A Path to Intrinsic Motivation: The Effective Use of Instructive Technology with Students At Risk of Failure

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Abstract

The purpose of this paper is to examine the relationship of instructive technology to intrinsic motivation as a factor in "time on task" in a learning activity and development of self-confidence in elementary school students classified as at-risk of failure. While research has demonstrated the positive effects of educational technology on basic skill acquisition and enhanced cognitive functioning, intrinsic motivation is often neglected as a significant factor in student success (Astleitner, 2004; Howse & Lange, 2003).

In response, then, this discussion reviews the literature germane to the correlation between instructive technology and intrinsic motivation as a factor in academic performance and the development of self-confidence in economically disadvantaged children. The intent is to offer an expanded understanding of instructive technology, one that integrates design, and the implications for facilitating success in the classroom for at-risk learners.

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In 1998, 10 million American school children were considered "poor readers." In high poverty public schools, 68 percent of fourth-graders fail to reach the basic level of achievement and only 1 in 10 fourth graders at these schools could read at the proficient level (NAEP 1998 Reading Report Card). More recent findings may be worse, indicating that 88% of African American 4th graders and 85% of Latino 4th graders were below proficient compared with 27% of Whites and 31% of Asian/Pacific Islanders (NAEP 2003 Reading Report Card).

These are students that are classified often as at-risk or economically disadvantaged and the most at-risk of not completing or benefiting from their elementary and secondary experiences; for whom traditional approaches of organizing and delivering instruction have worked the least (Hixson & Tinzmann, 1990). The characteristics of these students include a history of school absenteeism, poor grades, low reading and math scores, low self-esteem, behavioral problems, and low motivation., while experience exposure to unhealthy lifestyles, such as violence, drug culture, abuse, inadequate healthcare, absent parents, and obstacles in their ability to thrive (Collopy & Green, 1995), not only academically but also socially.

The social implications of ignoring these findings are best expressed by statistics from the National Institute for Literacy. In a 1998 study it reported that 70% of prisoners

in our jails fell into the lowest two levels of reading proficiency, indicating the relationship of low literacy to potential criminal behavior. Despite widespread concern about these national trends, programmatic research efforts to study the school-related behaviors of at-risk children have been sparse, and researchers know very little about the learning processes that are responsible for poor school readiness and low achievement profiles in these children (Howse, Lange, Ferral & Boyle, 2003).

This problem has not gone unnoticed by school administrators, educators, curriculum designers and learning specialists, all charged with finding solutions to this mounting problem. Programs (such as No Child Left Behind, the U.S. government's recent funding solution) demand research based approaches and accountability to solve this mounting social problem (U.S. Dept. of Education, 2001). In other words, what is to be done about the students who are not responding to traditional methods of instruction offered in the public schools and who are dropping out at increasing rates? Despite widespread concern about these national trends, programmatic research efforts to study the school-related behaviors of at-risk children have been sparse, and researchers know very little about the learning processes that are responsible for poor school readiness and low achievement profiles in these children (Howse, Lange, Ferral & Boyle, 2003).

Scholars have examined the possibility that poor achievement among economically disadvantaged students may stem from motivational factors (Alexander & Entwistle, 1988; Stipek & Ryan, 1997). Moseley & Higgins (1999) found that technology used in classrooms can be especially advantageous to at-risk students and can enhance

sense of achievement for many students who have previously been under-achieving, but there is still a limited amount of research on the effects of technology on intrinsic motivation or correlations between the two factors.

And while any kind of motivation seems preferable to none, there is compelling evidence that at-risk students, who are more intrinsically motivated rather than extrinsically motivated, perform better (Brooks et al. 1998; Deci & Ryan, 2000; Lumsden, 1994). However, in spite of published successes that demonstrate the potential of technology to reach students that suffer from low achievement and low motivation, there are still educators who have resisted the role of technology in the traditional classroom and have held it at arm's length with a healthy skepticism (Holcum & Gahala, 2001).

