Giddens and Bourdieu's understand of the relationship between structure and agency is very useful for our
50 analysis of the VMT. From the beginning the VMT project has been a design-based development project. And so
51 the practices of students using earlier generations of the chat environment (even starting with just AOL IM)
52 influenced design decisions for future environments. The goal of the design team has been to enable future activity
53 that the participant sought to engage in and to constrain activity that seemed to detract from the productive working
54 together of the problem-solving teams. But further the activity of the participants themselves solving a problem and
55 interacting with the technology begins to build up a kind of small group structure that then carries through to the

1 remainder of the session and may influence future work sessions of the same group. So looking at the micro
2 interactions of structure and agency for a particular problem solving team can help us understand how collaborative
3 problem solving works in this environment and how to further support the team work.
4

5 Creativity/Imagination/Identity

6 In a major article on agency, Emirbayer and Mische (1998) offer a critique of the Giddensian and
7 Bourdieuan position. Essentially they argue that the focus of Bourdieu and Giddens is too much on structure and
8 the production of habitual action and not enough on the creative emancipatory potential of human agency. The
9 conflict between Giddens and Bourdieu on the one hand and Emirbayer and Mische on the other represents a very
10 important paradox in social theory. On the one hand social theorists have to account for the dramatic patterning of
11 human action and the way much human behavior can be predictable. On the other hand one must also account for
12 the production of new culture and the process of cultural change. These two realities are difficult to contain within
13 the same theory and theorist tend to emphasize one pole or the other.
14

15 Our hope is to view agency as an act of creativity, which draws these two perspectives closer. Thus our
16 definition of creativity does not fit with the standard psychological definition. We would argue that much of social
17 life is constrained structures that themselves are the product of past action both conscious and habitual and that these
18 constraints are something that social actors must indeed face. But on the other hand as we will discuss below there
19 are creative potential for social actors to engage with those structures in new ways. We feel that online services like
20 the one the VMT is constructing in fact facilitate the creative and imaginative when students attempt to deal with the
21 constraints around learning math.
22

23 Emirbayer and Mische want to emphasize the creative dimensions of human agency. For them these
24 dimension have a future focus and are tied up with creativity, imagination, improvisation etc. This notion of identity
25 dovetails nicely with the work of Bandura (2001) and Dorothy Holland and her colleagues (Holland et al., 1998).
26

27 Bandura's (2001) model of agency offers a way to take the above characterizations into consideration and
28 describe them in a developing comprehensive theory. This theory articulates a model of agency composed of four
29 key components, which account for cognitive, affective and psycho-social characteristics: (1) intentionality, (2)
30 forethought, (3) self-regulation, and (4) self-efficacy. Agency is more than a mere self-regulating activity, rather it is
31 involves planning, reasoning, monitoring progress, and reflecting on beliefs about one's capabilities. Viewed in this
32 light, agency can be both a quality of actions produced by an individual as well as the interactions produced by a
33 group of individuals. In other words, when working collaboratively as a group, these four characteristics can be
34 transposed into jointly shared actions or enterprise. As a collective production, intentionality is jointly negotiated,
35 forethought is jointly shared, members engage in co-regulation of progress, and the group develops a sense of co-
36 efficacy or belief in a collective capability (Charles & Kolodner, submitted). In this manner self-regulation and self-
37 efficacy become more than cognitive acts, but social and culturally driven ones as well, in fact, Bandura claims that
38 self-efficacy promotes a "prosocial" orientation. Taken as a whole, these collective productions implicate changes to
39 identity – possibly shifts from individual identity to group identity (i.e., team member or even member of larger
40 discipline-specific member).
41

42 According to Holland et al. (1998), agency is intimately related to, and mediated by, identity. In turn,
43 identity is shaped through activity in social practice and is the principle way in which individuals come to "care
44 about and care for what is going on around them" (Holland, et al., 1998, p. 5). Thus agency and identity are mutually
45 constitutive systems that play out in two forms: (1) acts of improvisation; and, (2) acts of self-directed
46 symbolization. Improvisations are actions that are independent of structural or cultural constraints. They are
47 mediated by one's "sense and sensitivities," what we might also describe as awareness of perceived need to act.
48 Symbolization refers to the human ability to create imaginary worlds, "*figured worlds*." It allows learners to
49 participate in activities and use language, signs and symbols, to organize themselves and others in exploratory ways.
50 What Gee (1992) refer to as the disposition to engage in "pretending."
51

