Examination of Student Motivation and Group Dynamics in Internet-based Learning Experiences

Olga Werby, Ed.D.
Pipsqueak Productions, LLC
San Francisco, CA, USA
OWerby@Pipsqueak.com

Abstract

In this paper, I examine student motivation and group dynamics for the Internet-based learning materials. Student motivation and group dynamics play an important role in an instructional design. Student motivation can be improved through procedural goal alignment. Group dynamics specify whether the learning situation is collaborative, competitive, or cooperative. It notes the important conditions for these environments: the size of a group, the duration of the project, the scope of work, the individual time availability, the distribution of expertise among the group, the social status of group members, rate of communication/interaction among group members, and the distribution of work among members of the group. Online learning environments allow for collaboration, competition, and cooperation, but negotiating these interactions has to be more explicit since face to face meetings between members of a group are not possible. Recognizing the different forms of group dynamics and symmetries of member interactions is a necessary part of Internet-based learning environment design.

Introduction

Almost one hundred years ago, Albert Einstein said: “It is a very grave mistake to think that the enjoyment of seeing and searching can be promoted by means of coercion and a sense of duty.” Einstein echoes the sentiments expressed over two thousand years ago (85 A.D.) by Marcus Fabius Quintilianus: “Study depends on the goodwill of the student, a quality that cannot be secured by compulsion.” Both of these great men are stressing the importance of motivation to learning. The invention and spread of instructional materials on the Internet doesn’t change this fact: motivation is still a key component of education, independent of mode and medium of delivery. But it’s a mistake to believe that student motivation is a given once that student signs up for an educational experience. Motivational scaffoldings have to be built into instructional design just as any other cognitive and technical scaffolds.

Student Motivation

To understand student motivation, instructional designer needs to consider student goals for entering the educational situation. Is the student taking this course for fun? Is it a required course? Who requires it (work, school, licensing board, parents, etc.)? Do the student's goals align with that of other students in the class? How about those of the course developer? The teacher? What are the expectations of student as to the total duration and work load of the educational experience? Does it match the expectations of the instructional designer? The teacher?

Consider an example of educational software developed for young children. Kids' motivations for using a piece of computer software often don't match the optimistic educational goals that software developers have for those kids: entertainment versus education. Kids use computers to have fun. The designers, on the other hand, try to create educational opportunities for children. If a designer's job is to come up with a computer-based experience that teaches the alphabet to a non-English speaking adult, the goal of the curriculum designer and the goals of the prospective users match: everyone involved in the process shares the goal of having the user learn the alphabet. But if the software is aimed at a child audience, then the design task is doubled—not only does the instructional software developer have to come up with something that teaches the alphabet, but it also has to be done in a very entertaining way for its users. The instructional designer goal and the goal of the intended audience are inherently mismatched.

Once the goals of the students taking the class are understood, appropriate instructional strategies that help raise student motivation can be built into the structure of the course. Such strategies would vary based on both the goals of the course and on the students taking the course.

Here are some examples of children's behavior that comes directly from observing our own children at the computer. We use computers constantly—what chance do our kids have to escape their influence? When our youngest son was three years old, he had already been using the computer for two years. We have a large software library for kids, and our children go through a new software package every two weeks or so. We have one math game where the goal of the game is to add up the blocks as quickly as possible to reach the target number. The hope of the software developers of this game was to teach kids to associate numbers with actual quantities—in this case, with the number of blocks. Unfortunately, as soon as the kid reaches the right number of blocks, the round ends. Our son didn't like that. So instead of trying to get the right number of blocks, he played to get the wrong number, keeping the game going as long as possible—it was a lot more fun that way. In their desire not to hurt the feelings of the "losers," the designers developed better motivational scaffolds for failure than for success.

It is always important to figure out how the educational product will be used and by whom and why. Many of the most important design decisions and solutions will come from understanding these three criteria. In the example above, the contextual goals of the developers and end users didn't match, and that led to the mismatch of the procedural goals.

