The Use of Educational Technologies in a Cognitive Flexibility Theory Unit

Colleen Swain
Jennifer Greer
Stephanie van Hover
University of Florida

Abstract

Cognitive flexibility theory is a learning theory that enables teachers to promote the use of educational technologies in the learning process as well as allowing students to delve deeper into the complexities associated with the middle school curriculum. This learning theory has four basic tenets that dovetail into interdisciplinary teams, an organizational structure frequently found in middle schools. This article introduces the basic tenets of Spiro's cognitive flexibility theory, offers insight into how cognitive flexibility theory can be compatible with middle school interdisciplinary teams, presents examples of how various educational technologies can be used with this instructional method, and provides an application of a unit of Florida history that demonstrates cognitive flexibility theory for the middle school curriculum.

"Cognitive flexibility learning theory, which builds on constructivism and work done in media and learning interaction, can assist teachers in structuring activities that avoid oversimplification of complex concepts."
Learning theories shape how teachers design educational environments for their students. For example, constructivist learning theories encourage lessons that allow students to relate new information to prior knowledge, recognize the complexity of concepts, and create new knowledge structures. However, content is often presented in a relatively simplistic manner and the depth of knowledge inherent in the intended learning objectives is not recognized nor understood by students. Cognitive flexibility learning theory, which builds on constructivism and work done in media and learning interaction, can assist teachers in structuring activities that avoid oversimplification of complex concepts (Spiro, Feltovich, Jacobson, & Coulson, 1999).

Cognitive flexibility is a learning theory that “focuses on the nature of learning in complex and ill-structured domains” (Kearsley, 2000) and separates itself from many theories because it deals with the acquisition of advanced knowledge. Spiro and Jehng (1990) state,

> By cognitive flexibility, we mean the ability to spontaneously restructure one’s knowledge, in many ways, in adaptive response to radically changing situational demands... this is a function of both the way knowledge is represented (e.g., along multiple rather than conceptual dimensions) and the processes that operate on those mental representations (e.g., processes of schema assembly rather than intact schema retrieval) (p. 165).

The Theory Into Practice online database, maintained by Greg Kearsley (2000), lists the four principles of the cognitive flexibility theory as:

- Learning activities must provide multiple representations of content.
- Instructional materials should avoid oversimplifying the content domain and support context-dependent knowledge.
- Instruction should be case-based and emphasize knowledge construction, not transmission of information.
- Knowledge sources should be highly interconnected rather than compartmentalized (p.1).

The flexibility that a computer provides makes it an ideal learning tool in lessons crafted using cognitive flexibility theory. These principles work well in a middle school environment, particularly when combined with the use of interactive media. In middle schools, students study sophisticated concepts yet often fail to recognize the complexity of information presented. Lessons that utilize cognitive flexibility theory and incorporate interactive educational technologies encourage students to understand the complex nature of their learning and to explore a concept from multiple perspectives. For example, students can use a variety of resources on the Internet to explore topics from many facets and use multiple methods of presenting their knowledge such as videos, web pages, and multimedia presentations.
Educational Technologies in a Cognitive Flexibility Unit

The Middle School Interdisciplinary Team

The middle school interdisciplinary team is an organizational structure conducive to utilizing cognitive flexibility theory. The interdisciplinary team structure allows teachers to share the same group of students, the responsibility of planning, teaching, and evaluating those students, the same or similar schedules, and the same area of the building (George & Alexander, 1993; Pounder, 1999). The ways to structure a middle school interdisciplinary team are numerous. In some schools, team teachers plan together but each teacher maintains their own classroom. In other situations, the teachers have more autonomy in determining how they will share time, classroom space, and group students. Most models, however, include common planning time that allows teachers to coordinate efforts to produce a wide range of integrated learning activities. As Flowers, Mertens, and Mulhall (2000) explain, “the activities of most interdisciplinary teams fall into one of the following three categories: (a) curricular and instructional issues; (b) student-centered issues, and (c) issues about communication” (p. 1) These benefits, as well as the flexibility in scheduling associated with interdisciplinary teams, encourage the integration of technology into the learning environment for middle school students and teachers. For example, if students need extended time on a particular learning activity involving the use of educational technologies (producing a video, research on the Internet, etc.), many times the flexibility in the interdisciplinary team model allows the teachers to readjust the time allotment for subjects enabling students to complete learning tasks.
"Using the cognitive flexibility theory approach, students have the opportunity to explore a concept in depth and from multiple perspectives. Each subject area in the interdisciplinary team can explore the same concept from the unique perspective of that discipline."

Regardless of the structure of the interdisciplinary team, the teaming approach provides the opportunity to infuse educational technologies into learning environments based upon cognitive flexibility theory. Using the cognitive flexibility theory approach, students have the opportunity to explore a concept in depth and from multiple perspectives. Each subject area in the interdisciplinary team can explore the same concept from the unique perspective of that discipline. This can be accomplished by the cooperative planning of teachers on the team. Common planning time provides more opportunities for teachers to strengthen connections between the disciplines (Flowers, Mertens, & Mulhall, 2000). Additionally, providing a common theme for the integrated activity encourages the students to make associations between subject areas. This supports cognitive flexibility theory by allowing students to see the conceptual complexity and case-to-case irregularities associated with many of the topics they study. Students can see that “real-world” learning is not clean cut but often a messy process.

"The multidisciplinary team approach also allows for concepts to be studied in depth from numerous perspectives and provides opportunities to use educational technologies in different ways."