Also, not all of the studies on using technology as a learning tool have been conclusive. There is still debate whether constructivist student centered approaches that lend themselves to collaboration and authentic tasks produce better results than a behaviorist instructional model that focuses on basic skill acquisition and the use of a direct instructional approach. (Means, Blando, Olson, Middleton, Morocco, Remz, and Zorfass 1993)

Furthermore, Means (1994) pointed out that the success or failure of technology is more dependent on human and contextual factors than on hardware or software and that technology-enabled learning experience often depends on whether the software design and instructional methods surrounding its use are congruent. This would indicate, then, that the delivery of technology that combines motivational mechanisms

(Jones, 2005) with instruction to intrinsically motivate at-risk students (Song & Keller, 2001) deserves more attention from researchers.

The purpose of this paper, then, is to review the literature that examines the relationship of instructive technology and intrinsic motivation as integrated factors in academic performance and the development of self-confidence in economically disadvantaged elementary school students classified as at-risk of failure. Also, it is to explore the use of time on task in a learning activity, as an indicator of intrinsic motivation in a technology mediated learning environment.

Explanation of Terms

Discussions of motivation in this paper are based on the theoretical constructs of self-determination theory (SDT) posited by Ryan and Desi (2000), that defined extrinsic motivation as the performance of an activity in order to attain separable reward-focused external incentives like gold stars, best-student awards, honor rolls, and pizzas for reading, that have long been part of the traditional educational paradigm intended to motivate or reinforce student learning (Desi, Koestner & Ryan, 2000), and intrinsic motivation which refers to students performing an activity just for the satisfaction of the activity itself, without the need for external incentives (p. 1).

In addition, instructive technology refers to any range of computer-based instructional tools designed to promote motivation together with some form of systematic direct instruction. An accumulating body of research has demonstrated the effectiveness of motivationally designed instructional technology (MDIT), with at risk

students (Song & Keller) and suggests the value of intrinsic motivation over more traditional forms of extrinsic motivation (Ryan & Deci, 2000).

Furthermore, this paper will examine the components of a MDIT program called Smart Tutor, through the lens of Keller's (1983) psychological motivational design model ARCS (attention, relevance, confidence and satisfaction) and its use in a research study conducted in a small elementary school setting in El Dorado Arkansas (Lockett, 2004). The ARCS model is one that has been validated and grounded in a general macrotheory of motivation and performance (Keller, 1983). Also, time on task in this paper reflects the time students spend engaged in a learning activity that produces increased learning, self-confidence and its potential as measure or indicator of intrinsic motivation.

The El Dorado Study: The Beginning

Perhaps the first seeds were sown in the development of this paper after a review of the data from a research study in El Dorado Arkansas. The study took place at the West Woods Charter Elementary School a small school where all of its 60 students were not only classified as economically disadvantaged with some form of learning disability, and suffering from low achievement and low motivation, but most (85%) were receiving counseling for some form of emotional or past physical abuse.

The teachers and administrators at the school used an instructive technology program called Smart Tutor®. Smart Tutor is a research based advanced learning system designed to accelerate learning in reading and/or math, develop motivation, and increase potential in low-performing students considered at-risk of failure. A study

was done to determine the efficacy of instructive technology used to improve basic reading skills in at-risk elementary school students. While the results of the study showed a significant grade level gain (in the short period of 14 weeks) from the first one semester compared to another, an interesting piece of data emerged that garnered attention and prompted further examination.

The expected minimum use for measuring gains in the study was five hours time on task but the results revealed that the majority of the students in the study spent and average of eleven and a half hours with some students spending as much as 15 hours time on task. A review of the data, personal observation, and interviews with teachers and administrators revealed a potential relationship between student motivation and time on task. Educators acknowledge that when motivated, students will spend more time engaged in learning activities, work harder and learn more because of their personal interest in the material (Smaldino, 2002) and Draper (2002) and that time on task yields increased learning in intrinsically motivated students.

Likewise, teachers at West Woods reported that the students looked forward to working on the Smart Tutor program and an administrator was even quoted as stating, "Our students excelled in and accelerated their learning experience, and several of them chose to work on Smart Tutor rather than have playground time!" This brought up the question of whether intrinsic motivation may have played a role in extending the amount of time the students spent on the Smart Tutor program and whether time on task could be used as an indicator to measure intrinsic motivation. This paper is a

prelude to further research to answer those questions. But first, why is intrinsic motivation important when working with at-risk students?

