# Citizen Science in the Classroom: An Analysis of Teacher-Student Discourse

Amanda Barany, UW-Madison, School of Education
Christian Schmieder, UW-Madison, School of Education
Jilana Boston, UW-Madison, School of Education
Kurt Squire, UW-Madison, School of Education

## Teacher roles in the learning environment

Just as video games for education function as *designed experiences* that affirm certain ways of acting (Squire, 2006), classroom environments also supply rules, values, and contexts that shape student learning experiences (Gaydos, 2013). Naturally, teachers play a significant role in the development of that context. They select and organize course content, develop in-class activities and other curricular elements, and they structure classroom discourse in order to emphasize certain points, perspectives, or pieces of information.

Teacher involvement can profoundly shape student learning experiences. Teacher-influenced elements of classroom context such as instructional quality, student-teacher relationship quality, and the socioemotional climate of the classroom have all been shown to have lasting effects on the development of student engagement and academic achievement (Dotterer & Lowe, 2011). Teacher-student relationships are also linked to student feelings of support and connectedness (Connell, 1990).

The conversational discourse in a designed classroom experience also plays a role in shaping students' learning experiences. Teachers can choose to employ varying degrees of authoritative (teacher-led and controlled) or dialogic (student-led and teacher facilitated) discourse styles to suit the needs of the students, the activity and the content (DeWitt & Hohenstein, 2010). The use of questions in teacher-student dialogue can serve a variety of functions and establish differing levels of teacher control as well (DeWitt & Hohenstein, 2009). Types and methods of teacher-student interaction vary by classroom and by teacher, and certain styles and methods of discourse can potentially support or fail to support academic performance (Applebee, Langer, Nystrand, & Gamoran, 2003).

As classroom learning interventions, educational video games are subject to the same contextual influences as other designed classroom experiences. However, video games for education show particular potential as tools for learning, particularly in domains of science, technology, engineering, and mathematics (National Research Council, 2011). The educational game *Citizen Science*, used in our research, is a potential foray into the development of games for learning.

## Citizen Science

As both a video game and a classroom learning activity, *Citizen Science* was designed with principles of engagement (Gaydos & Squire, 2012) and playful learning (Squire, Barnett, Grant, & Higginbotham, 2004) in mind. *Citizen Science*, an educational adventure game, has been found to facilitate learning about issues in lake ecology and has been implemented in classrooms as both a stand-alone experience and as a curricular component (Gaydos, 2013). The game was designed with the intention that it could serve as a "springboard" that inspires students to develop interest in lake ecology content, both within the game and in supporting curricula (Squire, 2004), while prompting students to model active civic participation in the virtual Madison community (Gaydos, 2013).

In the game, players travel through time as the "steward" of the lake, collecting scientific evidence about the health of Lake Mendota in Madison, Wisconsin, and using it to formulate compelling arguments in support of environmentally beneficial practices. Players progress through the game narrative and unlock new evidence, areas of exploration, and other game components, with the overall goal of convincing non-player characters to make choices that benefit the lake, and helping to enact change that positively affects lake health over time. The game ends when the player has successfully completed each of the nine in-game arguments.

Previous research suggests that as a stand-alone intervention, *Citizen Science* can elicit player engagement and interest in in-game topics (Barany, Gaydos, & Squie, 2013). Establishing internal efficacy of the game as an intervention is an important step for assessment, yet a deeper scrutiny of how the game is situated in the classroom setting is a vital step toward making meaningful claims about the game's real-world efficacy (cf. Brown, Collins, & Duguid, 1989). This contextualized setting includes both the spatial environment and the physical and verbal interactions between students and educators. During its first exploratory phase, our research focuses on interactional elements of the classroom context.