But while the ultimate goals—the contextual goals—for the developers and kids are sometimes different, the procedural goals could be made to be the same. What kids want to do on the computer should be closely matched to what the game developers want them to do.

While above example illustrates goals mismatched between an individual user (our son) and the instructional software designers, it deals with only a single user. The problem of developing educational experiences on the Internet is multiplied as many very different students enter those experiences and participate in them as a group. Thus procedural goal alignment alone is not enough to develop motivational scaffolds. Group dynamics have to be entered into the instructional design equation.

Meaningful Learning

While designing online educational opportunities, I choose to adapt Jonassen's definition of meaningful learning and use it as a rubric for my work. Jonassen et al. (2003) defined meaningful learning as active, constructive, intentional, authentic, and cooperative.

Meaningful learning is active. The level of attention required by the students to complete or participate in an online learning activity varies a tremendous amount: from "press the space bar to continue" to "create a movie to illustrative this concept." Jonassen defines active learning by those instructional activities which fall into the latter part of this spectrum (Jonassen et al., 2003).

Meaningful learning is constructive. For an educational activity to be constructive, students have to articulate and reflect on their accomplishments. Constructive learning also implies that students are learning the lessons that their activities have to teach (Jonassen et al., 2003).

Meaningful learning is intentional. Jonassen et al. (2003, pp. 8) wrote: "When learners articulate what they have learned and reflect on the processes and decisions that were entailed by the process, they understand more and are better able to use the knowledge that they have constructed in new situations."

Meaningful learning is authentic. Unfortunately even in this day and age a lot of instruction is just busy work and students know it. "An important use of technology is its capacity to create new opportunities for curriculum and instruction by bringing real-world problems into classroom for students to explore and solve..." (Bransford et al., 2000, p. 207).

Meaningful learning is cooperative. Collaborative interactions, when all members of the group are responsible for all aspects of the project, tend to set up situations ripe for aggression among group members. Cooperations limit the interpersonal nastiness by carefully specifying the scope of individual's work and attributing all work to their contributors. Brown and Campione (1987, p. 17) wrote, "Cooperation creates a setting in which novices can contribute what they are able and learn from contributions of those more expert than they."

Motivational and cognitive scaffolds for online learning should, in my opinion, foster and support meaningful learning as described by Jonassen et al. (2003).

Notation and Variables

Individual (or group) motivation can be expressed as function of several variables: available time, required work, and interest in the project. For clarity and ease of manipulation, individual learner's motivation can be expressed as M_n, where M stands for motivation and subscript n signifies a particular individual (where n is a natural number and a non-negative integer). Motivation is a factor of individual learner's time availability. Time availability can be expressed as a variable t_n, where t stands for time and subscript n signifies a particular individual. Motivation is also a factor of the total amount of expected work required from an individual. This variable can be defined as Z_n, where Z stands for total work and subscript n signifies a particular individual. And finally, motivation is a factor of individual learner's interest in the project (I_n)—the greater the interest, the high the motivation. So for example, if work Z_n can't be accomplished in time t_n, then the structural instructional design parameters of the project are flawed. The equation $M_n = f(t_n, Z_n, I_n)$ can be partially solved by understanding the goals of the students entering a particular instructional setting.

Group Dynamics

While developing a group learning situation, it is important to understand the possible forms of interaction among the participants and adjust the group dynamics to increase the frequency of desired behavior among the group members and reduce that of undesired. In a classic classroom setting, there is one teacher and a group of students. This instructional situation allows for teacher-to-student and student-to-student modes of interaction. Teacher-to-student interactions are clearly different from student-to-student in both the direction of knowledge transfer and the social status of the participants in a group (teachers have a lot of power over students, making the interaction between them unequal). In more complex settings, there are more complicated group dynamics. A creative writing course, for example, might have multiple editors, multiple teachers, technologists (individuals that assist with technical aspects of publishing), advanced students and beginners, and an audience. The audience can of course be further broken down into professional readers, individuals seeking entertainment, reviewers, publishers, and so on.