Intrinsic Motivation

In general terms, student motivation refers to a student's willingness, need, and desire to participate in, and be successful in, the learning process (Bomia et al., 1997, p. 1). Students, who are motivated and engaged, select tasks that challenge them and when given the opportunity, initiate action and exert effort and concentration in a learning activity (Martens, Gulikers & Bastiaens, 2004). The learners show generally positive emotions during ongoing action, including enthusiasm, optimism, curiosity, and interest (Skinner & Belmont, 1991, p. 3). Less motivated, disengaged students, on the other hand, "are passive, do not try hard, and give up easily in the face of challenges"(p. 4) and are potentially disruptive. Student motivation is often divided into two categories:

1. Extrinsic motivation where a student engages in learning "purely for the sake of attaining a reward or for avoiding some punishment" (Dev, 1997). Traditional school practices that seek to motivate students extrinsically include publicly recognizing students for academic achievements; giving out stickers, candy, and other rewards; and taking away privileges, such as recess, on the basis of students' academic performance (Brooks et al., 1998). At-risk students often don't experience the positive aspects of extrinsic motivation and are usually the target for the forfeiture of privileges. For them extrinsic motivation precipitates a negative

experience. In fact, some research demonstrates that using extrinsic motivators to engage students in learning can both lower achievement and negatively affect student motivation (Dev, 1997; Lumsden, 1994).

2. Intrinsic motivation, as stated previously, can be described as motivation occurring from within: Intrinsically motivated students actively engage themselves in learning out of curiosity, interest, enjoyment, or in order to achieve their own intellectual and personal goals. (Dev, 1997)

According to Dev, 1997, "A student who is intrinsically motivated . . . will not need any type of reward or incentive to initiate or complete a task. This type of student is more likely to complete the chosen task and be excited by the challenging nature of an activity (p. 13)."

Students who are intrinsically motivated:

1. Earn higher grades and achieve higher test scores, on average, than extrinsically-motivated students (Dev, 1997; Skinner & Belmont, 1991)
2. Are less disruptive and better personally adjusted to school (Skinner & Belmont, 1991)
3. Employ metacognitive strategies that demand more effort and that enable them to process information more deeply" (Lumsden, 1994, p. 2)
4. Are more likely to develop self-efficacy and feel confident about their ability to learn new material (Dev, 1997)

5. Are more likely to engage in "tasks that are moderately challenging, whereas extrinsically oriented students gravitate toward tasks that are low in degree of difficulty" (Lumsden, 1994, p. 2)
6. Are more likely to spend mote time on task and complete assigned tasks (Dev, 1997; Smaldino, 2002)

Furthermore, while there is no argument that both factors play a role in school success, underachieving elementary students have not had many successful extrinsic experiences as supported in part by psychological research that has demonstrated negative effects of extrinsic rewards on students' intrinsic motivation to learn (Desi, Koestner & Ryan, 2000). Desi, Koestner & Ryan (2000) further suggested that rather than always being positive motivators, extrinsic rewards can at times undermine rather than enhance self-motivation, curiosity, interest, and persistence at learning tasks in underachieving students.

Some researchers, however, object to describing student motivation as either intrinsic or extrinsic. Sternberg and Lobar (as cited in Strong, Silver, & Robinson, 1995) for example, argued that it is too simplistic to think of motivation in terms of intrinsic versus extrinsic; that the dynamics of motivation that influence student success in school are complicated and reflect many complex and interrelated factors, both external and internal. The authors pointed out that most successful people are motivated by both intrinsic and extrinsic factors and suggested that educators build on both types when working to engage students more fully in school but underachieving students have not had many successful or positive extrinsic experiences.