52 Taking all these theoretical ideas into consideration, we will now move to the analysis of VMT data in an
53 effort to show some of the creative moments of agency and how the VMT system creates an opening for students
54 who are constrained by the norms of classroom mathematics to really open up and think about and practice
55 mathematics in new ways.
56

VMT Data Analysis

The data snippets that we are about to look at are part of a set of conversations that a group of four students¹ engaged in around a series of open-ended problems. Six other similarly composed groups participated in this pilot study. We selected this group because of their attendance record, which allowed us to better track the progress due to individuals' agency, or lack thereof. The students meet for the first time in the chat environment, thus had no prior histories together. They had four one-hour sessions working with and getting to know each other over several weeks. The full transcripts of these conversations are very long. Here we look at just a couple of moments in this much bigger problem solving activity. Before moving forward, we briefly describe the assigned tasks the students focused on during the featured segments.

The Assigned Tasks

The "stick" challenge starts with an identification of pattern and construction of mathematical rules to describe the growth of a graphical pattern. For example, in the first session, students are provided with the representation below (see Figure 1) and asked to account for the growth in numbers of sticks used and squares created when $N=4$, $N=5$, and so on. In the second session, which we discuss, the students continue to work on this problem, but this time they are asked to extend their reasoning to include creative problem solving such as constructing other mathematical problem related to the problem with the sticks. For instance, they are asked to consider other arrangements such as triangles, hexagons, 3-D figures, like cubes with edges. As well, they are asked to analyze their patterns using different methods such as induction, recursion, graphing, tables, and so on.

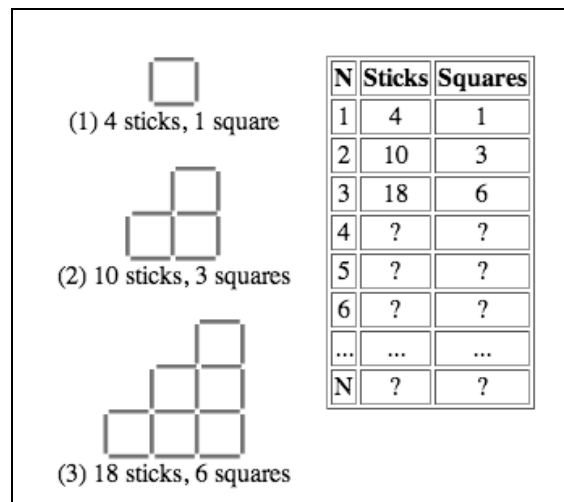


Figure 1 – Example of the initial sticks task.

A typical example of what the whiteboard looks like at the end of session 1, and the beginning of session 2 is below (see Figure 2). From this point, students negotiate the meaning of concepts such as recursion, coordinate drawings of graphical representations and jointly construct mathematical formulas to account for the patterns they identify. (NB. the formula on the whiteboard is $((1+N)*N/2 + n)*2$).

¹ Due to the design of the study, the participants were anonymous therefore we do not have exact ages for the individual students but they were approximately 12-14 years old. This design also ensured that the students had no prior history together.

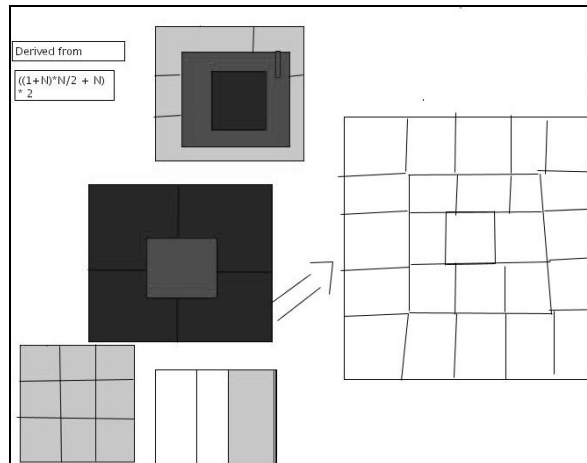


Figure 2 – Segment of Team B's whiteboard, Session 2

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The grid world challenge starts off with a situations where the students are asked to imagine they live in a world where one can only travel along the lines of a grid - for example, driving in a city like Manhattan or Philadelphia. They are asked to construct solutions for the shortest path between two points, A and B, remembering to stay along the grid. The are then asked to extend this reasoning by creating relationships between points when A is at (x_1, y_1) and B is at (x_2, y_2) . For instance, a solution used by Team 5 in their fourth session (see Figure 3). Such problems encourage students to define and calculate grid distances, define analogs to shapes defined in Euclidean geometry. In doing so, students engage in reasoning with mathematics as a creative enterprise.

