The effects of student-centered, technology-based instruction on the intrinsic motivation of secondary students

Ashley H. Phillips

Motivational techniques are often employed by teachers. Many of these techniques foster extrinsic motivation, meaning that students are either offered rewards or threatened with some type of negative consequence in order to lead to a desired action or behavior (Viadero, 1999). Although there is much debate on the usefulness of extrinsic motivation, the focus of this review is on intrinsic motivation, or motivation derived from a genuine interest or desire to learn on the part of the student (Viadero, 1999). While the debate over the effects of extrinsic motivation is beyond the scope of this review, Wilson and Corpus (2005) provide a good discussion of the place of extrinsic motivation in education.

Student-centered instruction is a potential method for enhancing intrinsic motivation among students (Hancock, Bray, & Nason 1995). Student-centered instruction attempts to engender active learning by using methods such as cooperative learning, open-ended assignments, critical thinking exercises, simulations, and problem solving activities (Felder & Brent, 1996). The goal of student-centered instruction is to shift student learning away from passive sitting and listening to a more active and dynamic learning experience. This approach leads to students being more challenged and being given more choice and control over instructional activities, which can enhance intrinsic motivation (Wilson & Corpus, 2005).

The term technology-based instruction, for the purpose of this review, refers to the use of technology, especially computers, in most or all instruction. The relevance of technology-based instruction to this examination of the literature on intrinsic motivation in secondary students stems from the fact that computers are often assumed to increase student motivation (Theroux, 1994). A thorough review of the literature, however, indicated that computer use alone does not necessarily lead to an improvement in intrinsic motivation (House, 2003; Wang & Yang, 2002). It is, therefore, important to examine the effects of student-centered instruction in conjunction with technology-based instruction on intrinsic motivation. Instructional design is crucial to linking these methods in an effective manner.

This examination of the literature will include both empirical and action research articles, recent studies, and theoretical articles. The review begins with a discussion of intrinsic motivation and the issues related to assessing intrinsic motivation. This will be followed by a discussion of the effects of student-centered and technology-based instruction on intrinsic motivation. Finally, instructional design issues relating to the implementation of the above methods will be examined including an example from a recent study. The conclusion will suggest key questions to consider based on the argument put forth throughout this literature review.
Intrinsic Motivation

Intrinsic motivation is important to students and teachers because of its effect on learning outcomes. Motivation is a significant predictor of academic performance (Tavani & Losh, 2003) which leads to the conclusion that intrinsic motivation is a major factor in determining academic success (Wilson & Corpus, 2005). If intrinsic motivation is beneficial to student learning outcomes, then it stands to reason that educators should strive to cultivate and enhance the intrinsic motivation of students. An examination of the current state of intrinsic motivation among secondary students shows that they are often unmotivated due to a perceived lack of relevance of their coursework and that the problem tends to be worse in passive learning environments (Bouris, Creel, & Stortz, 1998). This is certainly a concern, yet there is room for optimism because intrinsic motivation is not considered constant. Bouris, Creel, and Stortz measured motivation levels of 510 rural secondary math students at a single site before and after they experienced cooperative learning lessons tailored to real-life situations. After the cooperative learning lessons the students’ positive perceptions toward learning increased by 19% and parent perceptions by 21% according to a Likert scale motivation survey. Observations by the researchers indicated a 23% increase in on-task behavior, a 14% decrease in requests to leave the classroom for any reason, a 10% decrease in discipline problems, and a 14% decrease in sleeping during class.

Intrinsic motivation can change based on the learning context. The learning context includes instructional design as well classroom design and atmosphere (Brophy & Merrick, 1987; Pintrich, 2002). In a review of the literature on motivation and academic success, Pintrich (2002) used the term situational intrinsic motivation for this phenomenon. He stated that teachers can enhance situational intrinsic motivation and thus increase academic achievement by finding tasks and activities that are highly engaging for students. Even though many factors affect student intrinsic motivation, when motivational design is included in instruction, positive results can occur (Gabrielle, 2003).

