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# A Study Analyzing Five Instructional Methods for Teaching Software to Junior High Students

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# Teaching Software to Junior High Students

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# ABSTRACT

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If you ask 5 different teachers what the best way to teach a new technology to a student is you will get 5 different answers. (Bork, 2001; Cheong, 2008; Egal, 2009; Howell, 2001) What is the best way to teach a new computer software application to a student? In the technological world we live in today the effective transfer of technological knowledge is paramount. With varying opinions even among the leaders of national technology teacher associations (Haynie, 2005) there is a large level of ambiguity in relation to best practices in technology teaching. This study evaluates five commonly used methods of software application instruction used in technology classrooms. Students and teachers were questioned regarding the effectiveness and frequency of use of each of the instructional methods. Students were also instructed using five commonly used methods of instruction. Student's work was graded and average grades for each method of instruction were obtained.

Key findings include: 1 - Students perceive book learning to be the most effective method of instruction for themselves and for their classmates. 2 - Teachers perceived direct instruction as the most effective method of instruction and book learning as the least effective method of instruction. 3 - Although students reported book learning as the most effective method of instruction those receiving direct instruction received the highest grades.



Keywords: instructional methods, technology teaching, pedagogy, direct instruction, book-learning, video-tutorials, problem-based learning, collaborative learning, software application, instruction

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# 1 INTRODUCTION

## 1.1 Background

Literature from computer science, instructional psychology, instructional technology, and educational psychology includes a wide variety of ideas, suggestions, and methodologies related to computer software application instruction. Because of the nature of this study and the vast and varied fields related to computer software application instruction, particular attention was focused on literature in the Technology and Engineering Education field. Specifically, literature pertaining to computer software instruction in the communications subject area of Technology and Engineering Education was consulted for best practices and methodologies. Additionally, literature from Technology and Engineering Education related to best practices, teaching methodologies, and instructional methods was consulted. A careful review of this literature showed contradictory viewpoints as to what method of instruction is the most effective for computer software application instruction.

Among many competing ideas Farra (1998), Howell (2001), and DuDosq (2002) argue that problem solving in a project-based classroom is the most effective method of teaching software applications to students:

> The project method of teaching increases students' thinking and problem-solving abilities. Students working on projects also develop reflective thought processes and a sequence of order while working on a project (DuDosq, 2002).

Conversely, Westman's (1993) and Reading-Brown & Hayden's (1989) research revealed that technically minded students prefer direct instruction and other passive observation methods of instruction, claiming "Students in technical training programs display a learning style characterized by passive observation and reflection, combined with direct experience." More recently, the Southern Regional Education Board (Tanner, 2003) published an article supporting Westman's and Reading-Brown & Hayden's claims, stating that "direct instruction is the best way to teach skills, procedures, and processes that are essential components of the curriculum."

Others argue for scaffolding (Dickerson, 2009) and collaborative or group learning (Lou, 2001) as the best way to teach software applications to students. The literature reveals little consensus regarding which method of instruction proves to be the most effective when teaching a new computer software application.

In an attempt to survey trends and perceptions of leaders of Technology and Engineering Education, Foster (1996) conducted a survey, asking individuals what method of instruction should be used for technology education. Those surveyed included teachers, national board members, Technology Student Association advisors, and others. As reported by Foster:

> The six groups of leaders indicated that an approach to technology education appropriate at one level of public education may not be as appropriate at another. Respondents overwhelmingly chose to view technology education as a method at the elementary level. At the middle school level, they regarded it from an organizational standpoint. There was less agreement at the high school level, where the top choice related to the content of technology education and its integrative nature. Despite this variety, at all levels the leaders placed the process of design second among all priorities at every level of schooling.

In Foster's study, teachers and leaders in Technology and Engineering Education identified a "modular approach" as the most appropriate method of instruction for technology education. The second and third preferred methods were “design/problem-solving,” and a “career-emphasis” respectively.

In 2005 Haynie conducted a survey similar to the 1996 survey among leaders of technology education. Haynie’s survey focused on: What methods of instruction do those in leadership positions in the field of technology education favor? Haynie completed two versions of the same study, in 1989 and 2003 (Haynie 1991, Haynie 2005). Technology Student Association (TSA) advisors were asked questions about their teaching techniques and the perceived effectiveness of each method. Responses were gathered, data analyzed, and conclusions formed regarding the most commonly used forms of instruction in the technology classroom. He found that between 1989 and 2003 the availability and cost of computers changed in such a way as to allow for most technology classrooms to have a computer (Haynie, 2005), which influenced the way technology education was being taught. In his study “Direct Instruction,” or demonstrations, ranked as the most effective method in 1989 and “Lecture-Demonstrations” second most effective. However, in his follow-up survey in 2003 “demonstrations” fell from first place to fifth place and “Lecture-Demonstrations” fell to twelfth place. Haynie shows that although “both methods of instruction are still commonly used (75% of teachers use demonstrations and 57% use lecture-demonstrations) these methods have fallen significantly (down from 93% and 80% in 1989).”

Further, Haynie stated that:

> Technology education changed significantly from 1989 to 2003. Of those changes there was a significant decrease in long lectures, mass productions (line production projects), and discussion. In 2003 there was a great push in the technology education arena for problem-based learning (Gallagher, 1997). Another common method of instruction, problem-based learning, was ranked fourth in 2003 and continues to be one of the most commonly used methods of instruction (Cheong, 2008, Gallagher, 1997).

Technology and Engineering Education continues to evolve in contemporary times. Many of the changes we have experienced and continue to experience in instructional methods result from the invention and availability of the computer, the Internet, and other technologies available today. Haynie (2005) argued that in 2005 "learning by doing" and other "hands-on" approaches appeared to be the most dominant method of technology instruction.

> Those changes exhibited by TSA teachers show progress toward standards and problem-based learning taught in a computer rich environment. The 'learn by doing' approach remains the primary teaching method in TE, but the actual learning activities experienced by the students have changed to reflect the evolving curriculum." (Haynie, 2005)

In light or various changes and beliefs regarding what is the most effective instructional methods in software instruction, the same question exists today, in 2011. Consequently, this study asks the questions: Is "learning by doing" the most effective method of teaching a new computer software application to junior high students? Have significant advances in technology provided a more effective method of instruction? What would be seen in an effective classroom where new computer software applications are taught?

Recent surveys have been conducted related to learning preferences of post-secondary students (Costa, 2010) but no specific recommendations have been made regarding software instruction for Junior High students. Additionally, the majority of the research has surveyed perceptions of effectiveness (surveys done among teachers and leaders), but, few studies have been done attempting to actually identify which method(s) of instruction are in fact more effective (i.e. produce a higher grade for students).

## 1.2 Research

A thorough literature review, with specific emphasis on software instruction as part of Technology and Engineering Education, was conducted. General trends from numerous articles relating to technology, technology teaching, software application instruction, teaching best practices, and teaching methodologies were recorded. Using the literature review as a basis for the study five of the most commonly cited, recommended, and noted methods of teaching computer software applications were identified. These are: direct instruction, problem-based learning, video/tutorial based learning, cooperative/collaborative learning, and book/written script learning. This information was used to develop a research study involving adolescent students in technology courses at the Junior High level.

Additionally, a survey was conducted among the students and teachers of these classes; teachers were asked about their use of the identified methods in class, their perceptions of effectiveness, and other questions regarding teaching styles, methods, and implementations in their classes. Students completed a survey with questions relating to their preferences, perceptions, and experiences with the identified methods of instruction.

## 1.3 Methodology

The research methodology consisted of an eight-part process. First, five volunteer teachers were selected from a school district located in central Utah. Teachers and schools were selected based on similar class size, demographics, classroom equipment, teacher experience, and student experience with computer software applications. Second, each teacher was randomly assigned a specific teaching method – one of the five methods obtained from the literature review, and was asked to adhere strictly to it (whether or not it was their personal preference). Third, teachers taught a new computer software application to their students. This software application was chosen because of ease of use, correlation to similar software applications in industry and commonly found in public classrooms, and because none of the students had been exposed to this software application. Fourth, students were assigned the task of creating a CD cover for a musical artist/band using only the selected software application. Fifth, teachers recorded themselves while implementing the teaching strategy assigned to them, and responded to a survey, answering questions related to their experiences in their assigned computer-instruction method. Sixth, students responded to a survey regarding software application instruction and ranked the methods of instruction in order of effectiveness. Seventh, student work was collected and graded by a panel of graders with design background. Eighth, the average grades for each class was aggregated, and results were cross-analyzed with the method of instruction used.

### 1.4 Research Question

This research addresses a problem teachers of computer software applications face today: What is the most effective method of teaching a new computer software application to Junior High students? Technology and Engineering teachers, specifically those with communications and other related courses that involve computer software applications, face this problem as they teach students new computer software applications. The question of which method is most effective is one that affects not only teachers, but, trainers, and specialists of all age levels and experience, as computers and computer software applications have become a ubiquitous part of society. Despite the increase in computer software application use, the associated literature is inconclusive in regards to which method is the most effective.

In an effort to discover the most effective method of teaching a new computer software application to Junior High Students, several other questions were also posed: What method(s) of instruction do students believe to be the most effective for their own learning? What method(s) of instruction do students perceive to be the most effective for their classmates' learning? What methods of instruction do teachers perceive to be the most effective for the students' learning? What methods of instruction do students perceive their teachers using in class? Do student and teacher perceptions of methods being used in class align?

# 2 LITERATURE REVIEW

Literature from computer science, instructional psychology, instructional technology, and educational psychology includes a wide variety of ideas, suggestions, and methodologies related to computer software application instruction. Because of the vast and varied fields related to computer software application instruction, efforts for this study were focused on literature in the Technology and Engineering Education field. Specifically, literature pertaining to computer software instruction in the communications subject area of Technology and Engineering Education was consulted. Additionally, pertinent literature related to teaching practices and methodologies in Technology and Engineering Education was consulted to identify trends and best practices among teaching methodologies. A careful review of this literature reveals contradictory viewpoints as to what method of instruction is the most effective. The two areas to be discussed in this literature review are: (a) changes in Technology and Engineering Education and (b) instructional methods.

## 2.1 Changes in Technology and Engineering Education

Technology and Engineering Education is a field of study that continuously evolves – both in practice and name. Traditionally, technology education has been known as: Industrial Arts, Manual Arts, Manual Training, Technology Education, and Technology and Engineering Education.

Starting with apprenticeships that date back to the ancient Roman and Greek civilizations, technology education has existed for hundreds of years (Bennett, 1967). During the 1800's apprenticeships gradually led to formal schools and training processes for future workers; this change was commonly called "manual training." Manual training focused on the production of useful products and mastery of skill sets (Barella & Wright, 1981; Snyder, 1992).

At the turn of the century "manual training" began to move towards "manual arts." Led by powerful and influential reformers like Charles Bennett, manual arts focused on learning useful processes and manual art education expanded to include more general subjects outside of manual training processes (Bennett, 1967; Prakken, 1976; Salomon, 1904).

For much of the 1900's technology education was a constant battle ground for competing pedagogies, ideas, and processes (Mossman, 1924; Foster 1996) with two competing fields dominating the scene: industrial education and vocational education (Anderson, 1926; Barlow, 1976). Reformers like James Russell, Gordon Bonser, and Lois Mossman were influential in the emergence of "industrial arts." Industrial arts was a step forward in teacher training and focused on trade and technical education for students (Prakken, 1976).

In 1981 the influential "Jackson Mill" movement helped shift the focus of technology education to industry and technology (Barlow, 1976). This change led to the names "Industrial Education" and then "Technology Education." Around 2000 the emphasis shifted again and *Career and Technical Education* became a required class for all students in schools. Even today technology education is called by various names including: "technology education," "technology and engineering education," "STEM education," and "Trade and Technical Education." (Wai, 2010)

The purpose of this research is not to give a history of technology education or to explore these ideas in depth, but rather to identify which of these ideas, or which new approach to technology education is the most effective when teaching junior high students a computer software application.

Foster (1996), conducted a survey among selected leaders of technology and engineering education – these included teachers, national board members, TSA advisors, national organization members, and others. Individuals were asked what method of instruction they perceived as being best for Technology and Engineering Education. As reported by Foster:

> It is clear from the results of the study that there is significant agreement about approaches to technology education among widely varied groups of leaders in the field. This agreement is very strong at the elementary level, less so at the middle-school level, and even less so at the high-school level. This may confirm the sense some professionals have that the field's high-school program has yet to be solidified.

In Foster's survey teachers and leaders in Technology and Engineering Education identified a "modular approach" as the most appropriate method of instruction for technology education. This was followed by "design/problem-solving," and a "career-emphasis" approach. It appeared that there was some form of a consensus among technology education professionals – at least for the time being.

Haynie (2005) conducted a similar survey to that performed by Foster (1996). Haynie, using Foster's survey as a guide, conducted a similar survey and asked: What methods of instruction do those in leadership positions in the field of technology education favor? Technology Student Association (TSA) advisors were asked questions about their teaching techniques and the perceived effectiveness of each method.

Between 1989 and 2003 the availability and cost of computers changed in such a way as to allow for most technology classrooms to have a computer (Haynie, 2005). As shown in Haynie (2005), "All items from the 1989 survey which concerned computers used by teachers and students had significantly higher ratings in the [2005] study." Each of the items related to computers ranked in the top 10 most used items in 2003, while none of them did in 1989.

Direct instruction, or demonstrations, ranked first in 1989 and "Lecture-Demonstrations" ranked second. In 2003 "demonstrations" fell from first place to fifth place and "Lecture-Demonstrations" fell to down to twelfth place. Haynie showed that although both methods of instruction were less popular than before, each method was still commonly used by teachers.

> Both methods of instruction are still commonly used (75% of teachers use demonstrations and 57% use lecture-demonstrations) but, these methods have fallen significantly (down from 93% and 80% in 1989).

Technology Education continues to evolve as we have entered the 21st century. Many of these changes resulting from the invention and availability of the computer, the Internet, and other technologies increasingly available today. Commenting on the trends of technology education in 2003, Haynie said:

> Those changes exhibited by TSA teachers show progress toward standards and problem-based learning taught in a computer rich environment. The 'learn by doing' approach remains the primary teaching method in TE, but the actual learning activities experienced by the students have changed to reflect the evolving curriculum. (Haynie, 2005)

In 2010 Costa conducted a survey among postsecondary career and technical education students regarding their perceptions of instructional methods, learning style preferences, and preferences regarding instructional methods. It was found that the predominant learning style of those in technical education majors and classes is active, sensory, visual, and sequential.

Participants in the study ranked nine out of 12 instructional methods with over an 80% total effectiveness, and "lecture-only" was the only method perceived as not effective by the majority of students. Costa's research was limited to postsecondary students only; further research among different age groups was encouraged in order to identify preferences and effectiveness of levels of instruction in technical education at all age levels.

Most of the research and surveys in Technology and Engineering Education regarding instructional methods have only focused on the general perceptions of effectiveness among participants. There is a lack of literature regarding which method of instruction is actually most effective. While surveys inform of general perceptions of effectiveness, this study sought to also identify which method(s) (if any) are most effective when teaching a new computer software application to Junior High students.

## 2.2 Instructional Methods

Dating from ancient history to modern day, there have been many instructional methods documented (Egal, 2009). The pertinent question to this research project is, *Which instructional method(s) is the most effective for teaching a new computer software application to Junior High students*? Literature related to computer science, computers and learning, technology, technology teaching, instructional psychology, and other related fields was consulted to identify commonly cited, recommended, and used methods of instruction. Because this study focuses on Technology and Engineering education, literature related to this field was favored and more extensively researched. In Technology and Engineering Education literature related to communications technologies, and specifically to software instruction, was consulted for recommendations and instructional method analyses. After an extensive literature review five commonly used, cited, and recommended methods of instruction for technology classrooms were identified. These methods include: 1) Direct Instruction, 2) Problem-based learning, 3) Video-based/Tutorial learning, 4) Cooperative/Collaborative learning, and 5) Book/Written-script tutorial learning.

It is important to remember that hundreds of different methods and combinations of methods are possible, each one with strengths and weaknesses for the student's learning. Effectiveness of methods of instruction is related to a number of variables (i.e. student learning style, teacher personality, class size, etc.) and different methods are more effective for certain subjects (Smith, 2001).

As shown in Hlawaty (2009) adolescent students between the ages of 11 and 13 are developing and learning according to learning styles. Often learning styles of students aged 11-13 are different than those aged 13-15 or 15-17 (Hlawaty, 2009).

Additionally, Perry (1970), states that many students "journey" through nine "positions" relative to their intellectual and moral development. These stages are often highly correlated with age, experience, and student-teacher and student-peer relationships. Students begin their journey trusting in authority figures, seeking to know the "right" answer. As students mature they begin to think for themselves and "realize" that sometimes there isn't a "right" answer – this leads students to exploration, reflection, questioning, and self-directed learning.