## Data Collection

A 7th grade teacher from a public middle school in rural Wisconsin implemented the game *Citizen Science* (accompanied by her own curriculum) in each of her six 45-minute life science classes over the span of a two-day unit. The *Citizen Science* unit served as one section of this teacher's larger ecology unit that spanned the several weeks before and after *Citizen Science*. 90 students from Mrs. Robertson's class, equipped with school-issued PC laptops, agreed to participate in the research. A visiting field researcher attended class during the *Citizen Science* unit, and used audio and video recording devices to capture student interactions with Mrs. Robertson, other students, teacher aides, and the field researcher. The video recorder was set up in the rear of the classroom in an attempt to capture a broad range of classroom interactions. The audio recorder was carried to various parts of the room to capture individual conversations with greater clarity. In addition, the visiting field researcher created personal field notes on classroom interactions, and obtained copies of classroom artifacts such as PowerPoint slides, student assignments, and student feedback cards. During class in the week following the *Citizen Science* unit, students completed an online, 15-item survey designed to measure student interest in in-game topics (Barany, Gaydos, & Squire, 2013).

Spoken interactions in the recorded video data were transcribed using simplified Jeffersonian standards (Jefferson, 2004). After the full transcription of a third of the data, researchers began preliminary analyses. Initially, transcription included detailed descriptions of physical movements and gestures. However, it quickly became clear that these descriptions were both overly detailed and potentially biasing; further preliminary investigation was necessary to establish which gestures and movements might be important before completing final analyses. A transcript is always a form of reduction - and distortion - of data (cf. Jordan & Henderson, 1995; Ochs, 1979). To remedy this issue, it was necessary to sync video data with the transcripts and conduct analysis simultaneously. The original transcripts were time stamped (the program F4 was used for transcription and the qualitative data analysis software MAXQDA 11 was used to store, organize and annotate the analytic results). This process linked video data and transcripts in the qualitative data analysis software. Preliminary analytic process of the video data involved repeated viewing of vignettes among the research team. Transcriptions served as a de-accelerated documentation of the spoken components of the data, while the videos themselves served as the primary source for interpretations of the interactions in the classroom.

Review of the video data quickly revealed that the video recording setup was not ideal to facilitate the fine-grained analyses of interactions planned in the analysis phase: the camera's angle was not wide enough to capture the length of the room, and transcription of the audio data necessitated significant effort to understand students farther away from the microphone. Further analysis will involve the reconstruction of interactional patterns within the fully transcribed data. The research team will then scan the rest of the video data for vignettes in which those patterns can be identified. Analyzing those will provide the research team with the chance to test, revise, and flesh out patterns while avoiding the complete transcription of exploratory data. The result of this preliminary study will consist of a set of initial observations, which will greatly support us in terms of pre-training for educators, researcher guidance in the field and data generation (e.g. interview questions, self-reflection exercises for educators). First outcomes are discussed in the last section of this proposal.

## Outline of Analytic Strategy

Research goals for current and continuing analysis involve exploring how educators talk to students when they play *Citizen Science*: how teachers direct students and how they answer questions. By examining those interactions, we hope to learn how these practices frame the activity of 'playing *Citizen Science'*, and how meaning is constructed in these situated practices. In short, current research, as well as the continuation of this research, will be an exploratory study that focuses on interactions.

According to Garfinkel, "[t]o recognize *what* is said *means* to recognize how a person is speaking" (1967, p. 30, emphasis i.o.). Following this prerogative, the research team began (and will continue) analyses by looking at linguistic phenomena in the data. While a variety of analytic tools borrowed from Conversation Analysis as analytic heuristics will be used (cf. Gee, 2010), the goal is to uncover underlying narratives and world-views constructed by participants in and through interaction. However, the research team approached data in a mindset closely related to Conversation Analysis: after all, we want to "elucidate and describe the structure of a coherent, naturally bounded phenomenon or domain of phenomena in interaction, how it is organized, and the practices by which it is produced" (Schegloff, 1987, p.101). Conversation Analysis is guided by an open mindset of *noticing* (Clayman & Gill, 2012) and a focus on describing the mechanisms that structure actions. Given the study's focus on how classroom interaction works, this approach seemed appropriate for this exploratory study.