Cialdella, Herlin, and Hoefer (2002) conducted an action research project that examined an attempt to make significant changes in motivational levels by employing cooperative learning using multiple intelligences theory. A discussion of multiple intelligences theory and its integration into instruction is beyond the scope of this review, but Silver, Strong, and Perini (2000) provided a good starting point for examination of this topic. In studying elementary and middle school students using teacher checklists, student reflections, and report cards, Cialdella, Herlin, and Hoefer demonstrated that younger students were more likely to realize improvements in motivation when a shift was made from traditional instructional methods to cooperative learning activities. The middle school students in the study sometimes took advantage of the freedom of the learning environment by displaying inappropriate behavior. The authors suggested two possible reasons for the age-based discrepancy. The older students were not used to freedom in an academic setting and therefore did not know how to handle it. This belief suggests that it is advisable to begin student-centered instruction at an early age in order to achieve optimum results. Secondly, the study did not take place at the beginning of the school year, so students had to adjust to a new model of instruction. This adjustment may have led to the somewhat disappointing results among the middle school students. Overall, these results show promise for the potential effects of student-centered learning methods on student motivation but also highlight the importance of instructional design in order to realize significant improvements.
Factors such as the classroom environment and its cognitive demands play a role in intrinsic motivation as do the level of task interest and the novelty of instructional modes (Salovaara, Salo, Rahikainen, Lipponen, & Jarvela, 2001). Salovaara et al. studied 39 students ranging in age from 10 to 14 years using data such as student notes, interviews, video, and motivational orientations. They concluded that although the inquiries were often superficial, enhanced learning occurred with a combination of Computer Supported Collaborative Learning and inquiry-based learning.

Assessing Intrinsic Motivation

There are numerous choices as to how to assess intrinsic motivation. Naccarato (1988) listed three steps for choosing a motivation measurement instrument. Step one is to decide on the content and purpose of the measurement. Different assessment instruments are suited to specific content areas and the needs of various situations, so one must select an instrument based on the unique characteristics of a given situation. Secondly, Naccarato advises reviewing at least three instruments. The comparing and contrasting of multiple instruments helps in selecting the most appropriate one. Finally, the instruments should be reviewed in detail. It is important to choose the most suitable instrument available for the measurement of intrinsic motivation, and therefore it is worth the time and effort of an extensive review before making a decision. Naccarato also provided a useful checklist to help with the review process. The measurement instrument should be examined for relevance, ease, cost, materials provided, reliability, and validity.

With the above discussion in mind, I have selected three measurement instruments that could be useful in a study of intrinsic motivation among secondary students. The Motivated Strategies for Learning Questionnaire (MSLQ) assesses how students use prior knowledge in understanding new ideas and how students organize learning materials (McKeachie, 2005). The MSLQ is a self-report measure that includes 81 items with both motivation and learning scales. The motivation scales include items related to intrinsic and extrinsic motivation (Shia, 1998) and are appropriate for a variety of students ranging in age and the academic area being studied. The MSLQ is not norm referenced, so it does vary based on the context being studied (Pintrich, 2002). Ng (2002) used the MSLQ in a study on motivation among students in a distance learning program and found the results obtained from this measurement instrument consistent with other data in the study. One weakness pointed out by Shia (1998) is that the MSLQ contains only four questions each for intrinsic and extrinsic motivation, so it may not work well for a study focused solely on intrinsic motivation.

Another intrinsic motivation assessment instrument is the Academic Intrinsic Motivation Inventory. The Academic Intrinsic Motivation Inventory uses a 7-point Likert scale with items on various factors relating to both intrinsic and extrinsic motivation (Shia, 1998). Shia performed a study of 81 undergraduate students to test the Academic Intrinsic Motivation Inventory in comparison to the MSLQ and found it to be reliable and valid. Shia collected data using two questionnaires and performed reliability and correlation analyses. The Academic Intrinsic Motivation Inventory is designed for college students, and thus may not be appropriate for secondary students.
The third intrinsic motivation measurement instrument under review is the Instructional Materials Motivation Survey (IMMS) (Small, 1997). The IMMS uses 36 Likert scale items to determine a variety of aspects related to motivation based on the ARCS model (Keller, 1979; Small, 1997). The ARCS model of motivational design is a widely used method of instructional design that outlines four key areas to enhance motivation. These areas include attention, relevance, confidence, and satisfaction (Gabrielle, 2003; Small, 1997). Examples of the items used in the IMMS as cited by Small (1997) include:

--- These materials are eye-catching. (Attention)
--- It is clear to me how the content of this material is related to things I already know. (Relevance)
--- As I worked on this lesson, I was confident that I could learn the content. (Confidence)
--- Completing the exercises in this lesson gave me a satisfying feeling of accomplishment. (Satisfaction) p. 4