The interactions between members of a group can be classified into competitive, cooperative, and collaborative activities. The basic definitions of both collaboration and cooperation are two or more individuals working together on a project. But to be useful instruments in examining group dynamics, differences between collaborative and cooperative interactions among group members need to be specified.

In common speech, cooperation and collaboration have multiple meanings, and even sometimes used interchangeably. But they express different types of interactions among participants in a group. To examine these interactions in detail, Dillenbourg's (1999) explorations of collaborative learning in his book *Collaborative-Learning: Cognitive and Computational Approaches* are used as a starting point.

Cooperation vs. collaboration. Cooperation and collaboration do not mean the same thing. In a cooperative interaction, the overall goals are shared by all of the participants of a group, but the work load can be distributed in many different ways. Cooperative group members can make different contributions to the whole: some might take charge of the project's scheduling, some produce graphics and/or written materials, and others provide data. If group members work on different parts of the project, it's important to analyze the individual contributions and responsibilities to the whole. The relevant questions are: "Are all participants equally responsible for the overall project?" and "Are there disparities in work loads?" In a cooperative task, the work load does not have to be distributed equally among the group and usually is not. Collaboration, on the other hand, specifies that group members work together on all aspects of the overall project: all contribute to writing, managing, data collecting, and so on. This distinction between collaboration and cooperation is necessary if expectations for individual contributors to a group project are to be made clear. Scardamalia and Bereiter (1991, pp. 37-68) cautioned:

> It appears that children as early as the first grade understand and appreciate the value of cooperation, but by the fourth grade many students have acquired serious reservations about working in groups. They are aware of the variety of things that can go wrong: rivalries and domination, the suppression of novel ideas, time wasting, and the plain nastiness that often infects preadolescent social relations. … A common problem with cooperative group work in classroom is keeping the less able and less aggressive students from being sidelined.

Division of labor: Vertical vs. horizontal. Cooperation and collaboration can be discussed in terms of horizontal versus vertical division of labor among the participants. When division of labor is horizontal, each participant takes on only a part of the overall project (e.g., you write this chapter and I write the next, but we plan and evaluate the work product together). The decisions for the whole are shared equally. Thus horizontal division of labor implies collaboration. In a vertical division of labor, different participants are responsible for different aspects of the project. In this case, the decisions are not shared equally. Vertical division of labor implies cooperation. It might not be necessary to achieve equality of work load across the whole project in order for it to be collaborative. Some parts of a project can be performed cooperatively and some collaboratively. The result is a mixture of these group dynamics. Most real world activities are only partially collaborative.

Group Dynamics Variables

There are three variables that can specify interaction among members of a group: the size of a group (a pair of individuals, a small group, a large group, a community, and a society); the scope of a project or total amount of work required to complete the project (decorating a Christmas tree clearly has a different level of commitment and effort then writing a book together, for example); and the third variable involves time—total time required to complete the project (total time doesn't equal to the rate of interaction and can be expressed in man-hours). These three variables can be expressed as: N = the size of a group; Z = the total amount of required work; and T = total required time to finish the work (this variable deals with real time versus asynchronous interaction or rate of interaction).

From these three variables N, Z, and T (group size, project scope, and total time), the rate of interaction r(i) among group members can be specified as a ratio of the total time T required to finish the project and the individual's time contribution to the project t_n: $r(i) = t_n$ divided by T.

The rate of interaction r(i) and personal time contribution t_n need to be examined as part of the determining whether the learning situation is meaningful or not. For example, if personal contribution of a participant is minimal, then that individual is not engaged in meaningful learning according to Jonassen at al. (2003).

In real time interactions all the members of a group work together and at the same time. Thus real time interactions among the group members, where all the members of a group work together and at the same time ($T = t_n$), have a value of $r(i) = 1$. For example, assuming participation, a class discussion has a the rate of interaction equal to one—all members of the classroom group (students and teachers) are present at the same place and time for the duration of the discussion.