Although Perry used these stages of intellectual and moral development to describe college students, they have been applied to students at varying ages (Rapaport, 1987; Belenky, 1986). Adolescents between the ages of 11 and 13 will most likely be characterized by the early stages of Perry's intellectual development although progression through stages is not necessarily tied with age.

### 2.2.1 Direct Instruction

While many definitions exist, direct instruction can be defined as "a teacher-centered approach for training academic skills (Schuman, 1998)." Since 1976 when Rosenshine introduced the term "direct instruction" as part of his behaviorist teaching examination (Rosenshine, 1976), few teaching styles have been discussed, debated, and researched as extensively as direct instruction (Bock, Stebbins, & Proper, 1977). In 2001 the *Journal of Direct Instruction* was established as a peer-reviewed forum to discuss contemporary research relating to direct instruction (Slocum, 2003). Direct instruction was also included in the largest educational evaluation conducted, comparing direct instruction with 12 other teaching styles, across nearly 30 years, and involving nearly 75,000 students at 180 different locations (Bock, Stebbins, & Proper, 1977). This study found direct instruction to be effective and superior to other models in everything from learning engagement to achievement and student affect. In recent studies, done among second-language learners, direct instruction has been identified as "the most requested model," (Schuman, 1998) of teaching for student learning.

In his study Rosenshine (1976) emphasized the use of task analysis and teacher modeling at the center of direct instruction. Learners are expected to observe, ask, and learn from a teacher who will model a set of desired skills. The addition of the computer and projector to the technology classroom is a great proponent of direct instruction as it easily facilitates the modeling of computer use and computer-related skills. In the technology classroom the teacher is generally at the front of the room working with a computer and often a projector; students often follow along or mimic teacher movements.

As noted in their study Magliaro (2005) states that direct instruction "seems to have fallen out of favor in terms of philosophical trends of learning and instruction" (see also

Edmondson & Shannon, 2002). Many argue that direct instruction is not "student-centered" and that is detracts from students learning because it is "boring" and does not directly involve the students. Some argue that direct instruction is ineffective because, when used, students are passive learners, simply sitting and being "fed" information. Teachers are also required to be very knowledgeable and up-to-date in their field of study as direct instruction places them as the source of new information and answers to questions for their students.

Despite these arguments against direct instruction it is a widely used teaching method, both in the technology classroom and out, and has been shown to increase students' problem-solving skills (Good & Grouws, 1981) in engineering and other related settings. Allowing students to see processes, outcomes, and patterns is an effective method and students retain memories of teacher's examples long after the initial instruction.

### 2.2.2 Problem-based Learning

Problem-based learning (PBL) or Inquiry-based learning is a teaching style, which emphasizes student problem solving in rich real-world contexts. Problem-based learning has become increasing popular in recent years due to the focus of the K-12 community on engineering and math education (Gallagher, 1997). According to Barrows (1996), PBL has the following main characteristics:

> 1 - Learning is student-centered as students assume a major responsibility for their own learning; 2 - Learning occurs in small groups; 3 - Teachers are facilitators or guides; 4 - Problems form the organizing focus and stimulus for learning; 5 - Problems, similar to those one would face in future professions, are a vehicle for the development of problem-solving skills; 6 - New information is acquired through self-directed learning.

A typical problem-based learning scenario in a technology classroom would involve a challenge or question posed to the students, which they must solve using a particular technology or multimedia form. Students would be given little, if any, formal instruction regarding the topic and would collaborate with classmates and use other resources to find the answer. The teacher would typically be an available resource to the students but would allow the students to seek and find answers on their own.

Many teachers believe that one of the greatest benefits of problem-based learning is the development of higher level thinking skills, as referenced in Howard Bloom's research (Bloom, 1956). As shown in Duch (2001),

> Essential characteristics of a good PBL problem are: it should engage students' interest and motivate and connect them to the real world; students should make decisions/judgments based on facts, information, reasoning, etc; it should be complex enough to require cooperation as a group; divide and conquer strategies are not effective; initial questions are open-ended and group discussion is encouraged; and course content objectives are embedded in the problem and situation.

Currently, problem-based learning is used most often in the medical field and has been show as more effective in long-term content retention for students than traditional instructional methods (Norman & Schmidt, 1992). As noted in Liu (2004), studies have also shown that students learning through problem-based learning are more effective at applying information and integrating knowledge (see also Patel, 1991). Studies also show that students in PBL environments have better attitudes toward learning and higher motivation (Albanese, 1993; Norman & Schmidt, 1992). When problem-based learning moved into K-12 education, PBL was shown to be effective with mature gifted middle and high school students – especially in the development of problem solving skills (Gallagher, 1997; Hmelo & Ferrari, 1997).

Problem-based learning brings it's own unique set of challenges. Problem-based learning can be very difficult to implement in the classroom (Liu, 2004). A problem-based learning curriculum takes an extensive amount of time to develop and even longer to effectively implement in the classroom.  Problem-based learning is also more “costly” since it requires a greater investment of teacher time up front to prepare questions and resources and increased post-unit assessment-time for the teacher.  Additionally, PBL may be more effective when combined with other methods of instruction (Cheong, 2008).”

### 2.2.3 Video-based / Tutorial Learning

Tutorial learning is a method of learning and instruction dating back hundreds of years (Bork, 2000).  Tutorial learning commonly involves a highly skilled tutor and a student, or a small group of students who learn from the tutor and treat the tutor as an “authority” or “master” on a particular subject (Bork, 2000).  Until recently, private tutoring was reserved for the affluent – those who could afford a tutor, but with the improvements in technology a form of private tutoring (Video-based tutorials) is increasingly becoming available to the average citizen through technology and distance education settings via the Internet.  Recent years have seen a dramatic increase in distance education programs among high school, college, and universities (NCCTE, 2001).  Distance education often takes the form of video-based or tutorial learning as professors/teachers are able to pre-record instruction and transmit lessons to outlying locations. Students are then able to watch, review, and utilize lesson recordings in whatever manner best suits their educational needs.   The National Research Center for Career and Technical Education (NCCTE) concluded the following based on a national study of CTE teacher education programs.

> Increasingly, it appears that the profession is looking toward more distance education as a means to deliver education...In the next three years, the number of Web-based courses and interactive courses is expected to increase by at least one-third (NCCTE, 2001, p. 49).

Much research is being conducted in relation to the current use of tutorial learning. Tutorial learning through online or computer-based scenarios is a powerful method of learning. With the increased use of tutorial learning students are no longer dependent on a human teacher and therefore have no deadline for learning a particular concept. As shown in the research of Bork (2000):

> The notion of a fixed time to learn will vanish, along with the standard twelve years required to graduate from high school and the four or more years of university-level work. Tutorial learning will be a much more efficient use of the student's time, a continuous process from birth to death. Courses will not exist.

Supporting these conclusions, Wallace (1997) compared engineering students at MIT receiving tutorial learning with those receiving a traditional classroom experience. Wallace showed :

> The average grade performance of the students receiving web instruction was higher than for those receiving traditional classroom instruction. An achieved significance level of 0.063 provides reasonably strong evidence to reject the hypothesis that the two groups performed equally. Analysis of web-lecture use patterns revealed that the web-group students spent roughly the same amount of time on-line as the classroom group spent in lecture.

Tutorials offer students a means of combining online learning with hands-on real-life learning opportunities. As shown in Mckenna (1997),

> The online computer simulations, combined with the hands-on design and building activities, encourage the students to make connections between the more abstract principles and the actual physical system. This is a necessary connection that is often overlooked in engineering education.

Past studies related to tutorial learning have shown that students will develop a greater ability to construct, or discover, their own knowledge (Bork, 2000). In one study done at the

University of Irvine, “middle-school students, following procedures similar to those used by scientists, discovered the laws of genetics,” and a current proposal “suggests units in which all students will discover the Newtonian laws of motion, rather than being told the laws” (Bork, 2000) – all through the use of tutorial-learning.

In 2003, Merino compared the effectiveness of computer tutorials with traditional lecture instructional methods for a university accounting class. Merino concluded that:

> The results indicate that there was no statistically significant difference between the two methods. This was consistent with previous studies. This study concludes that computer-mediated tutorials could be substituted for traditional lectures without impacting what a student learns—at least for teaching accounting fundamentals.

Other related studies have yielded similar results. Sweeney (2001) showed that foreign students with weaker language skills prefer Web-based tutorials to traditional class lectures. Sweeney cites the ability to think about and develop answers as the primary reason students preferred video-tutorials.

In spite of all the positive aspects of tutorial learning, there are accompanying challenges. Because learners are usually stationed at a computer they can become complacent and passive-learners due to their environment (Bork, 2001).

In order for learning to be effective the teacher needs a knowledge of what the student already knows, how they learn best, what concepts have been covered - tutorial learning, as it is commonly used today, is not able to provide any of this for the teacher or learner.

> Current Internet systems store very limited student information, usually only to show overall progress and determining grades. They do not record information about student problems for later reference (Bork, 2001).

Skilled human tutors start each session with a vast amount of knowledge from previous experience while tutorials are created without this knowledge. Due to it's relatively recent inception, video-tutorials will prove to be a topic of much study, conversation, and experimentation for years to come.

### 2.2.4 Cooperative / Collaborative Learning

According to Crook (1998), there are three features of interaction that are central to successful collaboration: intimacy among participants, rich supply of external resources, such as computers, and histories of joint activity of those interacting. As pointed out by Brufee (1993, p.3) collaboration is "a reculturative process that helps students become members of knowledge communities whose common property is different from the common property of the knowledge communities they already belong to." For the purposes of this study we have chosen to use the following definition:

> Cooperative learning is defined by a set of processes which help people interact together in order to accomplish a specific goal or develop an end product which is usually content specific. (Panitz, 1996)

In a technology classroom teachers generally present a group of students with a task or challenge and the students work together to accomplish the task. Each group of students forms a "community of learners" (Brown 1994) in which the core activity is the sharing and distributing of expertise or knowledge. As stated by Brown (1994),

> Learning and teaching depend on creating, sustaining, and expanding a community of research practice. Members of the community are critically dependent on each other. No one is an island; no one knows it all; collaborative learning is not just nice, it is necessary for survival.

There are a great number of benefits, revealed through research, that come from using collaborative learning techniques. A great number of these benefits have resulted from computer use in collaboration. As learners use computers to collaborate they break down the physical barriers of school by removing time and space constraints. Learners no longer leave their group interactions at the classroom door – groups are connected and increased time for reflection, interaction, and collaboration is provided. Adding to the learner's available resources through groups and technological connections will further facilitate learner development in and out of the classroom.

As shown in Vygotsky's (1978) research on the zone of proximal development, learners are ready to learn different things at different times. With groups connected by technology and other means the chances for learning to occur within the zones of proximal development is increased. Lou (2001) found that, "Learning in pairs [is] slightly more effective than learning individually…groups with 3-5 members did better than pairs who, in turn, did better than individuals."

In support of these findings Terenzini (2001) conducted a study evaluating the learning of engineering students in a traditional lecture-based classroom with those in collaborative classroom settings. Terenzini found:

> Results indicated that "ECSEL" students (i.e., those taking courses taught using active and collaborative approaches to teaching design) reported statistically significant advantages in a variety of learning outcome areas when compared with 'non-ECSEL' students, who were enrolled in conventionally taught courses. ECSEL students reported learning advantages in three areas: design skills, communication skills, and group skills. The advantages enjoyed by ECSEL students were both statistically significant and substantial. On average, ECSEL students reported learning gains of 11–34 percentile points higher than those of their non-ECSEL peers in communication skills (11 points), design skills (23 points), and group skills (34 points). These reported learning gains, moreover, persisted even when controlling for relevant pre-course student characteristics

(e.g., gender, race/ethnicity, parents' education, high school grades, SAT scores, degree aspirations, and class year).

Terenzini's findings are further strengthened by ABET's *Engineering Criteria 2000* which calls for a reform in undergraduate engineering including the implicit belief that engineering courses with more collaborative approaches will be more effective that their lecture-based counterparts.

Like other instructional methods, challenges associated with collaborative learning present unique difficulties. Often group members in collaborative learning settings do not shoulder the load equally. Johnson and Johnson (2002) state that the two most common forms of behavioral problems in collaborative learning settings include "un-involvement" and "taking charge". Another commonly cited problem is hesitancy among teachers to use collaborative methods. As shown in Stahl (1999), "The clearest failures related to computer-supported collaborative learning environments are that for different personal and cultural reasons, students and teachers are hesitant to use them."

Often times in collaborative settings, physical or virtual, members are affected adversely by the personalities of others and learning is stinted. Unequal participation is the most common result of conflicting personalities in such collaborative settings (Johnson 2002). As teachers incorporate collaborative learning in their classrooms they face the challenge of proper assessment. Are all learners given equal points although all did not equally participate? Such challenges may be a reason that many educators today avoid collaborative learning strategies.

### 2.2.5 Book / Written Script Tutorial Learning

Learning from a textbook, or written script, is as old as school itself. For decades students have been given a text containing the wisdom, knowledge, and problems, of those who have gone before them. Students are expected to read the text, answer key questions posed to them in the text, and retain the knowledge for future use. Recently the addition of images, graphs, and iconic cues has increased the effectiveness of textbook learning (Houghton, 1987; Kamil, 2010; Schnotz & Kulhavy, 1994); in particular, research has demonstrated the value of combining text captions with illustrations to create annotated illustrations (Bernard, 1990; Guri-Rozenblit, 1988).

Textbooks offer a great resource to students. The combination of images and text in a format that is easily accessible to students has been very effective. Textbooks are a tangible vault of information which students can access as many times as needed in order to learn concepts. Textbooks are particularly useful in subject areas that are static, such as history or math. Teachers of these subjects can use the same textbook for years because the content does not change. Many textbooks have been through numerous revisions and have been honed down to the best questions that provoke learning and understanding from student learners.

Textbooks also have challenges associated with them. In personal conversations with teachers many related that they see "book work" as a punishment, which is somehow sub-par to other forms of learning – their students in many cases share their perceptions. Textbooks can be expensive and often are not handled properly, resulting in damage and costly repair or replacement costs. In addition to cost and storage, others have argued that textbook quality has declined in recent years (Thomas B. Fordham Institute, 2004). Students who do not have learning styles that are compatible with reading comprehension often complain about textbook use (Mayer, 1996).

> Students can carefully read a text-book lesson that contains a scientific explanation, and yet not be able to remember the explanation adequately or to use it to solve problems. Given the importance of textbooks as a commonly used vehicle for promoting student learning, evidence of students' difficulties in learning from text is particularly disturbing (Driscoll, Moallem, Dick, & Kirby, 1994; Garner, 1992; Tyson 1989).

In today's digital age many textbooks are becoming obsolete as E-books, PowerPoints, and Internet based video learning sites continue to grow (Corbeil, 2007). As a result of this current movement toward electronic media, many have wondered if electronic presentation of information is more effective than the presentation through a textbook. Mayer (1996) also conducted research to see whether one medium of presenting information was more effective than another – he reported:

> A persistent, if somewhat unproductive, question in media research concerns whether one medium is more effective than another. For example, in the domain of multimedia learning, a version of this question is: "Are computers more effective than textbooks?" To answer this question, one could compare the consequences of teaching a lesson using a textbook that contains words and illustrations versus teaching the same lesson using computer-generated graphics and narration…Consistent with prior research (Clark & Salomon, 1986), our results do not provide strong evidence of media effects. Overall, computer-based learning seems to yield 3% more solutions on a problem-solving test than does book-based learning – a difference so small as to be inconsequential. Yet, even this conclusion is misleading because, like most studies of media effects, there are serious methodological confounds in comparing the two media.

Technology and Engineering Education is a field of study that has been evolving for decades. During this time of change, methods of instruction common to this field have been created, adapted, and revised. Each method of instruction has it's own unique challenges and benefits and may be effective or ineffective depending on the setting. This study was conducted to identify perceptions regarding software instruction effectiveness by analyzing five commonly cited, recommended, and used methods of software instruction.

# 3 METHODOLOGY

## 3.1 Literature

The purpose of the research was to determine what is the most effective method of teaching a new computer software application to Junior High students. Knowing that there are countless lurking variables we sought to eliminate as many as possible and highlight the differences in student reaction to different teaching styles. Using the literature review as a basis for the study, we selected five commonly used, recommended, and noted methods of instruction in the technology classroom (Bork, 2001, Magliaro 2005, Schuman 1998): direct instruction, problem-based learning, video/tutorial based learning, cooperative/collaborative learning, and book/written script learning.