Gabrielle (2003) used the IMMS in an empirical study of motivation and academic performance involving 784 students at a military college in which technology-based instruction was infused into a program of study. Students were randomly divided into 48 sections. The experimental group received the same syllabus for the same course as the control group, but the experimental group also had access to Technology-Mediated Instructional Strategies (TMIS) based on Keller’s ARCS model. A TMIS was designed to assist learners in achieving course objectives by providing a motivational message, links to course content, and a survey, all of which were delivered via email. Gabrielle found more significant improvement in motivation and self-directed learning for the experimental group than the control group. This was true for all of the attention, relevance, confidence, and satisfaction sub-scores. Gabrielle also used qualitative data such as open-ended surveys and follow-up interviews to triangulate the results. The major weaknesses of this study stem from the fact that it takes place at a military college. This led to a homogenous sample and a high level of interaction between the control group and the experimental group.

Student-centered, Technology-based Instruction

This section examines the effects of a student-centered learning environment and of technology on motivation.

Effects of student-centered learning on motivation

According to Clifford (1990), the learning environment’s ability to affect intrinsic motivation is largely a product of the level of academic risk-taking that is promoted. Clifford listed attributes of risk-taking learning environments. For example, students are allowed to select activities and materials at various levels of difficulty. Success in more difficult tasks carries greater value than success in easier tasks. Also, when students make errors it is not only tolerated but also met with supportive feedback. Student-centered instruction can help to create such a learning environment for increased intrinsic motivation, an environment that
challenges students appropriately and gives them some choice or control over activities and instruction (Wilson & Corpus, 2005). In creating motivationally positive learning environments, schools should draw on the experiences and culture of their students as instruction is designed and implemented (Gehring, 2003). In short, schools should be organized around students’ work (Thornburg, 1995). A quasi-experimental study among university students using 55 participants randomly assigned to four groups supported this theory (Hancock et al., 1995). The researchers found that regardless of whether learners were self-directed or not, motivation improved with the use of student-centered instruction. Wasserstein (1995) surveyed 200 seventh and eighth grade students about their most memorable and best schoolwork in an ex post facto study. The students consistently cited examples of active learning as being memorable and rewarding regardless of gender, the amount of work required, the subject area, or the grade received.

One popular method of student-centered instruction, problem-based learning, was studied by Ommundsen (1999). This case study examined the ability of problem-based learning to improve student motivation. Ommundsen found that problem-based learning led to positive student comments on questionnaires, especially in relation to student enthusiasm. Lean, Mangles, and Moizer (1999) studied the use of simulations on student interest and motivation. They found that simulations helped instruction to merge subject matter with student interests, thus leading to improved motivation among students.

**Effects of technology on motivation**

The use of technology in education continues to become more prevalent, but it is important to integrate computer use with student-centered instruction. While computer use and cooperative learning have been found to increase student motivation, this increase does not occur with computer use alone (House, 2003). House examined the relationship between instructional practices and student motivation among Japanese math students. He used 2-stage random sampling in selecting the schools and classrooms to arrive at the sample of 10,271 students. The 13-year olds completed questionnaires to control for background factors that could affect the motivation measurements. House found that student enjoyment increased with the use of relevant examples and cooperative learning but not with computer use alone. Although it contradicted some earlier research, House’s notion was supported by Wang and Yang (2002) in a study of computer-based instruction. Using interviews with students, teachers, and experts they identified features of the World Wide Web that enhanced student motivation. Wang and Yang then studied 16 tenth grade science students in Georgia and found that computer use alone was not as successful as a combination of student-centered methods and computer-based instruction for improving student motivation. Tobin (1999) acknowledged the importance of technology in his study related to the effects of collaborative learning combined with technology use on student motivation. The study found that 74% of the students preferred using technology rather than traditional methods in combination with collaborative learning. Teachers in this study also observed increased student motivation and time on task among the students using technology.