Dimensions	# of paths
1x1	2
2x2	6
3x3	20

Ways (from U to E):
UYE, UAE, UPT E,
UVBE, UKOE, UWCE,
UFJE, UXDE, UVQTE,
UVLOE, UVQJE,
UWRTE, UWMOE,
UWHJE, UXSTE,
UXNOE, UXJE

A B C D E
F G H I J
K L M N O
P Q R S T
U V W X Y

A B C D E
F G H I J
K L M N O
P Q R S T
U V W X Y

A B C D E
F G H I J
K L M N O
P Q R S T
U V W X Y

ADP
AMP
ACGHP
ACKLP
ACOP
ABFHP
ABFGKLP
ABFCDP
ABJLP
ABJKDP
ABNP
AEHP
AEGKLP
AEGOP

Here are all the original questions:
1. What is a mathematical formula for the distance between any two points on the grid? Call the points "A" at some grid coordinate (x_1, y_1) and "B" at (x_2, y_2) .
2. How many shortest paths are there along the grid between pairs of points? Is a general formula?
3. Suppose that the left and right edges of the grid are connected, so there is 0 distance between them. For instance, the distance between $(0, 5)$ and $(11, 5) = 0$. (One could say that those two sets of coordinates are two different names for the same point.) Now what is the distance along the grid between points? How many shortest paths are there?
4. Suppose that all the edges of the grid are connected, so there is 0 distance between them. For instance, the distance between $(1, 5)$ and $(7, 10) = 2$. (One could say that all the edge coordinates are different names for a single point.) Now what is the distance along the connected grid between points? How many shortest paths are there?
5. You might wonder what you get if you find all of the points that are the same distance from a given point and then connect them (with the shortest path). In regular geometry this would give you a circle. What would you get here? What would be the ratio of circumference to the diameter? In regular geometry it is always the same number, pi.

1x1 --> 2 ways
2x2 --> 6 ways

Figure 3 – Snapshot of grid world whiteboard.

13
14
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1 Case Studies

2
3 We believe that synchronous online chat environments, designed specifically to engage participants in
4 learning, are special in that they require individuals to take on certain kinds of agency, which may have implications
5 on how and why they learn. This agency is demonstrated in a variety of ways, most noticeably in student's self-
6 efficacy, in their intentionality related to negotiation of the goals to be achieved, and in their co-regulation of the
7 progress of activities leading to the attainment of those goals.
8

9 This is different from traditional classroom learning (and perhaps other forms of online learning such as
10 teacher lead e-learning), and even perhaps what we generally see in face-to-face small group problem solving
11 because of the unique features of the environment. These features include purposeful equalizing of positional
12 identities (true sharing of authority because of the anonymity of participants – histories are developed within this
13 setting), the linear nature of the conversation (only one voice at a time), the “engraved” nature of time
14 (conversations and artifacts are archived and retrievable), and the cultural practices that are necessitated or made
15 possible by the technological tools (e.g., pointing back with the referencing tool; waiting to respond until after
16 reading a posting). We propose that to function within these structures may require or encourage/promote a certain
17 sense of agency.
18

19 Take the following excerpt as an example. It is the second of 4 sessions with three students (Quicksilver
20 and bwang8 and Aznx) working on a math problem involving sticks. In the beginning it is clear that Quicksilver and
21 bwang8 are capable of working together to find the solution to the problem presented. They engage in small linear
22 acts of building on the others ideas or questions, each time reflecting an interplay of planning the next step
23 (intentionality) and regulating how it fits the intended goal (i.e., solve the problem). What comes out of these small
24 linear actions is a sense of shared achievement and moving forward. For others, such as Aznx, however, it appears
25 that their sense of agency may be related to time to reflect on the archival structures of the environment.