In asynchronous interactions, the total time of interaction doesn't equal to the total individual contribution, and the rate of interaction is less then one—the total time of interaction is the sum of all individuals' times and is clearly a lot greater then one person's contribution. Asynchronous interactions, where $T \neq t_n$, have a value of $r(i) < 1$. A conversation via email is an example of asynchronous interaction.

The group dynamics variables can strongly influence the nature of group interaction, and these variables can change over the course of project's duration. For example, in a large group (N is large), the individual goals and motivations of participants can come in conflict with the group goals and turn the interaction from collaborative to competitive in nature. The structure of the situation can produce the same result: in a class where each student is given an individual grade, collaborative projects tend to fail since they require participants to take responsibility for others' work. If the project is large (the total amount of work is large—Z is large), it might be impossible to divide the labor equally among the group members, turning the collaboration into cooperation (as defined previously). When members of a group have a particularly low rate of communication (once a month, for example), the inherent *ramp up* and *slow down* in production makes true collaboration difficult to achieve. And finally, the exchange of ideas during collaboration has to be meaningful—just passively participating on an email list doesn't qualify that communication as active (Jonassen, et al., 2003). For an exchange to *count* as a meaningful interaction, it has to influence participants' thinking (or be *active* in Jonassen's definition).

Interaction symmetries. Group interactions can be analyzed by their symmetries among members (Dillenbourg, 1999). There are three types of symmetries: S(a) = symmetry of action, S(k) = symmetry of knowledge, and S(s) = symmetry of status. If all the participants in a group project are allowed the same types of actions, then the interaction is symmetrical in action: S(a) = 1. Symmetry of action S(a) is defined as all allowed actions (a_n is defined as allowed actions of n^{th} individual in a group) divided by all possible actions (a) in relation to a particular project: $S(a) = a_n / a$. Thus, if some members of the group have limits set on what they could do or on how they can contribute to the project (resulting in limits on individual set of actions), the project's interaction is not symmetrical in action: $a_n < a$ and $S(a) < 1$.

Group interactions can also be specified in terms of levels of expertise among the participants, where k_n is defined as knowledge of n^{th} individual in a group and k_a as average expertise of group members. If all the members of the group have similar knowledge levels (but not necessarily the same point of view), then the interaction can be judged as symmetrical in knowledge: $S(k) = k_n / k_a = 1$. In a case of a student and teacher working together, for example, the interaction between them can't be symmetrical in knowledge.

Finally, the symmetry of status S(s) specifies the differences in the social status of the participants of a group project. Symmetry of status can be defined in terms of the social status of one individual in a group divided by the social status of another: $S(s) = s_{n1} / s_{n2}$. If two individuals in a group (n_1 and n_2) have roughly the same social standing relative to one another, then the situation exhibits symmetry of status S(s) = 1 (at least with respect to two individual in a group). Using the student/teacher example, the unequal social status makes symmetry of status impossible. Figures 1 and 2 provide a list of the possible group projects and interaction types among group members given the definitions above.

Collaboration: N is small; T is limited and well defined; T is an intersection of ($t_1, t_2, t_3, \ldots, t_n$); S(a)=1; S(k)=1; S(s)=1; Z is limited by N; $Z_1=Z_2=Z_3=\ldots=Z_n$

Cooperation: N is large; T is unlimited and ill defined; T is a union of ($t_1, t_2, t_3, \ldots, t_n$); S(a)<1; S(k)<1; S(s)<1; Z is unlimited = $Z_1+Z_2+Z_3+\ldots+Z_n$

Competition: N =1 (or a small group); $T = t_1$; $Z=Z_1$

Project Type	*Group Size*	*Scope*	*Duration*
Collaborative	small group	limited in scope by the size of the group	limited in duration: based on the intersection of time availabilities of all project group members—all tasks have to be worked on jointly by the group
Cooperative	large group	unlimited in scope: from large to small	unlimited in duration: based on the combined total (sum) of available time contributed by all the members of the group—tasks are distributed among the group (members can come and go)
Competitive	single individual (or a small group competing with another individual or small group)	limited by individual's productivity	limited in duration: based on the total amount of time an individual can devote to a project

Figure 1: Group Projects versus Interaction Types.