## 3.2 Students

Using the five identified methods of instruction a research study involving adolescent students in computer-based technology and multimedia courses was developed. In previously performed micro-studies a common factor affecting data was previous experience with multimedia and computer-based software applications. In an effort to lessen the effect of this lurking variable adolescents in this study were between the ages of 11 and 13 and registered in public junior high or middle schools in the 7th or 8th grade. Because Junior High is often the age at which adolescents are first enrolled in technology classes (Utah, 2010) adolescents of this age range were chosen. To increase the reliability and commonality of standards for students, all were enrolled in the *Intro to Technology* class. *Intro to Technology* is a 7th & 8th grade class, part of the Utah CTE core classes, designed to introduce students to technology and allow exploration of technological systems and their impacts on society (Utah, 2010). This class was chosen because, for the majority of adolescents who take junior high technology classes, this is often the student's first exposure to a class devoted to the study of technology (Utah, 2010).

Demographic information such as grade point average, socioeconomic status, computer experience, and computer-based software application experience was collected (Appendix: Table 7-1). In addition, average technology course grades, and average grade for students in participating classes were collected. This demographic and scholastic information was used to check that the sample size was similar in nature and background. Average grade obtained in participating classes was also analyzed to check that a class with lower performing students did not skew the data in regards to the effectiveness of a certain teaching style.

Although individual student learning styles are influential and important in determining the effectiveness of different teaching styles, for the purpose of this study learning styles were not included as one of the measures. This was done for multiple reasons: a) this study focuses on the class as a whole, and it has been assumed for this study, that an average classroom (those sampled in this study) will have students with each of the possible learning styles and tendencies, b) adolescents aging 11-13 are still in the developmental stages of their learning styles and preferences, and their individual learning style is still likely to be refined and changed as they get older (Hlawaty, 2009).

## 3.3 Teachers

Schools and teachers were selected because they had similar facilities, similar student demographics, and offered similar class offerings – specifically, all chosen schools offered multiple periods of the *Intro to Technology* course. Teachers also had similar teaching experience, class size, and technological competency (Appendix: Table 7-2).

As part of the study each teacher completed a survey regarding his or her multimedia and teaching experience, classroom demographics, teaching styles, and subject areas. Each teacher was randomly assigned one of the methods identified in the literature review as the method of instruction they would use when teaching the new software application to the students. Teachers were asked to adhere strictly to their assigned instructional method while involved in this study (ex. direct instruction) whether or not it was their personal preference or regularly used teaching style. Teaching styles were assigned randomly to teachers and teachers were sent an explanation of the teaching style, definitions, examples, outlines, and associated procedures as a guide for their teaching experience. (See Appendix)

Teachers read through the rubric with the students and outlined the assignment and timeline. After covering the rubric and the timeline for the assignment, teachers provided instruction to the students using their assigned instructional method.

In order to ensure that correct teaching methods were used, teachers recorded themselves while teaching with a video camera, and the recordings were analyzed to ensure the identified teaching method was used. Teachers were provided with cameras and recorded for approximately 90 minutes. Teachers positioned the camera such that the majority of the class was visible and teacher-student interactions were captured digitally.

### 3.4 Software Application

An application (software) was needed for the study. This application needed to be new and unfamiliar to all students participating, yet similar enough to industry-standard applications that the data could be effectively applied to a broad range of applications, arenas, and situations. *Sketchpad* is an online image creation and editing software developed by Mugtug, an online community dedicated to the development of free online applications for image editing and creation. *Sketchpad* was chosen because: 1) *Sketchpad* is an application similar to Photoshop, Lightroom, and other image-editing applications typical to the multimedia industry; 2) *Sketchpad* is relatively easy to use with large icons, user-friendly tools, etc.; 3) *Sketchpad* has buttons, effects, and options similar to other multimedia applications; and 4) *Sketchpad* has a relatively small number of tools and options, which provided for a smaller learning curve and easier mastery. *Sketchpad* is a strictly online application, requiring no download, is free for use, and allows for an easy download of the finished product upon completion. As part of the study students were asked if they had ever used *Skethcpad* previous to participating in the study. It was confirmed that no participating students had previously used *Sketchpad*.

### 3.5 Data Collection

Data was collected in multiple ways: 1) Students and teachers completed a survey regarding their perceptions of the effectiveness of different types of instruction; 2) Students created a CD-Cover for an artist or band of their choice using the software application taught in class and student work was graded by a panel of graders with design experience; 3) Recordings of teacher instruction were assessed to ensure each teacher used the instructional method assigned to them.

### 3.6 Surveys

Students completed a survey prior to creating the CD-Cover. The survey was accessible by computer via the Internet and all responses were recorded using data aggregation software. Students were permitted to skip any question they did not wish to answer and all questions included an explanation for easier understanding. The survey consisted of 10 questions; questions were multiple choice or based on a Likert scale and related to demographics and student perception of varying methods of instruction. These survey questions included items such as: How much experience do you have with multimedia applications on the computer? How familiar are you with computers?

Additionally, students were asked to identify what, in their opinion, is the most effective method of teaching a new computer software application. Students were given options and definitions for each method of instruction. Students differentiated effectiveness of teaching methods for themselves and for their classmates. Students were also asked to identify frequency of use they perceived their teachers using in class. The appendix has a listing of all pre-test survey questions.

Teachers also completed a survey prior to teaching the students. The teacher survey consisted of 20 questions accessible online and data from this survey was recorded using data aggregation software. Teachers were asked to answer each question while thinking only about the specific class the study was being conducted in. Questions surveyed the teachers regarding teaching experience, class size, technology equipment use, teaching style, education, and multimedia application experience. These responses were analyzed to ensure that teachers were similar and that each teacher had a broad base of technology education experience to draw from.

Teachers identified the effectiveness of each of the identified teaching styles in teaching new software applications to students. Teachers were also asked to identify personal tendencies, preferences, and effectiveness in utilizing different methods for their classroom. Teacher responses were compared with student responses to determine what relationship teacher-student perceptions have in regards to use of instructional methods and overall effectiveness of different instructional methods.

Teachers were asked questions relating to their students grade point average, socioeconomic status, computer experience, multimedia application experience, and average class assignment grade. These results (Appendix: Table 7-2) were cross-analyzed with similar questions posed to students (Appendix: Table 7-1) to check data validity and reliability. Results were used to check that items such as student computer experience and average grade on assignments were comparable for different classrooms involved in the study.

### 3.7 Classroom Instruction

Each teacher in the study taught *Sketchpad* to the students using one of the outlined methods of instruction. Teachers were not permitted to choose or otherwise determine which method of instruction was assigned to them and were expected to adhere exactly to the assigned method. Teachers were provided with a definition of their method of instruction and asked to adhere strictly to this method of instruction, whether or not they or their students prefer this method of instruction. Teachers introduced the assignment to students, covered the associated rubric, and gave the students a timeline for completion. Teachers then taught the software application to the students and provided other instruction based on their assigned method. Teachers were given a copy of the rubric outlining how the final CD Covers will be graded and provided copies to the students. Each teacher completed the study during the course of two class periods (90 minutes), and recorded him or herself during each class period.

## 3.8 Student Assignment

Students were given a rubric and description of the assignment before working on the computer. Students also received instruction from their teacher and then each student produced a CD-cover for an artist/band of their choice. Students produced the CD-cover either by themselves or in a group, depending on the assigned method of instruction. Students were allowed to ask questions, interact with fellow students, and otherwise behave normally in class, but teachers were expected to adhere to their assigned teaching method when providing any instruction. Students were given approximately 60 minutes to complete their CD-Cover. All student CD-Cover files, consent forms, and surveys were collected and returned upon completion. As part of the study, students were informed that their participation in the survey and study would have no impact on their grade and that their final product would not be reflected in their class grade in any way. Teachers were encouraged to collect the files of the student work electronically, but any manner of collection used by the teachers was accepted. Student work was graded at a later date according to the provided rubric by the panel of graders with design background.

## 3.9 Teacher Recording

Teachers recorded themselves while teaching and final recordings were collected and assessed. Video-recordings were assessed according to the rubrics, instructions, and definitions given to the teachers. There were no teacher recordings that were removed from the study for failure to teach according to the prescribed method.

### 3.10 Grading

Students (19) from a college-level design course were joined by their professor in grading student work. Graders received a copy of the rubric and assignment instructions to assist them in grading. Each student-produced CD-cover was assigned a grade on a Likert scale from 1-5 by each of the graders. This scale used for grading matched the provided rubric given to teachers and students. Graders were blind to the student name, class, or instructional method while grading. Graders used an online data entry program for recording scores. Graders were given as much time as they deemed necessary to look at each CD-Cover and assign a grade before they proceeded to the next CD-Cover for grading. Student scores were compiled from each grader and an average score for each student and then each class was obtained. The average grade received by students from each class was compared with the instructional method used in that class in an attempt to identify effectiveness of each method.

### 3.11 Data Analysis

Student demographic information was analyzed to check for similar populations, similar familiarity with technology and computers, and similar experience in multimedia classroom settings (Appendix: Table 7-1; Table 7-2). The average scores for student work, as graded by the panel of graders, in each class was obtained and compared with the method of instruction provided, resulting in an average score for each method of instruction. Additionally, surveys for teachers and students were collected and cross-analyzed using various statistical and practical tests. The student's perceptions of methods used in the classroom were compared with the methods identified by the teachers in an effort to identify similarities and disparities in perceptions of instructional methods used in class.

Data was aggregated for statistical analysis. Two specific measures of significance were performed with regards to the data – a t-test and an effect-size test.

### 3.12 T-test

Using the mean scores for each response or grade a t-test was performed. A t-test assesses whether the means of two groups are statistically significant from each other. This is accomplished by dividing the difference in means by the standard error of the difference. The formula for the standard error of the difference (Equation 1) takes the variance for each group and divides it by the number of people in that group. These values are added and the square root of the sum is taken.

$$SE(\mu_{Group_1} - \mu_{Group_2}) = \sqrt{\frac{\text{var}\,iance_{Group_1}}{n_{Group_1}} + \frac{\text{var}\,iance_{Group_2}}{n_{Group_2}}} \quad (3\text{-}1)$$

The formula for a t-test (Equation 2) evaluates not only the difference in the means of two sample groups, but takes into account the variance in each of the sample groups. By comparing difference in means and difference in variance an accurate measure of the statistical significance can be obtained.

$$t = \frac{\mu_{Group_1} - \mu_{Group_2}}{\sqrt{\frac{\text{var}\,iance_{Group_1}}{n_{Group_1}} + \frac{\text{var}\,iance_{Group_2}}{n_{Group_2}}}} \quad (3\text{-}2)$$

The resulting value (t), is compared with a table of significance (Table 3-1) using the alpha level (for our study we used an alpha level of 0.05; meaning there is a 5 in 100 chance that the results of the study were a matter of mere chance) and the degrees of freedom (df = (n1+n2) - 2). Using the sample size for this study (between 17 and 100 for sample groups), if t < -2.04 or t > 2.04 a statistical significance is shown with an alpha level of 0.05.

**Table 3-1: Table of Statistical Significance**

| **Degrees of Freedom** | **Probability, p** | | | |
|---|---|---|---|---|
| | **0.1** | **0.05** | **0.01** | **0.001** |
| 1 | 6.31 | 12.71 | 63.66 | 636.62 |
| 2 | 2.92 | 4.30 | 9.93 | 31.60 |
| 3 | 2.35 | 3.18 | 5.84 | 12.92 |
| 4 | 2.13 | 2.78 | 4.60 | 8.61 |
| 5 | 2.02 | 2.57 | 4.03 | 6.87 |
| 6 | 1.94 | 2.45 | 3.71 | 5.96 |
| 7 | 1.89 | 2.37 | 3.50 | 5.41 |
| 8 | 1.86 | 2.31 | 3.36 | 5.04 |
| 9 | 1.83 | 2.26 | 3.25 | 4.78 |
| 10 | 1.81 | 2.23 | 3.17 | 4.59 |
| 11 | 1.80 | 2.20 | 3.11 | 4.44 |
| 12 | 1.78 | 2.18 | 3.06 | 4.32 |
| 13 | 1.77 | 2.16 | 3.01 | 4.22 |
| 14 | 1.76 | 2.14 | 2.98 | 4.14 |

**Table 3-1 Continued: Table of Statistical Significance**

| Degrees of Freedom | Probability, p | | | |
|---|---|---|---|---|
| | **0.1** | **0.05** | **0.01** | **0.001** |
| 15 | 1.75 | 2.13 | 2.95 | 4.07 |
| 16 | 1.75 | 2.12 | 2.92 | 4.02 |
| 17 | 1.74 | 2.11 | 2.90 | 3.97 |
| 18 | 1.73 | 2.10 | 2.88 | 3.92 |
| 19 | 1.73 | 2.09 | 2.86 | 3.88 |
| 20 | 1.72 | 2.09 | 2.85 | 3.85 |
| 21 | 1.72 | 2.08 | 2.83 | 3.82 |
| 22 | 1.72 | 2.07 | 2.82 | 3.79 |
| 23 | 1.71 | 2.07 | 2.82 | 3.77 |
| 24 | 1.71 | 2.06 | 2.80 | 3.75 |
| 25 | 1.71 | 2.06 | 2.79 | 3.73 |
| 26 | 1.71 | 2.06 | 2.78 | 3.71 |
| 27 | 1.70 | 2.05 | 2.77 | 3.69 |
| 28 | 1.70 | 2.05 | 2.76 | 3.67 |
| 29 | 1.70 | 2.05 | 2.76 | 3.66 |
| 30 | 1.70 | 2.04 | 2.75 | 3.65 |
| 40 | 1.68 | 2.02 | 2.70 | 3.55 |
| 27 | 1.70 | 2.05 | 2.77 | 3.69 |
| 28 | 1.70 | 2.05 | 2.76 | 3.67 |

The principles upon which the t-test and an ANOVA were developed (i.e. random selection and random assignment) were not possible for this study. Although the sample size is significantly large (total students = 230, average n = 45), it was not possible to randomly assign instructional methods to students in the same classroom. Despite these arguments the t-test, when computed on all students scores returned a p-value of 0.0085 suggesting that the mean scores from the students receiving different instructional methods are statistically significant.

### 3.13 Effect Size

In order to strengthen validity of the findings, an effect size was also computed for each comparison. An effect size allows for practical and educational significance among values to be obtained. An effect size ("*d*," sometimes referred to as "*cohen's d"*") was defined by Cohen as "small, d = 0.2," "medium, d = 0.5," and "large, d = 0.8." (Cohen, 1992)

An effect size is a metric, which enables researches to investigate the magnitude of the differences between mean scores or relationships between variables in a sample or population. Effect sizes are computed using the difference in mean from each group divided by the pooled standard deviation (Equation 3-3, Equation 3-4). Because effect sizes are independent of sample size and scale, they can be used to compare results from different studies and provide practical significance.

$$ES(d) = \frac{\overline{X}_{Group_1} - \overline{X}_{Group_2}}{SD_{Pooled}} \qquad (3\text{-}3)$$

$$SD_{Pooled} = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2}} \tag{3-4}$$

Effect sizes can also be interpreted in terms of the percentage of nonoverlap for the treated group's scores with the scores from the untreated group. An effect size (d) of 0.8 indicates a nonoverlap of 47.4%, meaning, 47.4% of the values for each group do not overlap – indicating a large variance in values between groups.

**Table 3-2: Cohen's d, Table of Significance**

| Cohen's Standard | Effect Size (d) | Percent of Nonoverlap |
|---|---|---|
| | 2.0 | 81.1% |
| | 1.9 | 79.4% |
| | 1.8 | 77.4% |
| | 1.7 | 75.4% |
| | 1.6 | 73.1% |
| | 1.5 | 70.7% |
| | 1.4 | 68.1% |
| | 1.3 | 65.3% |
| | 1.2 | 62.2% |
| | 1.1 | 58.9% |

**Table 3-2 Continued: Cohen's d, Table of Significance**

| Cohen's Standard | Effect Size (d) | Percent of Nonoverlap |
|---|---|---|
| | 1.0 | 55.4% |
| | 0.9 | 51.6% |
| **LARGE** | 0.8 | 47.4% |
| | 0.7 | 43.0% |
| | 0.6 | 38.2% |
| **MEDIUM** | 0.5 | 33.0% |
| | 0.4 | 27.4% |
| | 0.3 | 21.3% |
| **SMALL** | 0.2 | 14.7% |
| | 0.1 | 7.7% |
| | 0.0 | 0% |

Several variables are used when calculating effect size including r, d, and $d^2$. For an effect size, "r" represents the difference between the means of the experimental group and the control group divided by the control group standard deviation (Equation 5).

$$r = \frac{\mu_{Group1} - \mu_{Group_2}}{SD_{Group_1}} \qquad (3\text{-}5)$$

By comparing an $r^2$ value to the statistical table associated with Cohen's d (Table 3-2), conclusions regarding practical significance can be obtained. The $r^2$ value represents the percentage of the variance in values that is associated with a given variable. The $r^2$ values of 0.01, 0.06, and 0.138 represent a small, medium, and large significance in variance.