While it may be widely believed by educators that computers intrigue students and lead to higher quality work (Theroux, 1994), computers alone do not create intrinsically motivated students. The examples above seem to indicate that a combination of student-
centered methods and technology use can lead to improved motivation among students, but a study by Eom and Reiser (2000) partially contradicts this idea. Eom and Reiser examined 37 seventh and eight grade students to determine the effects of learner control versus program control on student motivation and learning. This randomly chosen sample was studied using a 15 question multiple choice posttest, a Likert item motivation assessment known as the IMMS, the amount of time spent on the work, and the number of events viewed within the instruction. Eom and Reiser found that there was no statistically significant relationship between motivation and learner control. This appears to shed doubt on the motivational effects of combining student-centered methods with technology. However, a closer examination of the study revealed that it dealt with computer-based instruction in which the level of control did not lead to any critical thinking or creativity on the part of the learners. The learner control only allowed them to change the order of the instruction. The students could not express themselves, work cooperatively, or take academic risks. They were simply given instruction by a computer and then assessed using a multiple-choice test. Astleitner and Keller (1995) stated that motivation is not enhanced when computer-based instruction follows a rigid structure, so it is not at all surprising that motivation did not increase with learner control when the learner control did not allow one to deviate from the structure of the instruction in a manner consistent with student-centered instruction.

Whether or not technology can play a key role in motivation is still a matter of some debate. Many educators would likely agree with the findings of Deaney, Ruthven, and Hennessy (2003) that students tend to perceive computer-based lessons as having a more relaxed atmosphere and being less boring. This study involved three year cohorts in 8th, 10th, and 12th grade at six different schools. Deaney, Ruthven, and Hennessy conducted a total of 27 focus group interviews. Students in this study did state that the positive effects of computer-based lessons could lessen as the novelty fades. Although computers are not a panacea for educational problems, they do seem to have a role that cannot be ignored. Reber (2005) illustrated the limited but important role of technology in improving student motivation in education. In the study, traditional instructional practices were replaced with the building of a class web site as a tool for learning. Reber found that while students rated the above mentioned course content, structure, and learning the same as they had done with traditional instruction, the students found the web building course method to be more interesting and fun.

The importance of the relationship between student-centered methods and technology was also illustrated by a study that examined the effects of websites in instruction versus traditional instructional methods (Sarapuu & Adojaan, 1999). This study used data collected through questionnaires administered to 86 students ranging in age from 14 to 17. The researchers found that using web sites with custom made worksheets designed to foster higher order thinking led to enhanced motivation among secondary students over traditional instruction. Seventy-eight percent of the students surveyed gave positive responses on the questionnaires in relation to the web-based instruction. Scheidet (2003) examined web-based, technology infused instruction versus traditional instruction. This study found that the group receiving the web-based instruction saw an increase in motivation and interest level at a rate of 97% while the group receiving traditional instruction was at 78%. Parent surveys corroborated these results with rates of 95% and 86% respectively. Scheidet studied 55 students separated into two sections taught by the same teacher. Qualitative data were also collected in the form of teacher comments and researcher observations. These data supported
the above statistics. Teachers described students as motivated and interested while taking part in self-exploration and critical thinking. One teacher said of the web-based group, “I had to kick them out at the end of the period” (p. 85)!

**Instructional design issues**

This section analyses the effects of designing student-centered instruction and integrating technology on intrinsic motivation. An example of combining student-centered, technology-based instruction is provided at the end of this section.

*Designing student-centered instruction to enhance intrinsic motivation*

Student-centered instruction can foster improvements in the intrinsic motivation of students if properly designed and implemented. Principles to remember in the design process include using flexible deadlines, engaging in less overt supervision in order to increase student independence, promoting a safe and risk-friendly learning environment, and providing students with choice and control over instruction (Clifford, 1990; Lashaway-Bokina, 2000). Problem-solving activities can be some of the most effective methods for using student-centered instruction to enhance intrinsic motivation. Sanacore (1997) demonstrated that problem-solving activities, especially when they employ real-life problems, increase student motivation and lead to more verbal, solution-oriented behaviors. Problem-solving can be combined with other student-centered methods through the use of simulations. Simulations have been found to lead to engaging learning experiences, but students need time to reflect upon their learning experiences in order to achieve improved academic outcomes to accompany the motivational benefits (Lean et al., 1999). This indicates the importance of quality instructional design for improving student learning outcomes.