During analysis, groups of two to three team members sat together and described the data in detail, word by word. Part of this initial process also involved the segmentation of transcriptions into stanzas (Gee, 2010), which supports the identification of possible patterns, specifically in the one-on-one interactions between teachers and students. The strategic goal is, in accordance to Gee's approach to Discourse Analysis, to discover "the situation-specific or situated meanings of forms used in specific contexts of use" (2010, p. 64).

During analysis sessions, the team took notes, which were later fleshed out and attached as memos to the respective data in the qualitative data analysis software. Throughout this process, we made sure to constantly ground emerging patterns in our data, and in concrete linguistic phenomena. By systematically comparing and contrasting these analytic memos, we identified and refined conceptual patterns emerging from the data (cf. Charmaz, 2006). These patterns later served as codes that we applied both to our data and the memos, thus creating a searchable index of emerging themes. This enabled us to further refine, crosscheck, and revise our analyses.

In short, the epistemological foundation of our analysis is ethnomethodological (Garfinkel, 1967; Cicourel, 1974), in such that we focus on distinctively language-based features in order to unveil how individuals do things with language, and how they indicate and negotiate meaning. The research team paid close attention to the ethno-methods displayed in the data; the goal is to scrutinize these indexical practices in order to reconstruct homologous patterns (Mannheim, 1993; Mannheim, 1952) of meaning making - which in turn provide insights in the concepts of the performed actions and enacted identities. Within this process, we utilized heuristics based upon findings from Conversation Analysis (Schegloff, 1987; C. Goodwin, 1979), specifically findings concerning direction-giving (Goodwin, 2006) and classroom interaction (e.g. Seedhouse, 2004; Seedhouse, 2005). Thus, techniques of analysis, documentation and self-reflection resemble memoing and coding techniques as utilized in the paradigm of Constructivist Grounded Theory (Charmaz, 2006), and the analytic stance taken in approaches falling under the paradigm of Discourse Analysis (Rymes 2009; Bloome et al 2008).

## Tentative Findings

Tentative findings suggest that the way in which teachers talk about the playful activity might impact the success of implementation. The way the teacher conceptualizes the game and the activities afforded by the playful learning environment may impact the efficacy of the game as an educational intervention. Lexical choice is an important element of distinguishing between conceptual worlds (cf. Gee, 2010). For instance, analysis revealed that the teacher regularly uses vocabulary that the team identified as 'instructionist' (see Vignette 1).

1 Student 2: what do i do?

2 Teacher: well honey you've gotta READ a little bit

3 S2: ok well (unintelligible)

4 T: ok so collect the secchi disk readings so here's the secchi disk right

5 here. oh now those things pop up and you DO the readings. [click right,

6 ok great] you've done em already?

7 S2: yeah

8 S2: yeah

**Vignette 1: Doing the readings**

At first, the teacher suggests *reading* as an activity that solves the student's proposed problem: the student does not know what s/he should do, therefore s/he should read. This is followed up by a concrete description of what the student needs to do in the game (4). Then, the teacher stresses to "DO the readings" (5); a game element that provides players with building blocks for arguments is named "readings" by the educator. Text such as this in the game could be referred to as "hints", "arguments", "what people have to say"; i.e. it could be connected to the domain of the playful activity. "Readings", in our opinion, refers to the realm of instruction; to a realm for which games for learning are trying to function as an alternative.[1] We suggest that lexical choices such as in vignette 1 might re-ground a playful activity in a traditional setting of learning and assessment. Put bluntly, *Citizen Science* is designed to imbue the traditional classroom setting with playfulness (Gaydos, 2013); however, analysis of lexical choices suggests that, to some extent, an instructionist classroom setting may instead permeate the playful

elements of the game. At this point in analysis, the research team only examined the video data, but we will explore this element further when we integrate findings from our ethnographic field notes.