# 4 FINDINGS

This chapter includes a reporting and an analysis of the collected data, and outlines the most prevalent findings. The most prevalent findings of this study are: (a) teachers and students have different perceptions about effectiveness of different instructional techniques; (b) teachers and students have different perceptions regarding frequency of use of instructional methods in class; and (c) student perceptions of higher instructional effectiveness did not correspond with higher grades received for the assignment. Each finding was analyzed statistically by a comparison of mean values (t-test) and through an effect size test (Cohen's d) to check for significance.

Significance and findings from this study may not be applicable to all students, schools, learning environments, and situations because of the participant demographics. For example most students participating in this study were between 12-13 years old, and reported an average GPA of 3.38 (See Appendix: Table 7-1; Table 7-2). Over 64% of the students reported being enrolled in two or more classes related to technology at the time the study was conducted. Students in this study also considered their learning in technology classes as slightly better when related to other classes they are currently enrolled in. Students self-evaluated themselves as very familiar with computers at the time this study was taken. For the study no time was taken to orient students in basic computer skills and navigation – this suggests that the findings for this study are most applicable to those with sufficient computer experience (teachers estimated their students had 30-40 hours of computer experience prior to the study).

## 4.1 Teachers and Students Have Different Perceptions About Effectiveness of Different Instructional Techniques.

There is a disconnect between what teachers and student perceive as effective instructional techniques. 1.) Student's perceive book learning to be the most effective method of instruction for themselves and their classmates. 2.) Teachers perceived direct instruction as the most effective method of instruction and book learning as the least effective method of instruction.

### 4.1.1 Student's Perceive Book Learning to be the Most Effective Method of Instruction for Themselves and Their Classmates.

Students were surveyed in regard to what instructional practice they perceived as best for their classmates. A Likert scale 1-5 was used to record their answers. Students ranked book learning above all other forms of learning in effectiveness for their classmates learning (Table 4-1). When compared with the other methods of instruction (Table 4-2), the variance between responses showed statistical significance ($t = 2.57, 4.01, 4.06, 3.6$): students believe their classmates learn best with book-based learning. Students were not asked what method they prefer, rather, students were asked what method of instruction is the most effective.

**Table 4-1: Student Ranking of Effectiveness of Instructional Methods for their Classmates' Learning**

| Instructional Method | Mean Score |
|---|---|
| **Book/written script tutorial learning**<br>**A form of learning in which the majority of learning involves students reading from books/written scripts, taking notes, and making applications.** | 3.04 |

**Table 4-1 Continued: Student Ranking of Effectiveness of Instructional Methods for their Classmates' Learning**

| Instructional Method | Mean Score |
|---|---|
| **Direct Instruction**<br>**Explicit teaching of a skill-set using lectures or demonstrations of the material** | 2.63 |
| **Collaborative learning**<br>**A situation in which two or more people learn or attempt to learn something together.** | 2.57 |
| **Video-based tutorial learning**<br>**A form of learning in which students watch videos/tutorials that guide them through the mastery of specific skills.** | 2.55 |

The difference between the two highest ranked methods (Book learning and Problem-based learning), in regards to effectiveness for classmates, is 0.28 (3.04-2.76) and indicates statistical significance at the 0.05 level (t = 2.57; Table 4-2). This means that students not only perceive book learning as the most effective for their classmates but the gap between book learning and the next most effective method (problem based learning) is statistically significant – suggesting an important difference for students between the effectiveness of each method of instruction.

**Table 4-2: Statistical Analysis of Student Ranking of Instructional Methods for their Classmates' Learning**

| Data sets compared | Mean | Std. Deviation | *t* | *d* | *r* | $r^2$ |
|---|---|---|---|---|---|---|
| **Book / Problem Based Learning** | 3.04; 2.76 | 1.28; 1.02 | 2.57 | 0.24 | 0.12 | 0.014 |
| **Book / Video-tutorial** | 3.04; 2.55 | 1.28; 1.33 | 4.01 | 0.37 | 0.18 | 0.032 |
| **Book / Collaborative** | 3.04; 2.57 | 1.28; 1.19 | 4.06 | 0.38 | 0.19 | 0.032 |
| **Book / Direct** | 3.04; 2.63 | 1.28; 1.14 | 3.6 | 0.34 | 0.17 | 0.029 |
| **Problem Based Learning/ Direct** | 2.76; 2.63 | 1.02; 1.14 | 1.28 | 0.12 | 0.06 | 0.003 |
| **Problem Based Learning / Video** | 2.76; 2.55 | 1.02; 1.33 | 1.90 | 0.18 | 0.09 | 0.008 |

**Table 4-2 Continued: Statistical Analysis of Student Ranking of Instructional Methods for their Classmates' Learning**

| Data sets compared | Mean | Std. Deviation | t | d | r | $r^2$ |
|---|---|---|---|---|---|---|
| **Problem Based Learning / Collaborative** | 2.76; 2.57 | 1.02; 1.19 | 1.83 | 0.17 | 0.09 | 0.008 |
| **Video / Direct** | 2.55; 2.63 | 1.33; 1.14 | 0.69 | 0.06 | 0.03 | 0.001 |
| **Video / Collaborative** | 2.55; 2.57 | 1.33; 1.19 | 0.17 | 0.02 | 0.01 | 0.0002 |
| **Direct / Collaborative** | 2.63; 2.57 | 1.14; 1.19 | 0.55 | 0.05 | 0.03 | 0.001 |

Book learning when compared with each of the other identified teaching methods was the only method to show statistical significance in the average mean difference in *every comparison* (ex. Book learning compared with video-tutorial; book learning compared with direct instruction; book learning compared with problem-based learning; and book learning compared with collaborative learning). No other method demonstrated such statistical significance; students perceive book learning a much more effective method of instruction as compared to all others for their classmates learning. The difference students perceived between the effectiveness of others methods of instruction (each method other than book as compared with other methods) was not statistically significant.

Several possible reasons could be cited for this perception. First, books often include images, graphs, screenshots, step-by-step instructions, and other effective tools, which assist the learning of a new computer software application. Although video tutorials can provide similar media content, books allow students the ability to tangibly hold the instructional material, and go at their own pace of learning. A book can be easily consulted for questions (Kamil, 2010) and can help the reader to access needed information quickly and repeatedly if needed.

Second, it is possible that student perception is skewed by the common practice of book learning – and they simply assume that book learning is the best way. Up through and including junior high, textbooks are the "primary mediator of learning" (Kamil, 2010) for students in and outside of the classroom. It is possible that students perceive this method of instruction as the most effective due to an increased exposure to this method as compared to others.

Third, developmentally junior high students are not quite ready to be self-learners (where they no longer need as much teacher led learning). In Perry's (1970) theory of intellectual and moral development, Perry states that students begin their development "trusting authority figures", but later seek to know the "right answer" on their own. As students develop and progress they begin to seek their own "right answer" and begin denying authority figures. At the junior high level students are still in the very beginning stages of intellectual and moral development and it is possible that one reason students perceive book learning as so effective is that, with a book, students have a built-in authority figure that they can reference whenever needing to find the "right answer."

Students were also asked to indentify the effectiveness of instructional methods for their own learning. Although learning styles were not taken into account for this research this question did allow students to independently identify which method(s) of instruction are effective for their own learning. Students were not instructed to think about any one particular class or subject in reference to this question.

In addition to perceiving book learning as the most effective method of instruction for their classmate's, students also think that book learning is the most effective method of instruction for their own learning (Table 4-3). Similar to the previous question, students were not asked what method of instruction they preferred, but rather what method of instruction they perceive as the most effective for their own learning. The difference in average scores of effectiveness for book learning when compared with each other method was statistically significant (Table 4-4; t = 2.64, 4.54, 3.17, 2.93). Additionally, when compared for educational significance each variance for book learning compared to other forms of learning showed educational significance (*d* = 0.25, 0.43, 0.3, 0.27).

**Table 4-3: Student Ranking of Effectiveness of Instructional Methods for their own Learning**

| Instructional Method | Mean Score |
|---|---|
| **Book/written script tutorial learning**<br>**A form of learning in which the majority of learning involves students reading from books/written scripts, taking notes, and making applications.** | 3.02 |
| **Problem based learning**<br>**A student-centered instructional strategy in which students collaboratively solve problems and reflect on their experiences.** | 2.71 |
| **Direct Instruction**<br>**Explicit teaching of a skill-set using lectures or demonstrations of the material** | 2.66 |
| **Collaborative learning**<br>**A situation in which two or more people learn or attempt to learn something together.** | 2.63 |
| **Video-based tutorial learning**<br>**A form of learning in which students watch videos/tutorials that guide them through the mastery of specific skills.** | 2.45 |

**Table 4-4: Statistical Analysis of Student Ranking of Effectiveness of Instructional Methods for their own Learning**

| Data sets compared | Mean | Std. Deviation | $t$ | $d$ | $r$ | $r^2$ |
|---|---|---|---|---|---|---|
| **Book / Problem Based Learning** | 3.02; 2.71 | 1.34; 1.16 | 2.64 | 0.25 | 0.12 | 0.01 |
| **Book / Video-tutorial** | 3.02; 2.45 | 1.34; 1.34 | 4.54 | 0.43 | 0.21 | 0.04 |
| **Book / Collaborative** | 3.02; 2.63 | 1.34; 1.29 | 3.17 | 0.3 | 0.15 | 0.02 |
| **Book / Direct** | 3.02; 2.66 | 1.34; 1.29 | 2.93 | 0.27 | 0.14 | 0.02 |
| **Problem Based Learning / Video** | 2.71; 2.45 | 1.34; 1.34 | 2.07 | 0.19 | 0.1 | 0.01 |
| **Problem Based Learning / Direct** | 2.71; 2.66 | 1.34; 1.29 | 0.41 | 0.04 | 0.02 | 0.0004 |
| **Problem Based Learning / Collaborative** | 2.71; 2.63 | 1.34; 1.29 | 0.65 | 0.06 | 0.03 | 0.001 |
| **Video / Direct** | 2.45; 2.66 | 1.34; 1.29 | 1.71 | 0.16 | 0.08 | 0.006 |
| **Video / Collaborative** | 2.45; 2.63 | 1.34; 1.29 | 1.46 | 0.14 | 0.07 | 0.005 |
| **Collaborative / Direct** | 2.63; 2.66 | 1.34; 1.29 | 0.24 | 0.02 | 0.01 | 0.0001 |

Despite the increase in availability and use of online video tutorials (Tew, 2007), students still perceive book learning as much more effective than learning from a video-tutorial. Not only did these students rank book learning as more effective than video-tutorials, students rank video-tutorials as the least effective of methods of instruction.

When comparing various learning settings it also appears that at the Junior High level students believe working alone is more effective than working with others. Book learning is typically an individual learning process, which allows students the autonomy to perform and achieve at their own desired level. A self-paced learning environment (book learning) was ranked as the most effective for their learning and their classmates learning. Because no question was posed to students regarding preferences it is unknown whether or not students prefer to work alone or simply regard it as more effective.

Although students believe working alone in a book based environment for the purposes of learning a new software application is most effective, students do not appear to think working in groups is completely ineffective. The data suggests that group work (collaborative learning) is considered effective as long as they are working with a common problem (problem-based learning) in mind. Problem-based learning was ranked as second in effectiveness by students for their own learning and the learning of their peers. One reason students may prefer problem-based learning to collaborative learning is the inherent group goal of solving the problem provides the group direction and unity.

It is equally important to note that students in this study ranked the effectiveness of instructional methods for themselves in the exact same order as they reported for their classmates. Although no learning style preferences were considered in this study, the data suggests that students perceive personal and peer learning styles to be similar.

### 4.1.2 Teachers Perceived Direct Instruction as the Most Effective Method of Instruction and Book Learning as the Least Effective Method of Instruction

In addition to student perceptions regarding most effective learning methods, teacher's perceptions were recorded and analyzed. Teachers were asked to rate the identified methods according to their perceived level of effectiveness in their class. Similar to the ranking system used by students, teachers used a 5-point Likert scale (1 = not effective; 5 = very effective) when ranking each method of instruction.

The findings reveal that teachers believe direct instruction is superior to all other methods of instruction – not surprisingly the teachers also reported that they most commonly use direct instruction in class, as compared with the other noted teaching methods. When the variance between response means for direct instruction and the other methods of instruction were compared, direct instruction was reported by teachers to be almost twice as effective as any of the other instructional methods (see Table 4-5).

**Table 4-5: Teacher Ranking of Effectiveness of Instructional Methods for Student Learning**

| Method of Instruction | Mean Score |
|---|---|
| **Book/written script tutorial learning**<br>**A form of learning in which the majority of learning involves students reading from books/written scripts, taking notes, and making applications.** | 2 |
| **Problem based learning**<br>**A student-centered instructional strategy in which students collaboratively solve problems and reflect on their experiences.** | 2.6 |
| **Collaborative learning**<br>**A situation in which two or more people learn or attempt to learn something together.** | 2.6 |
| **Video-based tutorial learning**<br>**A form of learning in which students watch videos/tutorials that guide them through the mastery of specific skills.** | 2.8 |
| **Direct Instruction**<br>**Explicit teaching of a skill-set using lectures or demonstrations of the material** | 4.6 |

Converse to what students reported as their preferred learning style, teachers believed that book learning is the least effective method of instruction for students. The difference in mean score for direct instruction when compared with other forms of instruction (Table 4-6) returned a t-test value of 5.09, 4.27, 3.53, and 2.55 – all showing a statistically significant teacher preference towards direct instruction. The effect size for each comparison was likewise significant (d = 3.22, 2.7, 2.23, 1.61) at the 0.05 level in each case.

**Table 4-6: Statistical Analysis of Teacher Ranking of Effectiveness of Instructional Methods for Student Learning**

| Data sets compared | Mean | Std. Deviation | *t* | *d* | *r* | $r^2$ |
|---|---|---|---|---|---|---|
| **Direct / Book** | 4.6; 2 | 0.55; 1 | 5.09 | 3.22 | 0.85 | 0.72 |
| **Direct / Problem-based learning** | 4.6; 2.6 | 0.55; 0.89 | 4.27 | 2.7 | 0.8 | 0.64 |
| **Direct / Collaborative** | 4.6; 2.6 | 0.55; 1.14 | 3.53 | 2.23 | 0.75 | 0.56 |
| **Direct / Video** | 4.6; 2.8 | 0.55; 1.48 | 2.55 | 1.61 | 0.63 | 0.4 |
| **Collaborative / Book** | 2.6; 2 | 1.14; 1 | 0.88 | 0.56 | 0.27 | 0.08 |
| **Collaborative / Video** | 2.6; 2.8 | 1.14; 1.48 | 0.24 | 0.15 | 0.08 | 0.01 |
| **Collaborative / Problem-based learning** | 2.6; 2.6 | 1.14; 0.89 | 0 | 0 | 0 | 0 |
| **Book / Video** | 2; 2.8 | 1; 1.48 | 1 | 0.63 | 0.3 | 0.09 |
| **Book / Problem-based learning** | 2; 2.6 | 1; 0.89 | 1 | 0.4 | 0.2 | 0.04 |
| **Video / Problem-based learning** | 2.8; 2.6 | 1.48; 0.89 | 0.26 | 0.16 | 0.1 | 0.01 |

When compared, no other comparison between methods (Collaborative, Book, Video-tutorial, & Problem-based learning – each compared with all other methods) showed a statistical significance in mean values for instructional effectiveness. However, a significant effect size was shown in two cases: teachers reported collaborative learning and video tutorials to both be more effective than book learning.

Teachers and students have very different perceptions regarding the effectiveness of different methods of instruction; in fact, their perceptions of effectiveness of different instructional methods are almost opposite (compare Table 4-1, Table 4-3, and Table 4-5).

## 4.2 Teachers and Students Have Different Perceptions Regarding Which Instructional Methods are Being Used in Class

A comparison was made between student perceptions of instructional methods used in class and teacher perceptions of instructional methods used in class. Students and teachers were asked to specifically think about the class this study was performed in while answering questions. Teachers and students were provided with definitions of each of the identified instructional methods. For this study it was assumed that students and teachers read and understood the definitions of each method and were able to identify method use in class.

### 4.2.1 Students Perceive Book Learning as the Most Commonly Used Method of Instruction in Class and Direct Instruction as the Least Commonly Used Method

Students perceive book/written script learning as the most commonly used instructional method in class (Table 4-7). Book learning is also the method of instruction reported by students as most effective for their own learning (Table 4-3), and the learning of their classmates (Table 4-1). It is worth noting that, direct instruction, which provided the highest grades for students, was perceived by students as the least common method of instruction used by their teachers in class. Direct instruction, ranked by students as least frequently used in class, was also ranked as the least effective instructional method for self and peer learning by the students.