591 Quicksilver 08.04.03: you guys can add on
592 Quicksilver 08.04.08: i just put the basic
593 Quicksilver 08.04.20: Maybe share our results?
594 Aznx 08.04.53: We technically had the same result.
595 Quicksilver 08.05.07: Whaddya mean?
596 Quicksilver 08.05.21: oh as yesterday?
597 Aznx 08.05.31: Yeah.
598 Aznx 08.05.36: And today.
599 Quicksilver 08.05.40: Still...
600 Aznx 08.05.43: Well today was really a discussion.
601 Quicksilver 08.05.46: we should say that'

26
27 His general contribution to the group changes significantly once he positions himself as someone who
28 makes observations such as the one above and has capabilities the group will need (i.e., he is good with words). In
29 this occasion he expresses a high degree of self-efficacy and takes on an active role in constructing the artifact to be
30 posted on the group's wiki.

609 Aznx 08.06.55: Wait, who is submitting?
610 Aznx 08.06.57: bwang?
611 bwang8 08.06.59: tell them the intervals between levels

612 Aznx 08.07.06: or quicksilver, or me?
 613 bwang8 08.07.08: sorry, i am bad with words
 614 Quicksilver 08.07.14: So am i
 615 Aznx 08.07.15: Not to worry.
 616 Aznx 08.07.21: We should write it out
 617 Aznx 08.07.22: here
 618 Quicksilver 08.07.24: Aznx to the rescue lol

1
 2 Here is a second example from a group of students working on a different problem called grid world where
 3 students explore the geometry of a world where everyone must always follow the grid and there is no movement in
 4 the space that is off the grid. In this example “meet_the_fangs” and “dragon” have been working on the problem and
 5 developing some more sophisticated ideas about how to solve the particular problem of navigating the grid.
 6 “Estrickmcnizzle” and “gdog” were quite quiet for a long time when they finally interrupted the interaction with
 7 “estrickmcnizzle’s” comment “we aren’t getting anything done.”
 8

9 218 estrickmcnizzle, 20:50 (19.05): we arent getting anything done
 10 219 meet_the_fangs, 20:50 (19.05): any suggestion?
 11 220 estrickmcnizzle, 20:51 (19.05): i dont know, maybe just a more simple problem
 12 221 estrickmcnizzle, 20:52 (19.05): less time consuming
 13 222 gdog, 20:52 (20.05): drop the questoin
 14 223 dragon, 20:51 (19.05): I think I know the answer...
 15 224 gdog, 20:52 (20.05): more simpel one that i can understnad plz :)
 16 225 meet_the_fangs, 20:52 (19.05): ask the mod to put up thequestions
 17 226 meet_the_fangs, 20:52 (19.05): or we can do the summer one

18
 19 Estrickmcnizzle’s comment opened the group to thinking about the problem, and possible solutions,
 20 differently. It also gave the two quieter members of the group different jobs to do in relationship to posting the
 21 group’s solution and how to share those results with the VMT staff and other groups.
 22

23 Discussion

24 Clearly, the unique features of the online chat and whiteboard tools influence the patterns of practices
 25 engaged in by the social actors in VMT, thus implicating the structure emerging from this social setting. In this case
 26 the structures produced through the interactions of the students involved act to negotiate and co-regulate the
 27 production of meaning, the norms and values of the jointly created figured world, as well as the exercise of power,
 28 what Giddens refers to as signification, legitimation and domination respectively.
 29

30 Traditionally the structure of the classroom, and what agency is expressed, are transposed from other
 31 similar sittings. Thus the constraints of past experiences may significantly limit what actions students take. In these
 32 relatively new online chat environments, however, such structures, if they exist, are borrowed from purely social
 33 experiences (e.g., chat rooms, blogs). Thus in many cases the signification and legitimation are all newly developing
 34 practices, and domination may not play a central role – at least not initially. Furthermore, with malleable structures
 35 there are malleable constraints, which offer greater opportunities for improvisations – the creative and unexpected
 36 making of dialogic turns. When we think of how these adaptive structures relate to agency in collaborative activity,
 37 we see collaborative group learning in a different light.
 38