This chart summarizes the classification of group projects into collaborations, cooperations, and competitions using the main variables: group size, scope of work, and project durations.

Interaction Type	*Symmetry of*				*Time*	
	Action	*Social Status*	*Knowledge*	*Work Output*	*Communication*	*Rate or Frequency of Interaction*
Collaborative	symmetrical between group members	symmetrical between group members	symmetrical between group members	equal	real time	high
Cooperative	unsymmetrical between group members	unsymmetrical between group members	unsymmetrical between group members	unequal	real time or asynchronous	high to low
Competitive	symmetrical between competing groups	symmetrical between competing groups	symmetrical between competing groups	equal between competing groups	asynchronous between competing groups	low between competing groups

Figure 2: Classification of Interactions.

This chart summarizes the classification of interactions among group members of collaborative, cooperative, and competitive projects together with values of associated variables.

Collaboration, cooperation, and competition are explored here from the point of view of an individual working on a particular project. In collaborations, everyone knows each other and each other's capabilities, groups tend to be small, and projects limited in scope. In cooperations, some group members know each other and some don't. Cooperative groups can be large with members having limited knowledge of what others are doing, and group members can come and go during the project's tenure. But individuals in both cooperative and collaborative projects share goals for the overall project and contribute their work towards achieving those goals.

Competitions are different in this respect. Competitors don't share any of the workload between themselves. They might not know the individuals that are competing against them or what they are working on. There is no shared information or work. The individual competitor's goal is to beat out the others. And while competition can be among groups (with those groups engaged in cooperative or collaborative interactions among themselves), N is set to 1 (in the formulaic definition of competition above) to highlight these differences.

Typical classroom interactions tend to be competitive, with students ranked by their achievement levels. As group projects, newspapers, magazines, journals are all cooperative—they feature authors and attribute work to individuals even if overall these publications are group projects. Authors could compete among themselves for accolades set by the norms of their communities. Since an instructional structure can define the community norms, it can specify how members of the group cooperate, collaborate, or compete with each other.

Attribution

When the overall quality of group work is the only form of assessment of individual contribution, it's difficult to control rivalries and accusations of lackadaisical work (especially in a large group). When all participants in a project are equally responsible for all the work, it could twist the dynamics of group interaction. Sometimes, a single individual ends up feeling the pressure to do all the work him or herself to maintain a certain standard that he or she feels is not being met by others. Attribution of individual contribution to the overall group work solves these issues and makes it easier to both manage the project and keep the participants happy. Note that attribution doesn't get rid of the need to keep the quality of the overall project high. It just allows of a bit of unevenness, which in turn opens the project up to novices who might not otherwise be allowed to contribute for fear of lowering the quality of the project and thus the perceived quality of work of its more experienced members. So for group projects with members coming from diverse backgrounds and with diverse experience, attribution of individual work product results in smoother group dynamics. And attribution doesn't imply a lack of symmetry of status among group members or a lack of symmetry of action. All group members could have equal social status and be allowed to take the same actions, if the project structure is set up to do so.

Summary

diSessa (2000, p. 105) wrote, "[A]lthough you may think you are designing a computer system, you are really designing mediated activities. That is, you are designing the material context that supports particular activities." It's not enough to think through the technical aspects of computer-based instruction. It's important to start with what are the ultimate goals for that instruction. What are we trying to teach? Why would students want to learn this material? What is their motivation for learning? What activities do we what to foster? In situations where the computer-based instruction is aimed at groups of individuals (as opposed to a single student), group dynamics have to be factored into the equation.

This paper aims at giving instructional designers some tools with which to examine their projects in terms of group dynamics and motivation. By carefully defining the structure of the learning group—cooperative, collaborative, competitive, or some amalgam of all three—problem interactions can be anticipated and positive outcomes and behaviors can be supported through built-in instructional and environmental scaffolds. Armed with this information, specific computer-based activities can be developed that support the desired outcome.

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