**Table 4-7: Student Ranking of Frequency of Use of Different Instructional Methods in Class**

| Method of Instruction | Mean Score |
|---|---|
| **Book/written script tutorial learning**<br>**A form of learning in which the majority of learning involves students reading from books/written scripts, taking notes, and making applications.** | 3.08 |
| **Problem based learning**<br>**A student-centered instructional strategy in which students collaboratively solve problems and reflect on their experiences.** | 2.94 |
| **Collaborative learning**<br>**A situation in which two or more people learn or attempt to learn something together.** | 2.86 |
| **Video-based tutorial learning**<br>**A form of learning in which students watch videos/tutorials that guide them through the mastery of specific skills.** | 2.73 |
| **Direct Instruction**<br>**Explicit teaching of a skill-set using lectures or demonstrations of the material** | 2.52 |

Problem-based learning, second in effectiveness for peer and self-learning – as reported by students, was perceived by students as the second most common form of instruction used in class. The variance between the reported use of book learning and problem-based learning is not statistically or practically significant (Table 4-8).

**Table 4-8: Statistical Analysis of Student Ranking of Frequency of Use of Different Instructional Methods in Class**

| Data sets compared | Mean | Std. Deviation | $t$ | $d$ | $r$ | $r^2$ |
|---|---|---|---|---|---|---|
| **Book / Problem Based Learning** | 3.07; 2.93 | 1.40; 1.15 | 1.15 | 0.11 | 0.05 | 0.003 |
| **Book / Direct** | 3.07; 2.52 | 1.40; 1.31 | 4.39 | 0.41 | 0.2 | 0.04 |
| **Book / Collaborative** | 3.07; 2.86 | 1.40; 1.33 | 1.71 | 0.16 | 0.08 | 0.01 |
| **Book / Video** | 3.07; 2.73 | 1.40; 1.33 | 2.73 | 0.25 | 0.13 | 0.02 |
| **Problem Based Learning / Direct** | 2.93; 2.52 | 1.15; 1.31 | 3.62 | 0.34 | 0.17 | 0.03 |
| **Problem Based Learning / Video** | 2.93; 2.73 | 1.15; 1.33 | 1.79 | 0.17 | 0.08 | 0.01 |

**Table 4-8 Continued: Statistical Analysis of Student Ranking of Frequency of Use of Different Instructional Methods in Class**

| Data sets compared | Mean | Std. Deviation | t | d | r | $r^2$ |
|---|---|---|---|---|---|---|
| **Problem Based Learning / Collaborative** | 2.93; 2.86 | 1.15; 1.33 | 0.68 | 0.06 | 0.03 | 0.001 |
| **Video / Direct** | 2.73; 2.52 | 1.33; 1.31 | 1.7 | 0.16 | 0.08 | 0.01 |
| **Video / Collaborative** | 2.73; 2.86 | 1.33; 1.33 | 1.05 | 0.1 | 0.05 | 0.003 |
| **Collaborative / Direct** | 2.86; 2.52 | 1.33; 1.31 | 2.75 | 0.26 | 0.13 | 0.02 |

Direct instruction, perceived as third most effective for classmates and personal learning, is reported by students as the least used method of instruction in class. When compared with each other method of instruction, direct instruction demonstrated a statistically significant variance in mean values (t = 4.39, 3.62, 1.7, 2.75). The data suggests a significant difference in perceived frequency of use of direct instruction – students perceive direct instruction as being used significantly less than other methods of instruction. In addition to a significant t-test value, a small or medium effect size was shown in three out of four of the comparisons for direct instruction (d = 0.34, 0.26, 0.16, 0.41).

Students perceived teachers using book learning more than any other method of instruction in class (t = 1.158, 4.39, 1.71, 2.73) and much more than direct instruction (t = 4.39). This was surprising because technology education has historically used an "apprenticeship model-follow approach" as it's primary form of instructional practice (see Foster, 1996; Mossman, 1924; Anderson, 1926; Barella & Wright, 1981; Snyder, 1992), where the instructor models a particular method and pupils mirror instructor movements until mastery has taken place.

The comparison of book learning and video tutorials shows statistical and practical significance. Students perceive their teachers as using books to teach materials far more frequently than videos or other multimedia, despite the digital nature of the classroom environment. This was surprising considering the nature of a "technology" class where computers, graphics, and other media are so commonly used.

### 4.2.2 Teachers Report Direct Instruction as the Most Commonly Used Method in Class and Book Learning as the Least Commonly Used Method

Students reported book learning as the most commonly used method of instruction in class and direct instruction as the least commonly used method. Conversely, teacher self-reports of instructional methods do not match student responses – in fact, they were almost opposite. Teachers were also asked to report their use of the identified methods of instruction in the particular class the study was performed in. Teachers were instructed to use a 5-point Likert scale (1 = used infrequently; 5 = used frequently) when evaluating their use of each method of instruction.

Teachers reported using direct instruction far more than any other method of instruction (see Table 4-9). When compared for statistical and educational significance (Table 4-10), the comparison of direct instruction use with every other method of instruction was highly significant ($t = 4.7, 4.7, 3.29, 2.8$). Book learning, which was ranked by the students as the most perceived method of instruction used by the teacher, was ranked among the least used methods (similar to problem-based learning) when reported by the teacher.

**Table 4-9: Teacher Ranking of Frequency of Use of Different Instructional Methods in Class**

| Method of Instruction | Mean Score |
|---|---|
| **Book/written script tutorial learning**<br>**A form of learning in which the majority of learning involves students reading from books/written scripts, taking notes, and making applications.** | 2.4 |
| **Problem based learning**<br>**A student-centered instructional strategy in which students collaboratively solve problems and reflect on their experiences.** | 2.4 |
| **Collaborative learning**<br>**A situation in which two or more people learn or attempt to learn something together.** | 2.8 |
| **Video-based tutorial learning**<br>**A form of learning in which students watch videos/tutorials that guide them through the mastery of specific skills.** | 2.4 |
| **Direct Instruction**<br>**Explicit teaching of a skill-set using lectures or demonstrations of the material** | 4.6 |

Direct instruction was reported as being used significantly more than any other method (4.6 average rating compared with 2.8 for collaborative learning, ranked second). When compared with the other methods (Table 4-10) of instruction the variance was statistically significant in each comparison (t = 4.7, 4.7, 3.29, 2.8). When compared for an effect size, educational significance was also found in each scenario (d = .083, 0.83, 0.72, 0.66).

**Table 4-10: Statistical Analysis of Teacher Ranking of Frequency of use of Different Instructional Methods in Class**

| Data sets compared | Mean | Std. Deviation | t | d | r | $r^2$ |
|---|---|---|---|---|---|---|
| **Direct / Book** | 4.6; 2.4 | 0.55; 0.89 | 4.7 | 2.97 | 0.83 | 0.69 |
| **Direct / Problem-based learning** | 4.6; 2.4 | 0.55; 0.89 | 4.7 | 2.97 | 0.83 | 0.69 |
| **Direct / Collaborative** | 4.6; 2.8 | 0.55; 1.09 | 3.29 | 2.09 | 0.72 | 0.52 |
| **Direct / Video** | 4.6; 2.4 | 0.55; 1.67 | 2.8 | 1.77 | 0.66 | 0.44 |
| | | | | | | |
| **Collaborative / Book** | 2.8; 2.4 | 1.09; 0.89 | 0.64 | 0.4 | 0.2 | 0.04 |
| **Collaborative / Video** | 2.8; 2.4 | 1.09; 1.67 | 0.45 | 0.28 | 0.14 | 0.02 |

**Table 4-10 Continued: Statistical Analysis of Teacher Ranking of Frequency of use of Different Instructional Methods in Class**

| Data sets compared | Mean | Std. Deviation | t | d | r | $r^2$ |
|---|---|---|---|---|---|---|
| **Collaborative / Problem-based learning** | 2.8; 2.4 | 1.09; 0.89 | 0.64 | 0.4 | 0.2 | 0.04 |
| **Book / Video** | 2.4; 2.4 | 0.89; 1.67 | 0 | 0 | 0 | 0 |
| **Book / Problem-based learning** | 2.4; 2.4 | 0.89; 0.89 | 0 | 0 | 0 | 0 |
| **Video / Problem-based learning** | 2.4; 2.4 | 1.67; 0.89 | 0 | 0 | 0 | 0 |

Perceptions for students and teachers are very different regarding instructional method used in class. Students perceived direct instruction as the least used method (mean rating of 2.52, 5-point Likert scale) as compared with teachers (mean rating of 4.6, 5-point Likert scale). The difference in student and teacher perceptions is alarming when considering that students and teachers both show strong leanings about which method of instruction is most effective.

Collaborative learning, ranked second by teachers in frequency used, when compared with other methods of instruction showed educational significance (d = 2.09, 0.4, 0.28, 0.4) for each comparison – teachers use collaborative learning strategies more than other methods of instruction. Collaborative learning was the only method, other than direct instruction, that received a ranking, which set it apart from the other methods (all other methods received an average of 2.4 when ranked by teachers).

Teachers report using book learning, video tutorials, and problem-based learning in similar frequencies in their classrooms. Because book, video, and problem based learning all were reported with the same average mean, no statistical significance can be inferred from any of the comparisons between these instructional methods.

## 4.3 Student Perceptions of Higher Instructional Effectiveness did not Correspond with Higher Grades Received for the Assignment

Each student produced a CD Cover using the software application taught in class. Students were given approximately 60 minutes to create their CD Cover and turn it in electronically. A random selection of 17 CD covers for each method was compiled into a slideshow consisting of a total of 85 CD covers. CD Covers for grading were presented to graders in a random order for grading and associated grade data was aggregated following the grading period.

A panel of 20 graders with design background graded the student work. Graders were blind as to the method of instruction received, and graded student work on a 1-5 Likert scale. A grading rubric was provided to the graders (see Appendix).

Student grades for each group were combined and a class average grade was obtained (Table 4-11). Each class average was compared and analyzed to determine how effective each method of instruction proved to be in respect to student performance and grade given. The data shows that students receiving direct instruction scored higher than any other method of instruction. When compared with other methods of instruction (Table 4-12) a significant difference in variance between scores for students receiving direct instruction and those receiving other instructional methods was shown for multiple comparisons ($t = 2.65, 0.45, 2.63, 0.95$).

**Table 4-11: Average Grade Received by Students – Separated by Instructional Method Used**

| Instructional Method Received | Avg. Grade |
|---|---|
| **Direct Instruction** | 3.02 |
| **Problem Based Learning** | 2.95 |
| **Book / Written Tutorial Learning** | 2.87 |
| **Video Tutorial-based Learning** | 2.49 |
| **Collaborative Learning** | 2.43 |

**Table 4-12: Statistical Analysis of Average Grade Received by Students - Separated by Instructional Method Used**

| Data sets compared | Mean | Std. Deviation | $t$ | $d$ | $r$ | $r^2$ |
|---|---|---|---|---|---|---|
| **Direct / Collaborative** | 3; 2.43 | 0.48; 0.52 | 2.65 | 1.13 | 0.49 | 0.232 |
| **Direct / Problem Based Learning** | 3; 2.95 | 0.48; 0.32 | 0.44 | 0.12 | 0.06 | 0.002 |
| **Direct / Video-tutorial** | 3; 2.48 | 0.48; 0.70 | 2.63 | .866 | 0.40 | 0.016 |
| **Direct / Book-written** | 3; 2.86 | 0.48; 0.24 | 0.94 | .369 | 0.18 | 0.032 |
| **Book / Collaborative** | 2.86; 2.43 | 0.24; 0.53 | 2.41 | 1.05 | 0.46 | 0.211 |
| **Book / Problem Based Learning** | 2.86; 2.95 | 0.24, 0.32 | 0.77 | 0.32 | 0.16 | 0.025 |
| **Book / Video-tutorial** | 2.86; 2.48 | 0.24; 0.70 | 1.71 | 0.73 | 0.34 | 0.116 |
| **Video / Collaborative** | 2.48; 2.43 | 0.70; 0.53 | 0.19 | 0.08 | 0.04 | 0.002 |
| **Video / Problem Based Learning** | 2.48; 2.95 | 0.70; 0.32 | 2.63 | 0.86 | 0.40 | 0.16 |
| **Problem Based Learning / Collaborative** | 2.95; 2.43 | 0.32; 0.53 | 3.08 | 1.19 | 0.51 | 0.26 |

When compared with problem-based learning and book/written script learning the t-test value is insufficient to demonstrate statistical significance (t = 0.447 and t = 0.9478). The comparison between direct (receiving the highest mean score from graders) and collaborative learning (receiving the lowest mean score from graders) is statistically significant (t = 2.654), suggesting that students receiving direct instruction received higher grades than those in a collaborative learning classroom. The comparison between direct instruction and video-tutorials showed a similarly significant variance ($t = 2.63$; $d = 0.866$, 48% non-overlap in values between groups); direct instruction appears to also result in higher grades than video-tutorial instruction.

The combined validity of multiple tests (t-test, cohen's d) adds weight to the assertion that direct instruction appears to be more effective than collaborative learning or video-tutorials in helping students score higher when taught a new computer software application at the Junior High level. The large effect size of the comparison between scores of students receiving book learning and students receiving collaborative learning ($d = 1.05$, 55.4% non-overlap in values between groups) denotes a strong level of educational significance, suggesting students can and do learn from books more effectively than collaborative learning situations.

Despite teacher and student perceptions regarding effectiveness and frequency of use of different instructional methods, direct instruction proved to produce the best grades for students when taught a new computer software application. The implications of this finding as well as discussion about impacts are contained in Chapter 5.

# 5 CONCLUSIONS & RECOMMENDATIONS

Teachers of software applications must re-evaluate teaching practices and ensure that their current teaching strategies represent best practices for student learning and achievement. Teachers must consciously and consistently evaluate their own teaching practices and seek to understand the perception of their students. An understanding of student perceptions will help to inform teachers regarding their instructional effectiveness and teaching methods used. Teachers should explicitly ask their students about techniques used in class to discover student perceptions and not rely solely on self-evaluation techniques for discovering effectiveness of instructional methods.

Additionally, teachers are invited to reflect on their own direct instruction. Direct instruction provided the highest average student grade for the assignment. Teachers also reported that direct instruction was the method they used most in class. Despite this, students perceive direct instruction as the least used method of instruction. Teachers need to find ways to improve their own direct instructional techniques and help to improve direct instruction perceptions in the eyes of students – students ranked direct instruction third in overall effectiveness. A lower ranking for effectiveness of direct instruction by students, as well as the perception that direct instruction is the least used method in class are both grounds for reflection among teachers.

Although the data suggests statistical significance for the findings presented in this study, further research must be performed before the findings related to this study are broadly applicable. Based on the findings from this study and the analysis of related data some recommendations can be made for application by teachers of computer software applications to Junior High Students.

## 5.1 Teachers Need to Understand the Perceptions of Their Students in Regards to the Teaching Practices Used in Class.

Teachers must consciously and consistently evaluate their own teaching practices and seek to understand the perceptions of their students. An understanding of student perceptions will help inform teachers regarding their instructional effectiveness and teaching methods used (Hicks, 2010). As shown in this study, oftentimes teacher perceptions of instructional methods being used do not match with methods perceived by students.

Teachers should explicitly ask their students about techniques used in class to discover student perceptions, and not rely solely on self-evaluation techniques for discovering effectiveness of instructional methods. Video recordings and post-teaching analyses (Wright, 2008) have been shown as effective in improving teacher cognition of methods used and improving teaching effectiveness. A simple survey, questionnaire, or even an open discussion with students could also provide such feedback for a teacher.

Oftentimes teachers are hesitant to seek feedback and even more hesitant to implement suggestions from students (L'Hommedieu, 1990). Hesitations stems from many sources: lack of desire to change, refusal to believe that someone less learned than the teacher could provide adequate feedback, comfort with current practices, or belief that a significant improvement will not result when feedback is implemented (L'Hommedieu, 1990).

Teachers must be open and willing to learn from their students and adjust to meet their needs. Classes often demonstrate different personalities, excitement levels, and each student possesses individual learning styles (Kolb, 1984) – teachers must discover these traits that will affect the learning environment and improve student understanding.

### 5.2 Teachers Should Reflect on Their Own Direct Instruction Techniques

In this study, direct instruction provided the highest average student grade for the assignment and was reported by teachers as the most effective instructional method. Aligning with teacher's belief that direct instruction is the most effective method of instruction, teachers also reported using direct instruction significantly more than any other method of instruction. Conversely, students perceived direct instruction as the least used method of instruction in class. Students also ranked book learning and problem-based learning as more effective than direct instruction for their own learning and their classmates learning.