1 In the examples we've given you, we show that learning can be described as creative and improvised acts
2 of agency – both individual and collective. The online chat and whiteboard environment appear to free the students
3 from the other kinds of social constraints that exist in their worlds and give them opportunity to make creative
4 problem solving decisions. It may also be that the types of students who are drawn to these settings are those that
5 more familiar and comfortable with these newer social constraints. In the first example it is a problem that asks
6 students to think about the relationship between the numbers of sticks one uses to make squares and then what
7 happens when one puts those squares into different shapes. This is a very open-ended kind of problem that might be
8 very intimidating in a typical classroom setting. But in the VMT chat the students are creatively playing off of one
9 another in order to make some insights about the sticks and squares problem. They are able to take up a sense of
10 agency as they play with the problem and help to define what new questions to ask. In the second example we see
11 one pair of students having the agency to stop the more “knowledgeable” students and ask them to engage in a set of
12 questions they can all understand. Again this is a remarkable breaking with traditional classroom norms.
13

14 Pulling back, agency, in some respects, requires individual and collective actions. When individuals begin
15 to interact in coordinated or shared states of intentionality, forethought, self-regulation and self-efficacy, there is the
16 converging and emergent values and beliefs – sensibilities and awareness of interdependencies, and
17 interconnectedness. Interdependencies are characterized by the development of mutual accountability and co-
18 regulation – socially negotiated responsibilities, expectations and standards from which everyone is evaluated,
19 including oneself. Interconnectedness is characterized as the development of mutual benefit – awareness of
20 distributed capabilities, i.e., that everyone does (may) benefit from the noticings (attending), problem solving,
21 reasoning and reflections of individuals; and the awareness of the development of a shared culture, resources and
22 social history – ways of asking questions, producing solutions to the math problems. So again in the second
23 example the students work together to define the questions they want to answer. There is a pressure to collaborate
24 and a scaffold to encourage all to speak and play with the problem.
25

26 Returning to Bandura's (2001) proposal that group achievement are the products of, and produced by, the
27 interactive, coordinated, and synergistic dynamics of members' transactions, and not merely by the individual's
28 intentions, knowledge, and skills, recall that transactions are an ongoing dynamic process that brings about a state of
29 interconnectedness and interdependency (transformational process). Thus, because of transactional dynamics, the
30 interconnectedness and interdependency of individuals with shared beliefs in their collective power and efficacy can
31 result in the perceived group-level emergent property described here as a sense of collective agency. In the brief
32 examples shown, we see the interplay between individual and group. The VMT chat is a space that in some senses
33 is liberated from the social constraints of a physical space. With virtual bodies and minds students have the tools to
34 play off of each other and enjoy the creativity of that play. This potential for a open and free interaction encourages
35 individuals to be agentic, but it also encourages the group to feed the individuals and to get students to act like
36 mathematicians, asking questions of the worlds they have created.
37

38 Conclusion

39 When one looks at the larger passages of interaction one sees this dance of creativity and agentic behavior
40 more clearly. Our brief examples have been drawn from larger sessions where groups of students work in 3 or 4
41 sessions of about an hour to two hours. These sessions largely involved the same participants and so a sense of
42 community was created among the students who worked together. In this larger set of data one can really see the
43 ways that groups take up problems, define them, attempt to answer them, explain their answers and move on to new
44 problems.
45

46 The VMT chat then has created something very unique. It has created an online world where students take
47 control, define problems, respond to each other and then attempt to answer these problems. In this way they look
48 more like professional mathematicians, in training, than students in a classroom. We would suggest that the VMT
49 Chat environment has the potential to overcome the structural constraints that one might see on social action from a
50 Giddensian or Bourdieuan perspective. These constraints are to some extent avoided because the environment
51 creates a collaborative space that can be defined by the participants and does not readily reproduce the hierarchies or
52 power relations in traditional school settings. Though it can also be argued that eventually a certain kind of social
53 network will develop based on the social interactions possibly producing hierarchies and power relationships.
54

55 Further, the social action that students engage in, in the VMT environment, creates new structural realities
56 for their further work in that space. As Giddens suggests there is a self-consciousness to this social action and the

1 social action that is encouraged is creative and draws upon the participants' imaginations to see knowledge
2 production as a fun, interesting and possible activity for ordinary people. Further understanding how to harness this
3 agentic behavior and leverage it for deeper learning will be a next step for this research.
4

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