Time on Task and Intrinsic Motivation

As stated previously, educators acknowledge that motivation yields time on task, and time on task as a potential motivational variable, leads to increased learning, indications of which were found in the El Dorado study. And as reasonable as time on task may be as an indicator of motivation and explanation of poor student performance, Howse, et al., (2003) found that the present research provided little support for this view. They discovered only two comparative studies that have focused specifically on the motivational variables for measuring early school success among at-risk and not-at-risk children (a) a longitudinal study by Entwistle and her colleagues with children in the primary grades of the Baltimore City Schools (Entwistle, Alexander, Cadigan, & Pallas, 1986), and (b) research conducted by Stipek and Ryan (1997) with preschoolers and kindergartners.

The primary measure of motivation that Entwistle and her colleagues used was children's expected report-card grades. Their findings showed that, regardless of social class, children's grade expectations were unrealistically high and were unrelated to school success. Stipek and Ryan (1997) used a diverse battery of motivational measures that included children's feelings about school and emotions in school and task settings (child worry ratings, anxiety ratings, and enjoyment ratings), expectations for success, preferences for challenge, and dependency on the investigator in task settings. The researchers found (a) that disadvantaged preschoolers and kindergartners maintained high motivation levels throughout the school year and (b) that fall pre-assessments of

the children's cognitive skills were far better predictors of end-of-year achievement than were other motivational variables.

The work of Howse, et al., (2003) was the closest to explore time on task as a motivational variable. Howse found that motivation might be of limited value for young student's achievement if it is not accompanied by the student's ability to self-regulate behavior and spend more time on task engaged in a learning activity. Lange, Farran, and Boyles (1999) reported that a student's tendencies to monitor and self-regulate task behaviors in the classroom, predicted higher achievement scores more consistently than did other general motivational indicators.

Furthermore, Borkowski and Thorpe (1994) found that failures in self-regulation are particularly evident in underachievers that have not had success with using strategies and planning, when attempting to complete an intended task. Further, that students who lacked motivation were more easily diverted from completing a task and spend less time on tasks related to learning and that resulted in poorer scholastic mastery and lower levels of achievement. Future research that examines self-regulation and its relationship to time on task as a measurable motivational variable may be warranted when studying successful intervention strategies with at-risk students.

Instructive Technology and Intrinsic Motivation

Researchers for the U.S. Department of Education categorize learning technology into four basic categories: Tutorial, Exploratory, Application, and Communication. This part of the discussion will focus on the tutorial model. Tutorial technology applications are educational technologies that are designed to teach specific facts or skills, typically in a lecture-like or workbook-like format. Kim & Axelrod, (2005) referred to this approach as teacher-centric or a direct instructional model.

Direct Instruction (DI) is a highly structured instructional approach, designed to accelerate the learning of at-risk students. Curriculum materials and instructional sequences are designed to move students to mastery at the fastest possible pace. Tutorial or direct instructional models rely on expository learning, in which the system provides information, demonstrations and practice exercises where the system requires the student to solve problems, answer questions, or engage in some other form of assessment.

Research that compared a variety of educational approaches found DI techniques to be the most effective along all measures for the education of at-risk students (Kim & Axelrod, 2005). Kim & Axelrod (2005) found that Direct Instruction outperformed other models deemed to be cognitive or affective in nature, not only in basic skills achievement, but in cognitive and affective achievement as well, yet few school systems use the procedures This may be due in part to education reforms initiated by the government.

The following is an except from a US Department of Education study, Using Technology to Support Education Reform conducted in September of 1993. The study expressed strategies that may have set the stage for conditions that now exist, which the current No Child Left Behind legislation addresses:

> Reformers argue that students should be given tasks that are personally meaningful and challenging to them (e.g., describe their city to students in another part of the world). Meaningful tasks almost always will be more complex than the tasks assigned with a discrete-skills approach. Students take a more active part in defining their own learning goals and regulating their own learning. They explore ideas and bodies of knowledge, not in order to repeat back verbal formalisms on demand, but to understand phenomena and find information they need for their project work. Within this learning model, the teacher becomes a facilitator and "coach" rather than knowledge dispenser or project director. While the vision of a transformed classroom offered by reformers is important for all students, the change in practice would be especially dramatic for those who have been variously characterized as disadvantaged or "at-risk." (Means, et al., 1993).