Although students were not asked to offer specific examples of why they ranked instructional methods in the order they did, the difference between direct instruction and other instructional methods was shown to be statistically significant. Teachers should reflect on these findings and assess their own use of direct instruction in the class. A vast library of data including journals, articles, books, and more can be referred to for best practices in direct instruction (Adams, 1996) and teachers should be familiar with current best practices so they can implement them. Additionally, as teachers seek to understand and clarify student perceptions about instructional techniques being used in class, teachers can reflect on their findings and implement ideas to improve student perceptions of direct instruction and it's use in class.

## 5.3 Further Study Needs to be Conducted (Study Delimitations)

Despite the beneficial findings of this research, limitations to this study include:

- Students ranged from 11-13 in age
- No attempt was made to account for learning styles or preferences
- Only one software application was selected and used for this study
- All students included in this study reside in the same school district
- The majority of students were enrolled in their first technology class at the time of this research
- Differing interpretations may exist among students and teachers regarding instructional methods

In light of the limitations, it is recommended that additional research be conducted to further solidify and explore instructional method effectiveness for software application learning. The scope of this research was limited to adolescent students aged 11-13, many of whom were enrolled in their first technology class. A similar study could be conducted among different age groups, among those with differing technology backgrounds, with different types of computer software applications, etc.

No attempt was made to account for learning styles and preferences when administering the survey and assigning instructional methods. Students with different learning styles could show preferences toward a certain instructional method and excel with specific methods of instruction.

As noted in chapter 2, students "travel" through various stages of intellectual development (Perry, 1970). Further research should be conducted among students at different points of intellectual development, thus allowing comparisons to be made between findings, demographics, age, skill level, and other factors that could possibly affect the effectiveness of learning.

Although students and teachers were provided with identical rubrics and definitions of teaching styles it is possible that different perceptions existed between teachers and students. Students ranked direct instruction as the least used method of instruction in class; conversely, teachers ranked direct instruction as the most used method in class. It is possible that although definitions were provided for all participating in the study, different ideas and perceptions exist – resulting in different reporting regarding instructional methods being used in class. Additional research should be conducted to ensure that similar definitions of instructional methods are understood among teachers and students to increase validity of findings.

# 6 SUMMARY

## 6.1 Statement of Problem

This research addresses a problem teachers of computer software applications face today: What is the most effective method of teaching a new computer software application to Junior High students? Technology and Engineering teachers, specifically those with communications and other related courses that involve computer software applications, face this problem almost daily as they guide students through computer software applications designed to assist in graphic design, web design, programming, robotics, and a wide variety of other applications. The question of which method is most effective is one that affects not only teachers, but, trainers, and specialists for all age levels as computers and computer software applications become increasingly important in society. Despite the increase in computer software application use, the associated literature is inconclusive in regards to which method is the most effective.

In an effort to discover the most effective method of teaching a new computer software application to Junior High Students, several other questions were also posed: What method(s) of instruction do students believe to be the most effective for their own learning? What method(s) of instruction do students perceive to be the most effective for their classmates' learning? What methods of instruction do teachers perceive to be the most effective for the students' learning? What methods of instruction do students perceive their teachers using in class? Do student and teacher perceptions of methods being used in class align?

## 6.2 Background

A careful review of the literature associated to computer software instruction reveals contradictory viewpoints as to what method of instruction is the most effective (Lou, 2001). Although the introduction of e-learning, e-classrooms, and distance-education has dramatically effected the instructional environment for teaching software, Haynie's (2005) survey of Technology and Engineering Education leaders reveals that "The 'learn by doing' approach remains the primary teaching method" in technology related classes. However, Haynie does not make claims as to what is the most effective method of instruction. Consequently, "Is 'learning by doing' the most effective method of teaching a new computer software to junior high students?"

## 6.3 Methodology

A thorough literature review on numerous articles relating to technology, technology teaching, teaching best practices, and teaching methodologies was conducted and general trends were recorded. Using the literature review as a basis for the study the five most commonly cited, recommended, and popular methods of teaching computer software applications were identified. These are: direct instruction, problem-based learning, video/tutorial based learning, cooperative/collaborative learning, and book/written script learning. This information was used to develop a research study involving students in technology courses at the Junior High level.

Each teacher participant was asked to complete a survey regarding instructional methods and student performance. The survey asked questions regarding teacher use of the identified instructional methods, their perceptions of each method's effectiveness, and a few questions regarding teaching styles, and instructional method implementation. Students in each of the classes also completed a similar survey with questions relating to their preferences and experiences with the identified methods of instruction and their effectiveness for their own learning and the learning of their classmates.

The five identified instructional methods were used to develop a research study involving adolescent students in computer-based technology course. The research participants were students between the ages of 11 and 13 registered in public junior high or middle schools in the $7^{th}$ or $8^{th}$ grade – an age where an adolescent typically has the option of taking their first class focused solely on computer technology (Utah, 2010).

Demographic information such as grade point average, socioeconomic status, computer experience, and computer-based multimedia application experience was collected. In addition, average technology course grades, and average grade for students in participating classes were collected. Demographic and scholastic information was used to ensure that the sample size was similar in nature and background. Schools and teachers were selected based on similar: facilities, teaching experience, technological training, class sizes, student demographics, and class offerings technological competency.

Each teacher was assigned one of the methods identified in the literature review as the method of instruction they would use when teaching the new software to the students. Teachers were asked to adhere strictly to their assigned instructional method while involved in this study (ex. direct instruction) whether or not it was their personal preference or regularly used teaching style. Instructional methods were assigned randomly to teachers, and teachers were sent an explanation of the teaching style, definitions, examples, outlines, and associated procedures as a guide for their teaching experience. In order to ensure that correct teaching methods were used, teachers recorded themselves while teaching with a video camera, and the recordings were analyzed to ensure the assigned teaching method was in fact used.

Teachers outlined the assignment for their students covering the grading rubric as well as the project timeline. Teachers were informed that they could explain the grading rubric and the expectations in any manner they deemed best and afterward were instructed to provide instruction for the application in the specified manner.

Students were given a rubric and description of the assignment (to create a CD-cover) before working on the computer. A new software application, *Sketchpad*™, was chosen for the study. *Sketchpad*™ is a free online application similar to other image-editing applications which allows for easy access and free image saving.

Students produced the CD-cover either by themselves or in a group, depending on the assigned method of instruction. Students were allowed to ask questions, interact with fellow students, and otherwise behave normally in class, but teachers were expected to adhere to their assigned teaching method when providing instruction. Students were given approximately 60 minutes to complete their CD-Cover. As part of the study students were informed that their participation in the survey and study would have no impact on their grade and that their final product would not be reflected in their class grade in any way. Teachers collected electronic files of student-produced CD-covers and student work was graded at a later date according to the provided rubric by a panel of 20 teacher education majors (graders) possessing design background and experience.

Graders received a copy of the rubric and assignment instructions to assist them in grading. Each student-produced CD-cover was assigned a grade on a Likert scale from 1-5 by each of the graders. This scale matched the provided rubric given to teachers and students. Graders were blind to the student name, class, or instructional method while grading and used an online data entry program for recording scores. Graders were given as much time as they deemed necessary to look at each CD-Cover and assign a grade before they proceeded to the next CD-Cover for grading. Student's scores were compiled from each grader and an average score for each class was obtained. The average grade received by students from each class was compared with the instructional method used in that class in an attempt to identify effectiveness of each method.

The sample size for this study consisted of 226 students from 4 different junior high schools. The junior high schools from Utah reside in the Alpine School District boundary. The average age of participants was 12 yrs old, average grade level of participants was $7^{th}$ grade, and the class used by teachers was *Introduction to Technology*.

## 6.4 Findings

This study revealed several key findings: 1.) There is a disconnect between what teachers and student perceive as effective instructional techniques. 2.) Although students reported book learning as the most effective method of instruction, those receiving direct instruction received the highest grades. 3.) Teachers and students do not agree on the methods of instruction being used in class. Each of these findings will be discussed in turn.

### 6.4.1 There is a Disconnect Between What Teachers and Students Perceive as Effective Instructional Techniques.

There were three differing perceptions identified in this study: 1.) Students believe book instruction is the most effective instructional method for their own learning, 2.) Students believe book learning is the most effective for their peers. 3.) Teachers reported that they believe direct instruction as the most effective instructional method.

*Students believe book instruction is the most effective instructional method for their own learning and their classmates' learning.* Although direct instruction proved to produce the best scores for students, they surprisingly reported that book learning would be best for themselves and their peers. The difference between what students reported were the two most effective instructional techniques for their peers (Book learning and Problem-based learning), was .28 (3.04-2.76) and shows statistical significance ($t = 2.57$). In addition to perceiving book learning as the most effective method of instruction for their classmate's, students also think that book learning is the most effective method of instruction for their own learning. Similar to the previous question students were asked what method of instruction they perceive as the most effective. The difference in average scores of effectiveness for book learning when compared with each other method was statistically significant.

*Teachers believe direct instruction is the most effective method for student learning and book learning is the least effective.* Converse to what students reported as their preferred learning style, teachers believed that book learning is the least effective method of instruction for students. Teachers perceptions of instructional method effectiveness did not only differ from students – they were almost opposite. The difference in mean score for direct instruction when compared with other forms of instruction (Table 4-6) returned a t-test value of 5.09, 4.27, 3.53, and 2.55 – all showing a statistically significant teacher preference towards direct instruction. The effect size for each comparison was likewise significant ($d = 3.22, 2.7, 2.23, 1.61$) at the 0.05 level in each case.

### 6.4.2 Although Students Reported Book Learning as the Most Effective Method of Instruction, Those Receiving Direct Instruction Received the Highest Grades.

The data collected from grading the student work showed that the students who received the highest grades were those taught using direct instruction. Problem-based learning provided the second highest grades, while book/written tutorials was the third, followed by video tutorial, and collaborative learning.

The combined validity of multiple tests (t-test, cohen's d) adds weight to the assertion that direct instruction appears to be more effective than collaborative learning or video-tutorials in helping students score higher when taught a new computer software at the Junior High level. These findings help solidify the argument that although direct instruction "seems to have fallen out of favor in terms of philosophical trends of learning and instruction" (Magliaro, 2005), direct instruction is a highly effective method of helping students to learn a computer software (Schuman, 1998). The large effect size of the comparison between scores of students receiving book learning and students receiving collaborative learning (d = 1.05, 55.4% non-overlap between values) denotes a strong level of educational significance, suggesting students can and do learn from books more effectively than collaborative learning situations.

### 6.4.3 Teachers and Students do Not Agree on the Methods of Instruction Being Used in Class.

Students were asked to identify how often they perceived their teachers using the different identified methods of instruction. Students and teachers were given a definition of each method of instruction as part of the survey. Students and teachers used a 1-5 Likert scale (1 = used infrequently; 5 = used frequently) to rate the frequency each method of instruction was used in class.

Students perceived book/written script learning as the most commonly used instructional method by their teachers to teach them in class. Students also reported that direct instruction, which provided the highest grades for students, as the least common method of instruction used by their teachers in class. Paradoxically, teachers reported using direct instruction more commonly than any other method of instruction, and book learning as the least commonly used method of instruction.

When compared with each other method of instruction, direct instruction demonstrated a statistically significant variance in mean values (t). This suggests that students perceive direct instruction as the least commonly used method of instruction (mean rating of 2.52, 5-point Likert scale), and that direct instruction is perceived by students as used significantly less than all the other methods of instruction (book learning, video tutorials, self-study techniques, collaborative learning, problem based learning).

Teacher responses of the same survey questions were compared with the student responses. Opposite to what the students stated, teachers reported using direct instruction far more than any other method of instruction (4.6 average out of 5, based on a 5-point Likert scale ($t = 4.7, 3.29, 2.8$)). When compared for statistical significance, the comparison of direct instruction with the other methods of instruction was highly significant. Book learning, which was ranked by the students as the most commonly used method, was reported by teachers as the least used method.

## 6.5 Conclusion and Recommendations

The findings of this study suggest that teachers of computer software must re-evaluate teaching practices and ensure that their current teaching strategies represent best practices for student learning and achievement.

Teachers should reflect on the findings of this study and their own direct instruction use in class. Although direct instruction provided the highest average student grade for the assignment in this study, students reported that their teachers rarely use direct instruction. Even the students in this study who explicitly received direct instruction, reported that they received other types of instruction much more frequently. Teachers need to find ways to improve their own direct instructional techniques and help to improve direct instruction perceptions in the eyes of students (i.e., they need to be more creative, innovative, engaging, and proactive with such techniques as good board/projection displays, proximity, etc.). There is a vast library of research related to best practices and direct instructional techniques that could be used to facilitate this improvement.

Teachers also need to be aware of student perceptions of their teaching, and of student learning styles. An understanding of student perceptions will help inform teachers regarding their instructional effectiveness and teaching methods used (Hicks, 2010). Teachers should explicitly ask their students about instructional methods use in class the effectiveness of differing methods for student learning. Oftentimes teachers are hesitant to seek feedback and even more hesitant to implement suggestions from students. Hesitations stems from many sources: lack of desire to change, refusal to believe that someone less learned than the teacher could provide adequate feedback, comfort with current practices, or belief that a significant improvement will not result when feedback is implemented (L'Hommedieu,1990). Teachers must be open and willing to learn from their students and adjust to meet their needs. Classes often demonstrate different personalities, excitement levels, and each student possesses individual learning styles (Kolb, 1984) – teachers must discover these traits that will affect the learning environment and improve student understanding.

## 7 REFERENCES


Adams, G. L. and S. Engelmann. 1996. *Research on direct instruction: 25 years beyond DISTAR*.

Albanese, M. A. 1993. Problem-based learning: A review of literature on its outcomes and implementation issues. *Academic Medicine* 68, no. 1: 52-81.

Anderson, L. 1926. *A history of manual and industrial school education*. New York: Appleton.

Barella, R. and R. Wright. 1981. *An interpretive history of industrial arts*. Bloomington, Illinois: McKnight.

Barlow, M. L. 1976. *Implications from the history of vocational education*. Columbus: Center for Vocational Education, Ohio State University

Barrows, H. S. 1996. Problem-based learning in medicine and beyond: A brief overview. *New Directions for Teaching and Learning* no. 68: 3-12.

Belenky, M. F., B. M. Clinchy, N. R. Goldberger, and J. M. Tarule. 1986. *Women's ways of knowing: The development of self, voice, and mind*. New York: Basic Books.

Bennett, C. A. 1967. *History of manual and industrial education up to 1870*. Peoria, Illinois.

Bloom, B. S. 1956. *Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain*. New York: David McKay Co Inc.

Bock, G., L. Stebbins, and E. Proper. 1977. Education as experimentation: A planned variation model (Volume IV-A & B). *Effects of follow through models*. Washington, D.C.: Abt. Associates.

Bork, A. 2001. Tutorial learning for the new century. *Journal of Science Education and Technology* 10, no. 1: 57-71.

Bork, A. 2000. Learning technology. *EDUCAUSE Review* 35, no. 1: 74-81.

Brown, A. L. 1994. The advancement of learning. *Educational Researcher* 23, no. 8: 4-12.

Brufee, K. 1993. *Collaborative Learning*. Baltimore: Johns Hopkins University Press.

Cheong, F. 2008. Using a problem-based learning approach to teach an intelligent systems course. *Journal of Information Technology Education* 7, : 47-60.

Clark, R. E. and G. Salomon. 1986. Media in teaching. *Handbook of research on teaching*, ed. M. C. Wittrock. 3rd ed., 464-478. New York: Macmillan.

Corbeil, G. 2007. Can PowerPoint presentations effectively replace textbooks and blackboards for teaching grammar? Do students find them an effective learning tool? *CALICO Journal* 24, no. 3: 631-656.

Costa, M. 2010. Students' perceptions of instructional methods used in postsecondary career and technical education. Ph.D., Capella University ProQuest.

Cohen, J. 1992. A Power Primer. *Psychological Bulletin* 112, no. 1: 155-159

Crook, C. 1998. Children as computer users: The case of collaborative learning. *Computers & Education* 30, no. 3-4: 237-47.

Dickerson, J., S. Williams, and J. B. Browning. 2009. Scaffolding equals success in teaching tablet PCs. *The Technology Teacher* 68, no 5: 16-20

Driscoll, M. P. and Others. 1994. How does the textbook contribute to learning in a middle school science class? *Contemporary Educational Psychology* 19, no. 1: 79-100.

Duch, B. J., S. E. Groh, and D. E. Allen. 2001. The power of problem-based learning. *The power of problem-based learning*, ed. B. J. Duch. 1st ed., 47-53. Sterling, Virginia: Stylus Publishing.

DuDosq, J. F. 2002. Take it to the Next Level: Individualized instruction in technology education. *Tech Directions* 61, no 7

Edmondson, J. and P. Shannon. 2002. The will of the people. *Reading Teacher* 55, no. 5: 452-54.

Egal, S. 2009. Comparative effects of traditional- versus contract activity packaged - versus programmed learning-sequenced versus tactual-instructional presentations of course content on the achievement and attitudes of undergraduate students in a private metropolitan college. ProQuest LLC.