*Integrating technology into instructional design*

Instructional design is extremely important in order to realize motivational improvements using technology-based instruction. If poorly designed, computer-assisted instruction has been found to lead to unintended motivational consequences that can actually have negative effects on intrinsic motivation (Astleitner & Keller, 1995). One method of designing instruction in a motivationally adaptive way provides a roadmap for using technology effectively to improve motivation. Song and Keller (1999) employed the ARCS model along with computer-assisted instruction with 66 tenth-grade students and demonstrated positive outcomes in terms of student motivation. The sample was drawn from Florida’s Developmental Research School, which is designed to be representative of Florida’s overall population. The students were divided into three classes, and motivation levels were measured with a 16 item simplified version of the IMMS. Whether it is the ARCS model or another method for designing instruction, educators must use instructional design methodology effectively in order to enhance student motivation. McKinnon, Sturt,
Nolan, and Sinclair (2000) studied student attitudes toward computer use and motivation in New Zealand. Their data included an attitude survey, a motivational questionnaire, student comments, and focus group interviews. The findings of this longitudinal study demonstrated an overall enhancement of student motivation from grades eight through ten. The students, however, indicated a less positive attitude toward computers after the three years. Student attitudes toward school in general remained constant or became more positive during the course of the study. The lack of novelty for using computers may account for this change in attitude toward computers.

In addition to the fact that computers do not always lead to positive results in terms of student motivation, not all computer related activities lead to the same outcomes. Deaney, Ruthven, and Hennessy (2003) reported that students did not indicate equal motivation or enjoyment from all computer-based lessons. The data gathered through focus group interviews of students led to the conclusion that simulations and games were very popular while applications such as spreadsheets were not interesting or motivating for students. This strengthens the argument for a combination of student-centered and technology-based methods in order to affect an improvement in the intrinsic motivation of secondary students.

Combining student-centered instruction with technology-based instruction: An example

Shapiro (1999) studied an example of a simulation that combined student-centered instruction with technology to enhance intrinsic motivation among secondary students. This study examined a large-scale simulation that took place in Akron, Ohio called project “Moonbase America”. Out of a pool of 750 students, 96 applicants were chosen without regards to grade point average. The students, 52 boys and 44 girls ranging from 8th through 12th grades, were organized into 15 teams of specialists. The students were then immersed in a six-day simulation of a moon base built on their school campus. Twelve students stayed at the school as ground control, but the other 84 were inside the moon base for six days and nights without adult supervision. The only contact allowed with the outside was by way of telephones, two-way radios, cameras, and computers. The students had to form their own government and deal with conflicts and issues as they arose. Each of the specialty teams had science-related jobs to carry out, but the group as a whole dealt with real-life issues such as food preparation and sanitation. The study used qualitative data and was done after the simulation had been completed. The data included student journals kept during the six-day project, video, video reflections of the participants, and interviews with the participants. Shapiro found a number of instances of collaborative and real-life problem solving using higher-order thinking skills. Students were extremely motivated even without the presence of typical extrinsic rewards. This was an example of active learning that brought about an opportunity for “true-to-life” experiences while reducing real-life risks. This is one of the key goals of student-centered, technology-based instruction.

Conclusion and implications for research

Student-centered learning and technology both offer exciting possibilities for education in the area of intrinsic motivation. Neither will accomplish great improvements,
however, without quality instructional design to integrate the techniques of student-centered instruction with the tools of technology. D. H. McKinnon stated that if teachers construct learning experiences using technology as a tool to help students solve problems and face issues that are important to them, students will be intrinsically motivated to learn (personal email, February 16, 2005). Specific content learning is not as important as learning how to learn (Tapscott, 1999). Therefore computer use in education should not be for gathering specific content knowledge but rather to foster life-long learning and intrinsic motivation (Flake, 1994). This can happen if quality instructional design is in place along with methods of student-centered instruction meshed with technology.

Research should be used to examine three key questions relating to the role that student-centered, technology-based instruction plays with intrinsic motivation among secondary students.

1. What specific methods of student-centered, technology-based instruction lead to improvements in the intrinsic motivation of secondary students?

Teachers need to know what to do in specific terms. Action research and case studies can provide an avenue for discovery that teachers can draw from in order to improve motivation.

2. How effective are the methods of student-centered, technology-based instruction in improving intrinsic motivation among secondary students?

The studies cited in this literature review provide some indication that these methods may improve intrinsic motivation, but further research is needed to solidify this notion. Teachers need to be able to see examples of the trials and successes of student-centered, technology-based methods if they are to incorporate them into teaching practices.

3. What role does novelty play in motivational improvements based on the use of student-centered, technology-based instruction?

Any departure from the normal routine may lead to positive results simply because of the novelty of the design for the students and teachers involved. How effective the practices of student-centered, technology-based instruction are long-term is the real key to the improvement of intrinsic motivation.

References