This created a problem for the at-risk, underachieving student that not only lacked mastery of basic skills and the ability to self-instruct themselves, but also the necessary intrinsic motivation ((Means, et al., 1993). These students were left behind often developing Binder (1996) called a "cumulative dysfluency" that escalated into patterns of academic failure. Binder understood fluency to be an indicator of true mastery. (p. 15)

Smart Tutor, A Model of Combined Direct Instruction and Motivational Design

Smart Tutor used in the El Dorado study is a web-based advanced learning system designed to accelerate learning, develop motivation, and increase potential in low-performing students. It is based on a foundation of direct instruction and motivational theory with design features congruent with the ARCS model of attention,

relevance, confidence, and satisfaction. Smart Tutor uses bright colors, flash animation, and a host of interesting characters as well as precise interaction to engage and gain the attention of the learner. The use of real world examples and instruction individualized by a diagnostic/ formative pre-assessment makes the content relevant to the learner. Content is presented in a non-threatening, non judgmental, environment that allows the learner to proceed at their own pace.

Furthermore, the learning material is challenging but allows students to be successful and that success brings about increased confidence and positive expectations. The use of positive feedback reinforces learning and brings about satisfaction causing the student to continue to use Smart Tutor and to spend more time on task in a learning activity, and to persist in the learning activity over a prescribed period of time needed for the manifestation of success, an intrinsically motivated self-confident learner.

Smart Tutor uses DI as the basis for its instructional approach for at-risk students and the teaching practice of explicit instruction. Swanson (2001) argues that for students with disabilities and students who are at risk, this approach is crucial for the retention of new skills. The teaching practice of explicit instruction has been used classrooms since the late 1960s and research has indicated that explicit instruction is an instructional approach that is most effective for teaching basic or isolated skills (Kroesbergen & Van Luit, 2003).

The program starts with an online diagnostic pre-assessment to determine where the gaps are in a student's reading and/or math knowledge base the automatically generates and individualized program in reading and/or math that is explicit and

focuses on key concepts allowing students to call to conscious attention what is being taught and clarify learning objectives.

Observations

The utilization of instructional technology can lead to an enhanced sense of achievement for many students who have previously been under-achieving. Learning gains and increases in motivation have been found in literacy and mathematics (Moseley & Higgins 1999). Therefore, the fact that minority (African American and Latino) children's academic achievement scores in the United States do not match those of the majority of children is a cause of great concern.

The growing interest in standards-based reform, however, has drawn attention to the realities of the achievement gap: that there is a disheartening percentage of under performing students within Black and Latino ethnicities, that minorities continue to trail the white mainstream in academic achievement, and that this achievement gap directly translates into the perpetuation of poverty and disenfranchisement for a growing segment of the American population (Kober, 2001).

The fact that technology based learning systems that can reduce or eliminate this discrepancy, which are infused with teaching strategies and motivational mechanisms (Jones, 2005), do exist, but are not fully used, is a cause for concern. Students who used educational technology in school felt more successful in school; were more motivated to learn and had increased self-confidence and self-esteem (Software and Information Industry Association 2000).

Although studies reveal a range of positive impacts on students, there are many interesting questions around the effects of motivationally designed instructional technology intrinsic motivation on at-risk students, questions that relate to measures of

time on task and self-determination. Also interesting inquiries such as, what is an effective period of use, e.g., are two hours per week of instruction better than one hour or what is the optimum exposure to assure success? Which subjects respond the best to motivationally designed instructional technology? Are intrinsically motivated students less disruptive in the classroom? How long is motivation sustained and is intrinsic motivation in one context transferable to another context?

These are relevant questions that invite plausible, meaningful responses. There is yet additional research to be done; that is unavoidable if education balanced by social change is to progress. Nevertheless, the evidence (Moseley & Higgins, 1999; Song & Keller, 2001; Kim & Axelrod, 2005) supports a move now into classrooms to address the needs of learners through appropriately designed instructive technology. Such a move might be an effective step in resolving the mounting social and teaching challenges that face students at risk.

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