Engineering Accreditation Commission, Accreditation Board for Engineering and Technology Inc. 1998. Engineering criteria 2000: Criteria for accrediting programs in engineering in the United States. In . 2nd ed., 41. Baltimore, Maryland.

Farra, H. 1998. The reflective thought process: John Dewey revisited. *The Journal of Creative Behavior*, 22, no. 1: 1-8

Foster, P. N. 1996. Selected Leaders' perceptions of approaches to technology education. *Journal of Technology Education* 7, no. 2

Gallagher, S. A. 1997. Problem-based learning: Where did it come from, what does it do, and where is it going? *Journal for the Education of the Gifted* 20, no. 4: 332-62.

Garner, R. 1992. Learning from school texts. *Educational Psychologist* 27, : 53-63.

Good, T. L., D. A. Grouws, and Missouri University Columbia College of Education. 1981. *Experimental research in secondary mathematics classrooms: Working with teachers. Final report*.

Guri-Rozenblit, S. 1988. The interrelations between diagrammatic representations and verbal explanations in learning from social science texts. *Instructional Science* 17, no. 3: 219-34.

Haynie, W. J. and W. V. DeLuca. 1991. Perceptions and practices of Technology Student Association advisors on implementation strategies and teaching methods. *Journal of Technology Education* 3, no. 1:4-15

Haynie, W. J., V. W. DeLuca, and B. Matthews. 2005. Perceptions and practices of technology Student Association advisors on implementation strategies and teaching methods. *Journal of Technology Education* 16, no. 2: 25-36.

Hicks, T., L. Lewis, G. Munn, E. Jordon, and K. Charles. 2010. An assessment of teacher education students' perceptions and satisfaction of their learning experiences in a summer pilot program. *College Quarterly* 13, no. 1.

Hlawaty, H. 2009. "Lernen" and learning styles: A comparative analysis of the learning styles of German adolescents by age, gender, and academic achievement level. *European Education* 40, no. 4: 23-45.

Hmelo, C. E. and M. Ferrari. 1997. The problem-based learning tutorial: Cultivating higher order thinking skills. *Journal for the Education of the Gifted* 20, no. 4: 401-22.

Houghton, H. A. and D. M. Willows. 1987. The psychology of illustrations. *Instructional Issues* 1, : 152-198.

Howell, R. T. 2001. Fostering self-directed team members. *Journal of Technological Studies* 27, no. 1: 51-53

Johnson, D. W. and F. P. Johnson. 2002. *Joining together: Group theory and group skills.* Boston, MA: Allyn Bacon.

Kamil, M. 2010. *Adolescent literacy and textbooks: An annotated bibliography*. Ed. Carnegie Corporation of New York. 1st ed. Vol. 1. New York, NY: Carnegie Corporation.

Kolb, D. A. 1984. *Experiential learning*. Englewood Cliffs, New Jersey: Prentice Hall.

L'Hommedieu, R. 1990. Methodological explanations for the modest effects of feedback from student ratings. *Journal of Educational Psychology* 82, no. 2: 232-241.

Liu, M. 2004. Examining the performance and attitudes of sixth graders during their use of a problem-based hypermedia learning environment. *Computers in Human Behavior* 20, no. 3: 357-379.

Lou, Y., P. C. Abrami, and S. d'Apollonia. 2001. Small group and individual learning with technology: A meta-analysis. *Review of Educational Research* 71, no. 3: 449-521.

Magliaro, S. G., B. B. Lockee, and J. K. Burton. 2005. Direct instruction revisited: A key model for instructional technology. *Educational Technology Research and Development* 53, no. 4: 41-56.

Mayer, R. E. and Others. 1996. When less is more: Meaningful learning from visual and verbal summaries of science textbook lessons. *Journal of Educational Psychology* 88, no. 1: 64-73.

McKenna, A., and A. Agogino. 1997. Engineering for middle school: A web-based module for learning and designing with simple machines. Pittsburgh, Pennsylvania, Frontiers in Education, November 5-8.

Merino, D. N. and K. D. Abel. 2003. Evaluating the effectiveness of computer tutorials versus traditional lecturing in accounting topics. *Journal of Engineering Education* 92, no. 1: 189-194.

Mossman, L. 1924. *Changing conceptions relative to the planning of lessons*. New York: Teachers College, Columbia University.

National Research Center for Career and Technical Education. 2001. *The status of career and technical teacher education teacher preparation programs*. Minneapolis, Minnesota: University of Minnesota.

Norman, G. R. and H. G. Schmidt. 1992. The psychological basis of problem-based learning: A review of the evidence. *Academic Medicine* 67, no. 9: 557-65.

Panitz, T. 1996. A Definition of Collaborative vs Cooperative Learning. http://www.londonmet.ac.uk/deliberations/collaborative-learning/panitz-paper.cfm (accessed 6/8, 2011).

Patel, V. L. 1991. Effects of conventional and problem-based medical curricula on problem solving. *Academic Medicine* 66, no. 7: 380-89.

Perry, W. G., Jr. 1970. *Forms of intellectual and ethical development in the college years: A scheme*. New York: Holt, Rinehart, and Winston.

Prakken, L. W. 1976. *Industrial education in America***.** Prakken Publications, Inc.

Rapaport, W. J. 1987. Philosophy for children and other people. *American Philosophical Association Newsletter on Teaching Philosophy*, 19.

Reading-Brown, M. S. and Hayden, R. R. 1989. Learning Syles: liberal arts and technical training: What's the difference? *Psychological Reports* 64, 5-7-518

Rosenshine, B. 1976. Recent research on teaching behaviors and student achievement. *Journal of Teacher Education*.

Salomon, O. 1904. The teacher's handbook of Sloyd. Boston, MA: Silver Burdett & CO.

Schnotz, W. and R. W. Kulhavy. 1994. Comprehension of graphics.

Schuman, D. 1998. Direct Instruction: A Review of Research. Thesis from the University of North Carolina at Wilmington, Watson School of Education. http:// people.uncw.edu/kozloffm/shumanthesisdi.html. (accessed 10/23, 2003).

Shaver, J. 1985. Chance and nonsense. *Phi Delta Kappan* 67, no. 1: 57-60.

Slocum, T. 2003. Evaluation of direct instruction implementations. *Journal of Direct Instruction* 3, no. 2: 111-37.

Smith, P. J. 2001. Technology student learning preferences and the design of flexible learning programs. *Instructional Science* 29, no. 3: 237-54.

Snyder, M. 1992. The transition from industrial arts to technology education in the United States: A historical perspective. Doctoral, Virginia Polytechnic Institute and State University.

Stahl, G. 1999. Reflections on WebGuide. Seven issues for the next generation of collaborative knowledge-building environments. In C. Hoadley (Ed.), *Proceedings of CSCL '99: The Third International Conference on Computer Support for Collaborative Learning*. Mahwah, NJ: Lawrence Erlbaum Associates. 600-610

Subrahmanyam, K., R. Kraut, P. Greenfield, and E. Gross. 2000. The impact of home computer use on children's activities and development. *The Future of Children: Children and Computer Technology* 10, no. 2: 123.

Sweeney, J. and I. Deborah. 2001. A comparison of traditional and web-based tutorials in marketing education: An exploratory study. *Journal of Marketing Education* 23, no. 1: 55-62.

Tanner, B. M., G. Bottoms, C. Feagin, A. Bearman, and Education Board Southern Regional. 2003. *Instructional strategies: How teachers teach matters*.

Terenzini, P. T., A. F. Cabrera, C. L. Colbeck, J. M. Parente, and S. A. Bjorklund 2001. Collaborative learning vs. Lecture/Discussion: Students' reported learning gains. *Journal of Engineering Education*: 123-130.

Tew, C.. WebTVWire.com. http://www.webtvwire.com/the-growth-of-internet-video-are-video-search-engines-the-next-to-boom/ (accessed 4/16, 2011).

Thomas B. Fordham Institute. 2004. *The mad, mad world of textbook adoption*. Washington, D.C.: Thomas B. Fordham Institute.

Tyson, H. and A. Woodward. 1989. Why students aren't learning very much from textbooks. *Educational Leadership* 47, no. 3: 14-17.

Utah State Board of Education. K-12 core curriculum. Utah State Board of Education. http://www.uen.org/core (accessed March/14, 2011).

Vygotksy, L. S. 1978. *Mind in Society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.  Published originally in Russian in 1930

Wai, J., D. Lubinski, C. P. Benbow, and J. H. Steiger. 2010. Accomplishment in science, technology, engineering, and mathematics (STEM) and its relation to STEM educational dose: A 25-year longitudinal study. *Journal of Educational Psychology* 102, no. 4: 860-871.

Wallace, D. R. and P. Mutooni. 1997. A comparative evaluation of world wide web-based and classroom teaching. *Journal of Engineering Education* 86, no. 3: 211-219.

Westman, A.S. 1993. Learning Styles – liberal arts and technical training: What's the difference?, *Psychological Reports* 73, 512-514

Wright, G. 2008. How does video analysis impact teacher reflection-for-action? Doctoral, Brigham Young University.

**APPENDICES**

## Appendix 1 – CD Cover Grading Rubric

Students should create a CD cover for the band of their choice. Students should only use the application *Sketchpad* when creating their CD covers. The following will be considered when grading the CD covers.

**Requirements:**

- Students demonstrate that they can use/place text
- Students demonstrate an ability to use design tools
    - Spirograph, paint bucket, paint brush, calligraphy, pencil, stamp
- Students demonstrate an ability to use selection tools
    - Marquee, crop, eraser, eye dropper
- Students demonstrate an ability to use shape tools
- Students demonstrate an ability to use color tools
    - Color, patterns, and/or gradients used

**Grading Scale**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Student does not meet expectations. Many required pieces are missing from the CD cover. | Student meets most requirements but others are not met. | Student meets all requirements. | Students meet all requirements. Student combines tools beyond required procedures. | Student meets all requirements. Student combines/uses tools in an exceptional manner demonstrating a higher level of mastery |

**Appendix 2 - Consent Forms**

CONSENT FORM: Parental permission for Classroom Observation

INTRODUCTION

This research is being conducted by Scott Bartholomew & Geoff Wright to study and analyze effective method(s) of teaching multimedia and draw conclusions as to their effectiveness.

Students & Guardians:

We have selected your child's class for participation in a study about multimedia and technology learning. The teacher will be teaching your child's class a new technology and we will be video recording their teaching as well as the student-teacher interaction during instruction. This study will help us to analyze the current methods of teaching multimedia and make suggestions (if appropriate) that will benefit future class experiences in the STEM content areas.

PROCEDURES

The research will be conducted over 3 class periods. There are minimal risks involved in this study as the results of this study will not be connected with your child(ren) and they may withdraw at any time. Students not wishing to participate or those students without parental permission will sit behind the camera and will not be asked to do anything for the research. They will still receive the same instruction, be able to complete any assignments, and their grade will not be affected in any way.

RISKS / DISCOMFORTS

There are minimal risks for participation in this study. However, your child may feel uncomfortable in front of the camera. Involvement in this research project is voluntary. You may withdraw at any time without penalty or refuse to participate entirely.

BENEFITS

There are no direct benefits to your child for participating in this study. However, it is hoped that through your child's participation researchers will learn more about effective methods of teaching multimedia.

CONFIDENTIALITY

The video coding will be completed by Geoff Wright and Scott Bartholomew and no other parties will see the videos. Video recordings are for transcription purposes only. They will be stored for 3 years and then destroyed.

PARTICIPATION
Participation in this research study is voluntary. You have the right to withdraw at anytime or refuse to participate entirely without jeopardy to your class status, grade or standing with the university.

QUESTIONS ABOUT THE RESEARCH
If you have questions regarding this study you may contact Scott Bartholomew at 801-368-7875 or Geoff Wright at (801) 422-7804. If you have questions regarding your rights as a participant in research projects, you may contact the BYU IRB office at A-285 ASB, Brigham Young University, Provo, UT 84602; phone, (801) 422-1461; email: irb@byu.edu
Parental Consent

I ________________________ consent to allow the student to be a part of this study.
(Guardian Print Name)

_____________________________________ ________________
(Signature) (Date)

Child's Consent

Scott Bartholomew at Brigham Young University is studying effective methods of teaching multimedia.
You will be asked to be video recorded while your teacher teaches you.

You will be invited to take an online, anonymous survey. It will take less than 10 minutes to complete. If you choose to take the survey it is expected that you will complete it within 1 week of the classroom video recording experience.

I understand that I do not have to do any part of this study. If I change my mind, I can quit the study at any time. Only the researchers will see my answers unless my parent/guardian want a copy.

*******************************
Now I think I know about the study and what it means - Here is what I decided:

No, I do not want to be in the study OK, I will be in the study

_________________________________________ _________________
Your name (printing is OK) Date

I certify that this study and the procedures involved have been explained to ____________ in terms he/she could understand and that he/she freely assented to participate in this study.

______________________________________ ________________
Signature of Person Obtaining Consent Date/Time

Consent to be a Research Participant: Teachers

INTRODUCTION

This research is being conducted by an undergraduate student at Brigham Young University, Scott Bartholomew, and a professor, Geoff Wright, to study what the most effective method(s) of teaching multimedia are.

You were chosen to participate in this survey because of your involvement in the Utah Media Arts film Festival.

There are no risks for participation in this study and you will not receive any compensation for your participation. However, the findings from this study will greatly benefit all multimedia teachers as we seek to identify important trends in technology learner's ability to respond and learn from different teaching styles. This study will help us to analyze the current methods of teaching multimedia and make suggestions (if appropriate) that will benefit future in the STEM content areas.

PROCEDURES

You will be recorded on 3 different occasions while teaching different multimedia concepts to your students. You will be given a new technology concept to teach as well as a specified method of instruction. You will not be asked to answer any questions or do anything else for the study other than teach the new technology in the specified way and answer a brief survey afterwards about your experience. Videos will never be shown or used again for any other purpose than analysis performed by Scott Bartholomew and Geoff Wright.

The research will be conducted over 3 class periods.

RISKS / DISCOMFORTS

There are minimal risks involved in this study. You may feel uncomfortable being recorded and you may withdraw from the study at any time. Students not wishing to participate or those students without parental permission will sit behind the camera and will not be asked to do anything for the research.

Involvement in this research project is voluntary. You may withdraw at any time without penalty or refuse to participate entirely.

BENEFITS

There are no direct benefits to you for participating in this study. However, it is hoped that through your participation researchers will learn more about effective methods of teaching multimedia.

CONFIDENTIALITY

The video coding will be completed by and Scott Bartholomew and no other parties will see the videos.

The video coding will be completed by  and Scott Bartholomew and no other parties will see the videos.  Findings from video coding will not be linked to any particular participant in any way. Recordings will be stored for the duration of the study and then destroyed.

QUESTIONS ABOUT THE RESEARCH

If you have questions regarding this study you may contact Scott Bartholomew at 801-368-7875 or Geoff Wright at (801) 422-7804

If you have questions regarding your rights as a participant in research projects, you may contact the BYU IRB office at A-285 ASB, Brigham Young University, Provo, UT 84602; phone, (801) 422-1461; email: irb@byu.edu

I ________________________________________ consent to be a part of this study.
(Print Name)

________________________________________ __________________
(Signature) (Date)

## Appendix 3 – Student Survey

Student Survey 1/29/11 2:25 PM

# Student Survey

Please fill out the survey below. Your answers are totally anonymous and will not be linked with you or affect your grade in any way. If you do not know the answer to a question please give your best guess.