Another finding of our analyses concerns the way the term “learning” is used by the educator when students have questions about the game. The research team noticed that the word is used by the educator to describe, justify and explain the activity at hand. We started to de-indexicalize this expression by compiling and comparing vignettes in which the term is used. The team also noticed that ‘learning’ is often introduced as a remedy when students are stuck with the game; “learning” is conceptualized in the interactions as something that happens within concrete moments or within temporal boundaries (and oftentimes as a future event) (See Vignette 2).

1 Student 4: what IS this thing?

2 Teacher: OH that’s a GREAT question y-know what, do you have your document

3 up?

4 S4: yeah

5 T: put your-pu-get your DOCUMENT up and go down to where it says vocabulary

6 and write that word euTROphic in there, ok, good job. and then when we get to

7 START LEARNing, you might be able to go in [for] inforMATion ok, excellent,

8 perfect

9 (2.5 sec)

10 T: and i’m gonna let YOU figure it out, because they’re gonna TELL you through

11 gathering the EVIdence and LEARNing, ok

12 S4: ok

**Vignette 2: Learning**

Here the teacher provides the term “learning” as a solution to the student’s proposed problem: The educator essentially says that learning will happen (6; 11) - and when it happens, the student will know the answer to the question. The student does not know the meaning of a word; the educator suggests that at a later point, *within* a process of learning (6) and *through reception* of learning (10f), the student will be able to discover the meaning of the unknown word.

The use of ‘learning’ in this vignette also illustrates how the teacher conceptualizes the tool *Citizen Science*. The educator says that “they” (i.e. the characters in the game) will provide a definition for the unknown word: on one hand by providing evidence and on the other hand by providing ‘learning’. In terms of agency (Emirbayer, & Mische, 1998), this frames the student as a recipient of learning, as opposed to being an agent in learning (such as in line 8). It is not our intent to point out that the educator is using ‘faulty’ language in any way. However, we believe that careful analyses of how certain central terms are perpetually used in classroom interaction can help us to provide researchers and educators with hints for implementing video games and other playful activities more successfully in the classroom.

## Initial Consequences and Suggestions

*Citizen Science* was designed to promote engagement and learning when “embedded and supported by classroom curriculum” (Gaydos, 2013, p. 36). We suggest that putting the playful, experience-driven activity into a semantic (and thus conceptual) framework of instructionism may inhibit students’ playful engagement with the activity. This will have to be taken to the test in our subsequent study of *Citizen Science*. In our next round of data generation, we also will have telemetric play data available via the ADAGE framework (Halverson & Owen, 2013). With this data, we hope to be able to track whether certain conceptualizations - such as the ones shown above - impact the ways in which students use the game.

Analyses also suggest that it may be fruitful to interview both educators and learners concerning their conceptualization of central terms, such as “learning”. This will provide further insight into the life worlds of the

people who actually use the tool – since, after all, the tool will be situated within their conceptual framework. Based on our ongoing exploration of the data, we will be able to share question guides for semi-structured qualitative interviews and group discussions at the GLS conference.

Our work so far has raised the question of how we can prepare future educators and researchers to optimally communicate about the game and game-related activities. Specifically, it may be beneficial to have conversations with educators concerning the terms and metaphors used when talking about a genuinely playful activity. Based upon these ongoing analyses, we plan to design a series of intervention techniques and self-reflection tools that educators can use prior to the implementation of games such as *Citizen Science*, and information regarding the development of these intervention techniques will also be discussed.

## Endnotes

(1) When we returned to this specific piece of data after the peer review process, we realized that our reading of "doing readings" is not as one-dimensional as we suggest in this version of the paper. In fact, the term "reading" is also a professional term used in the game: a reading from a scientific measurement device, the secci disk. While our data still supports the idea that "to read" is introduced with an instructional connotation, it is crucial to note that the teacher later connects the game experience (i.e., collecting and analyzing scientific data) with a professional term – a term that learners may know from the realm of their life world in school. Through referring to the experience of professional vision afforded by the game, the teacher supports the expansion of this term's meaning into a new, scientific-professional realm. This forcefully reminded to us to not overlook the realm of the game while doing analyses of audible interaction in the classroom.

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