* Required

**How familiar are you with computers?**
1 = not familiar, 5 = very familiar

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not familiar | ○ | ○ | ○ | ○ | ○ | Very familiar |

**Please select your school** *

Mountain Ridge

**How much experience do you have with multimedia programs on the computer?**
Programs for video or image editing

- ☐ None
- ☐ 10 hours or less
- ☐ 10-20 hours
- ☐ 20-30 hours
- ☐ 30-40 hours
- ☐ 40+ hours

**How much experience do you have with photoshop?** *
Program for image editing

- ☐ None
- ☐ 10 hours or less
- ☐ 10-20 hours
- ☐ 20-30 hours
- ☐ 30-40 hours
- ☐ 40+ hours

**How much experience do you have with illustrator?** *
Program for image editing

- ☐ None
- ☐ 10 hours or less

https://spreadsheets.google.com/viewform?hl=en&formkey=dGxUbmZuNzRjUE5JbEFhdWxuMFh2VHc6MQ#gid=0 Page 1 of 6

- 10-20 hours
- 20-30 hours
- 30-40 hours
- 40+ hours

**How much experience do you have with gimp? ***
Program for image editing

- None
- 10 hours or less
- 10-20 hours
- 20-30 hours
- 30-40 hours
- 40+ hours

**How much experience do you have with inkscape? ***
Program for image editing

- None
- 10 hours or less
- 10-20 hours
- 20-30 hours
- 30-40 hours
- 40+ hours

**How much experience do you have with Paint? ***
Program for image editing

- None
- 10 hours or less
- 10-20 hours
- 20-30 hours
- 30-40 hours
- 40+ hours

**What is your average GPA?**
GPA = grade point average

- 4.0 (A student)
- 3.5 (B+ student)
- 3.0 (B student)

- 2.5 (C+ student)
- 2.0 (C student)
- 1.5 (D student)
- 1.0 (F student)

**What course are you in?**
Class Name

- Intro to Technology
- CTE Intro
- Communications Technology
- Intermediate Technology
- Advanced Technology

**How many courses have you taken that relate to technology?**

- 1
- 2
- 3
- 4
- 5
- 6+

**What is your age?**

- 10
- 11
- 12
- 13
- 14
- 15

**What techniques has your teacher used to teach you in this course?**
Rank them from 1-5 (1 = used most often; 5 = used least often)

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Direct Instruction: explicit teaching of a skill-set using lectures or demonstrations of the material | ○ | ○ | ○ | ○ | ○ |
| Problem based | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| learning: a student-centered instructional strategy in which students collaboratively solve problems and reflect on their experiences. | ○ | ○ | ○ | ○ | ○ |
| Collaborative learning: a situation in which two or more people learn or attempt to learn something together. | ○ | ○ | ○ | ○ | ○ |
| Book/written script tutorial learning: a form of learning in which the majority of learning involves students reading from books/written scripts, taking notes, and making applications. | ○ | ○ | ○ | ○ | ○ |
| Video-based tutorial learning: a form of learning in which students watch videos/tutorials that guide them through the mastery of specific skills. | ○ | ○ | ○ | ○ | ○ |

**Please rank the following in order of effectiveness for YOUR learning**

How do YOU learn best? (1 = best method for you to learn, 5 = worst method for your learning)

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Direct Instruction: explicit teaching of a skill-set using lectures or demonstrations of the material | ○ | ○ | ○ | ○ | ○ |
| Problem based learning: a student-centered instructional strategy in which students collaboratively solve problems and reflect on their experiences. | ○ | ○ | ○ | ○ | ○ |
| Collaborative learning: a situation in which two or more people learn or attempt to learn something together. | ○ | ○ | ○ | ○ | ○ |
| Book/written script | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| tutorial learning: a form of learning in which the majority of learning involves students reading from books/written scripts, taking notes, and making applications. | ○ | ○ | ○ | ○ | ○ |
| Video-based tutorial learning: a form of learning in which students watch videos/tutorials that guide them through the mastery of specific skills. | ○ | ○ | ○ | ○ | ○ |

**Please rank the following in order of effectiveness for THE MAJORITY OF YOUR CLASSMATES learning.**

How do YOUR CLASSMATES learn best? (1 = best method for you to learn, 5 = worst method for your learning)

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Direct Instruction: explicit teaching of a skill-set using lectures or demonstrations of the material | ○ | ○ | ○ | ○ | ○ |
| Problem based learning: a student-centered instructional strategy in which students collaboratively solve problems and reflect on their experiences. | ○ | ○ | ○ | ○ | ○ |
| Collaborative learning: a situation in which two or more people learn or attempt to learn something together. | ○ | ○ | ○ | ○ | ○ |
| Book/written script tutorial learning: a form of learning in which the majority of learning involves students reading from books/written scripts, taking notes, and making applications. | ○ | ○ | ○ | ○ | ○ |
| Video-based tutorial learning: a form of learning in which students watch | ○ | ○ | ○ | ○ | ○ |

videos/tutorials that guide them through the mastery of specific skills.

**Do you consider your learning in this class better, worse, or similar to other subjects?**

- Better
- Similar
- Worse

**What is an ideal learning situation for you?**

What would be present, what would be absent, what would happen?

Submit

# Appendix 4 - Teacher Survey



## Teacher Survey

Please answer the questions below - thanks so much for your time, cooperation, and efforts.

* Required

**Male or Female** *

- Male
- Female

**How many students are in your class?** *

10-15

**How many computers are in your class?** *

10-15

**What is the average grade of your students in THIS class?** *

Current average grade in this class

- A
- A-
- B+
- B
- B-
- C+
- C
- C-
- D+
- D
- D-
- F

**What is the average GPA of the students in this class?** *

Current average GPA for these students in ALL courses

- A
- A-
- B+
- B
- B-

- C+
- C
- C-
- D+
- D
- D-
- F

**# of years teaching** *

Not including your student teaching

- 1-5
- 6-10
- 11-15
- 16-20
- 20+

**At the time this study was completed how much average experience do you believe your students have with computers?** *

In or out of class

- 10 hours or less
- 10-20 hours
- 20-30 hours
- 30-40 hours
- 40+ hours

**At the time this study was completed how much average experience do you believe your students have with multimedia programs?** *

Image or video-editing programs - In or out of class

- 10 hours or less
- 10-20 hours
- 20-30 hours
- 30-40 hours
- 40+ hours

**At the time this study was completed how much time have your students spent in class on the computer?** *

IN CLASS time only

- 10 hours or less

- 10-20 hours
- 20-30 hours
- 30-40 hours
- 40+ hours

**Degree Earned** *

- HS Diploma
- Bachelor Equivalent
- Masters
- PhD

**Rate your computer literacy skills on a scale of 1-5** *

5 = highly proficient, 3 = average, 1 = little proficiency

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| little proficiency | ○ | ○ | ○ | ○ | ○ | highly proficient |

**Select the type of computer and/or technology courses you teach** *

Select only courses you CURRENTLY teach

- Intro to Technology
- Communications Technology
- CTE Intro
- Intermediate Technology
- Advanced Technology

**Please rank the techniques you use in your classroom when teaching multimedia** *

5 = use most frequently, 1 = use least frequently

| | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|
| Demonstration with projector - student watch as you demonstrate | ○ | ○ | ○ | ○ | ○ |
| Student Screens - you project your screen onto students and they watch | ○ | ○ | ○ | ○ | ○ |
| Video Tutorials - students watch previously prepared tutorials and learn new concepts | ○ | ○ | ○ | ○ | ○ |

| | | | | | |
|---|---|---|---|---|---|
| Written Tutorials - students read from text and learn new concepts | ◯ | ◯ | ◯ | ◯ | ◯ |
| Board analogies, examples, drawings, etc. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Collaboration - students are taught new concepts by their peers | ◯ | ◯ | ◯ | ◯ | ◯ |
| Free exploration - students are given time and learn new concepts through self-discovery | ◯ | ◯ | ◯ | ◯ | ◯ |

**Please rate the effectiveness of your instructional methods** *

5 = very effective, 1 = not effective

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not effective | ◯ | ◯ | ◯ | ◯ | ◯ | Very effective |

**Where did you learn these instructional techniques?** *

- ◯ School
- ◯ Personal Experience
- ◯ Peer
- ◯ Other

**How often do you change your instructional techniques?** *

- ◯ Hourly
- ◯ Daily
- ◯ Monthly
- ◯ Every time a new unit starts

**Do you consider your teaching to be a** *

- ◯ Presentation
- ◯ Demonstration
- ◯ Invitation for student exploration

**Please rank the following techniques according to your use in the classroom** *

1 = most frequently used, 5 = least frequently used

| | 1 | 2 | 3 |
|---|---|---|---|
| Direct Instruction | ○ | ○ | ○ |
| Direct Instruction | ○ | ○ | ○ |
| Problem-based Learning | ○ | ○ | ○ |
| Problem-based Learning | ○ | ○ | ○ |
| Collaborative / Cooperative learning | ○ | ○ | ○ |
| Book/Written Script Learning | ○ | ○ | ○ |
| Book/Written Script Learning | ○ | ○ | ○ |

**Please select the top three technologies you use most to enhance your teaching** *

- ☐ Computer
- ☐ Projector
- ☐ SmartBoard
- ☐ Dry-erase Board / Chalk Board
- ☐ Audio equipment (stereo system)
- ☐ DVD Player / VHS Player
- ☐ Internet
- ☐ Printer, Scanner
- ☐ Digital Camera
- ☐ Elmo System (live camera projection)

**What do you consider to be the best practices for teaching a new computer software application to students?** *

Please rank them in order (1 -5, 1 = best)

| | 1 | 2 | 3 |
|---|---|---|---|
| Direct Instruction | ○ | ○ | ○ |
| Direct Instruction | ○ | ○ | ○ |
| Problem-based Learning | ○ | ○ | ○ |
| Problem-based Learning | ○ | ○ | ○ |
| Collaborative / Cooperative learning | ○ | ○ | ○ |
| Book/Written Script Learning | ○ | ○ | ○ |
| Book/Written Script Learning | ○ | ○ | ○ |

**Appendix 5 - General Information Questions Related to Student Academic Performance and Multimedia Application Use as Reported by Students**

| Question | Mean response for all students |
|---|---|
| **How many courses have you taken related to technology?** | 2.1 |
| **What is your age?** | 12.83 |
| **Do you consider your learning to be better, similar, or worse in this class when compared to other classes?** (-1 = worse; 0 = similar; 1 = better) | .53 |
| **How familiar are you with computers?** (5 point scale; 1 = not familiar, 5 = very familiar) | 3.9 |
| **How much experience do you have with multimedia applications on the computer?** (0 = none; 1 = 10 hrs or less; 2 = 10-20 hrs; 3 = 20-30 hrs; 4 = 30-40 hrs; 5 = 40+ hrs) | 1.53 |
| **How much experience do you have with Photoshop?** (0 = none; 1 = 10 hrs or less; 2 = 10-20 hrs; 3 = 20-30 hrs; 4 = 30-40 hrs; 5 = 40+ hrs) | .96 |
| **How much experience do you have with Illustrator?** (0 = none; 1 = 10 hrs or less; 2 = 10-20 hrs; 3 = 20-30 hrs; 4 = 30-40 hrs; 5 = 40+ hrs) | .53 |
| **How much experience do you have with Gimp?** (0 = none; 1 = 10 hrs or less; 2 = 10-20 hrs; 3 = 20-30 hrs; 4 = 30-40 hrs; 5 = 40+ hrs) | .48 |
| **How much experience do you have with Inkscape?** (0 = none; 1 = 10 hrs or less; 2 = 10-20 hrs; 3 = 20-30 hrs; 4 = 30-40 hrs; 5 = 40+ hrs) | .25 |
| **How much experience do you have with Paint?** (0 = none; 1 = 10 hrs or less; 2 = 10-20 hrs; 3 = 20-30 hrs; 4 = 30-40 hrs; 5 = 40+ hrs) | 1.75 |
| **What is your average GPA? (GPA = Grade Point Average)** (4.0 = A; 3.0 = B; 2.0 = C; 1.0 = D; 0.0 = F) | 3.38 |

## Appendix 6 - General Information Questions Related to Student Academic Performance and Multimedia Application Use as Reported by Teachers

| Question | Mean response for all teachers |
|---|---|
| **How many students are in your class?** | 35.75 |
| **What is the average grade the students in this study are receiving in THIS class?** | 3.5 |
| **What is the average GPA of the students in this class?** | 2.94 |
| **At the time this study was completed how much average experience do you believe your students have with computers?** (0 = none; 1 = 10 hrs or less; 2 = 10-20 hrs; 3 = 20-30 hrs; 4 = 30-40 hrs; 5 = 40+ hrs) | 4 |
| **At the time this study was completed how much average experience do you believe your students have with multimedia applications?** (0 = none; 1 = 10 hrs or less; 2 = 10-20 hrs; 3 = 20-30 hrs; 4 = 30-40 hrs; 5 = 40+ hrs) | 1 |
| **At the time this study was completed how much time have your students spent in class on the computer?** (0 = none; 1 = 10 hrs or less; 2 = 10-20 hrs; 3 = 20-30 hrs; 4 = 30-40 hrs; 5 = 40+ hrs) | 1 |
| **How many computers are in your classroom?** | 31.75 |
| **Please rate your own computer literacy skills.** (1-5 scale; 1 = illiterate, 5 = extremely literate) | 4 |
| **Please rate the effectiveness of your instruction – according to your perception.** (1-5 scale; 1 = ineffective, 5 = very effective) | 3.5 |

*All teachers participating in the study have a Bachelor's degree with the exception of one of the teachers with a Masters degree. The average length of time teaching for the teachers was between 5 and 10 years. All teachers participating in this study were male between the ages of 25 and 45.

**Appendix 7 - Teacher Instructions**

INSTRUCTIONS:

Each teacher will be using a different method of teaching and we will be attempting to qualify the effectiveness of each method in regards to teaching multimedia. It is very important that you adhere strictly to the method of teaching prescribed to you – it may not work like you want it to, it may be tempting to try something else – please stick to the method assigned to you.

Choose a class that you would be willing to do this project in (more than one class could be done if you would be willing, and if it won't mess up your schedule).

Explain to the students that you will be teaching them a new tool that they can use - this tool can do most of the basic functions of Photoshop, but it's free and students could use it anywhere they have internet access. Mention to your students that the instruction will be video recorded to document instructional practices. Provide each student with a consent form to be signed by them and their parent(s) or guardian. Let the students know that the consent form will have no bearing on their grades – they will not be punished if they don't give consent to be on camera. This should be done a minimum of two days before you will teach the actual concept.

On the day that you teach the new concept, those students who have not returned a consent form signed by themselves and or their parents should be seated somewhere behind the camera where they can still learn, ask questions, and be monitored, without be recorded by the camera.

Explain to the students that you will be introducing to them a new concept and that before the period is over you would like them to create the CD cover for their favorite band/artist using the new "tool" taught in class. Please adhere strictly to the method of teaching that was assigned to you. Explain to students that their CD cover will be graded according to the principles of design and those items covered on the grading rubric. The purpose of this lesson is not to teach the principles of design so let the students know that their CD cover should be neat, professional work, and they should do their best to design it as such but don't spend time teaching design principles.

The application is found here:
http://mugtug.com/sketchpad/

Please reserve the last 15 minutes of class for the students to complete the survey and turn in their finished .jpg files. This entire teaching/learning should be completed in approximately 1.5

hrs (1-2 class periods depending on the school schedule). Please see the attached rubric as a reference for you/the students to know how the CD Covers will be graded.

Your name is next to the method of instruction assigned to you. Please follow the instructions and do your best to explain the application within the bounds of your assigned teaching style. You will find the definitions of each teaching style below.

TIMELINE OF LESSON
90 Minutes

15 Min – Get students on the computers. Explain the assignments, the rubric, and the study. Collect permission forms.

15 Min – Instruction (depending on the method assigned to you).

35 Min – Students work on their CD Covers

20 Min – Students & Teacher complete the survey

5 Min – Wrap up, gather all files from students, etc.

1- DIRECT INSTRUCTION – ********
Walk them through step-by-step as you explain each tool – focus on demonstrations with you lecturing at the front of the room and then them following. Optional: broadcast your screen onto theirs.

2 - PROBLEM BASED LEARNING – *********
Show them the website and then either pose a list of questions, project a list, or simply ask a list of questions that will lead them to find out how to use the tools. Focus on the problem of "How can we use the tools here to make a CD-Cover?" Ask a series of questions like: "How would we fill the whole screen with one color?" "How could we put words in?" Etc.
Each question should lead them to figure out a tool for themselves.

3 - VIDEO BASED/TUTORIAL LEARNING – ********
Students will be directed to the website and a folder on the shared drive with video tutorials of how to use each tool. They will then be expected to watch the videos they need and complete the project. Observe students and ensure that they are receiving help from the tutorial only – not from other classmates, the teacher, etc.

4 - COOPERATIVE/COLLABORATIVE LEARNING – *********
Students will be put into groups of 2-3 and then given access to all resources (teacher, tutorials, website, etc.). They will complete the CD cover together. Focus on having each student help each other find out answers, drawing on each other's knowledge, etc. Never answer a question right off – make them ask others first.

5 - BOOK/WRITTEN SCRIPT TUTORIAL LEARNING – *********
Students will be introduced to the project and each student will be given a handout explaining different tools and processes – students will be expected to learn without the help of other resources. The book should be their only guide to learning the tools.

I know that we all have differing definitions of what each of those things mean – for the purpose of this study we have chosen to use the definitions included below.

DEFINITIONS:

Direct Instruction: explicit teaching of a skill-set using lectures or demonstrations of the material
Problem based learning: a student-centered instructional strategy in which students solve problems and reflect on their experiences.
Collaborative learning: Cooperative learning is defined by a set of processes which help people interact together in order to accomplish a specific goal or develop an end product which is usually content specific.
Book/written script tutorial learning: a form of learning in which the majority of learning involves students reading from books/written scripts, taking notes, and making applications.
Video-based tutorial learning: a form of learning in which students watch videos/tutorials that guide them through the mastery of specific skills.