The multidisciplinary team approach also allows for concepts to be studied in depth from numerous perspectives and provides opportunities to use educational technologies in different ways. For example, the language arts and social studies teachers could use the Library of Congress Internet sites to find literature and accurate statistics about a specific time period in history. Both classes could analyze primary source documents for a deeper understanding of the vernacular of that time period, factors shaping historical events, and societal influences on literature. Science and mathematics teachers could assess relevant data for charts and graphs, and conduct experiments comparing “then” and “now”. Using different types of software packages and technologies allows students to expand their technological expertise as well as adding variety to the way students display their knowledge. They are not only becoming consumers of knowledge but also creators, producers, and presenters of this new knowledge. In a multidisciplinary team approach students would not be creating a web page in every class; rather, they could use a variety of technologies to present their knowledge to their peers, teachers, and parents.
Educational Technologies in a Cognitive Flexibility Unit

Moving from Theory to Practice

In many states, teaching all of the state instructional standards is mandated by the state legislature. In addition, it is becoming more common for the effectiveness of teachers and schools to be evaluated by students’ success on the state standardized test. This pressure often causes teachers and administrators to consider using teaching methods that allow students to mimic the responses needed for the state-required test. Yet, there are strategies that allow for students to meet all state standards and gain a deeper understanding of concepts. The middle school interdisciplinary team utilizing the cognitive flexibility theory is a perfect example of a vehicle to create meaningful and engaging learning environments that approach a thematic topic from multiple perspectives while covering numerous state standards.

Take, for example, the concept of Florida history. According to the Florida Sunshine State Standards, students learn Florida history in elementary and middle school. At the middle school level, students are expected to understand the history of Florida and its people. The Florida Sunshine State Standards call for middle school students to explore the history of Florida in more depth but many of the lessons students encounter remain at the lower levels of Bloom’s taxonomy. With the increase of the Internet in the classroom, students are able to explore historical landmarks in Florida in new ways but often the connection between other societal and cultural events are missed. One way middle school students can deepen their understanding of Florida history is to participate in a unit that models cognitive flexibility theory. (Recall that the central premise of cognitive flexibility theory is that it is to be used for advanced knowledge acquisition.) Utilizing this method encourages students to study Florida history from several seemingly unrelated approaches while enabling
the learner to construct new ideas about the growth and development of the state as well as recognize the complexity involved in this area.

An Application of Theory to Practice

The main curricular focus of the Florida history thematic unit is social studies but also incorporates areas of study in geography, architecture, science, and mathematics. For this unit, students will work together in small groups to investigate three areas of Florida history during the late 1800s and early 1900s: the hotel industry, the railroads, and Florida’s Gilded Age. It is important to note that students should possess a fundamental understanding of Florida history prior to beginning this unit. As students investigate the three topics, they will search for common themes. Additionally, the groups will try to determine why these events are important and how they changed Florida history. Once students discover major themes, teachers from other content areas can begin to incorporate lessons that dovetail into the thematic unit. The project culminates with group presentations that allow students to share information with other students on the team. This instructional unit allows students to construct new knowledge of an important time in Florida history through group research, sharing information with others, and analyzing historical events. "

"This instructional unit allows students to construct new knowledge of an important time in Florida history through group research, sharing information with others, and analyzing historical events."
Educational Technologies in a Cognitive Flexibility Unit

Unit Details

The Florida history unit, located at http://www.coe.ufl.edu/Faculty/Swain/Florida/home.htm, is one practical example of how cognitive flexibility theory and educational technologies can be used with middle school students. The web site provides a unit outline for teachers. In the table of contents teachers will find: introduction, common themes, language arts, mathematics, science, social studies, and unit standards. The introduction presents an overview of the interdisciplinary unit, lists the three research topics, and offers teen safe search engines. Each subject area page provides lesson suggestions and resources for teachers to incorporate into the Florida history unit. For example, the mathematics section recommends a lesson in which students chart population changes in Florida between 1850-1950. Other subject area pages include handouts to guide students through different activities within each discipline. The common themes page gives teachers information about common threads students will generate in the course of their research and can be a springboard for discussion following group presentations. Finally, the unit standards page ties this activity to the Florida Sunshine State Standards. It should be noted that this web site does not provide specific lesson plans or explicit guidelines but rather gives teachers broad suggestions for implementing a Florida History Unit that meets the principles of cognitive flexibility theory.

Conclusion

Educational technologies can greatly enhance the learning environment for middle school students. Used in conjunction with cognitive flexibility theory educational technologies allow students to learn and discover the complexities in concepts in seemingly unrelated areas. The inherent flexibility of a computer makes it an exemplary tool for this learning environment. The Florida History unit described in this article meets the four principles of cognitive flexibility theory in several ways. First, by encouraging students to use several sources to examine common themes that emerge from different perspectives of Florida history, the unit provides multiple representations of content and does not oversimplify the content domain. Students can use multiple types of educational technologies, such as the Internet, software packages, and communication tools, to search for multiple representations of the content. Second, the activities are based within the context of Florida history and emphasize student construction of knowledge through research, collaboration, and conversation among groups. Again, the research, collaboration, and conversation can be greatly enhanced by the use of various educational technologies. Third, the unit allows students to revisit the historical content from many different
perspectives and academic areas. Finally, the unit incorporates several subject areas and asks students to recognize the connection between the disciplines within the larger context of Florida history. By doing this, students make the connection between information they learn in school and real life and can recognize that they are powerful elements in the learning environment. Again, students can use various types of educational technologies (multimedia presentations, videos, web pages, etc.) to present their newly discovered connections related to the content. Additionally, this unit works well within the middle school interdisciplinary team structure. The flexibility in scheduling, the continuity between the different classes, and the communication among the team teachers promotes a stronger learning environment for students. In conclusion, middle school students can and should be exposed to the complexities associated with the academic content they encounter in their educational program. Cognitive flexibility theory in conjunction with the use of educational technologies and interdisciplinary teams is one way this can occur.
Educational Technologies in a Cognitive Flexibility Unit

About the Authors

**Colleen Swain**  
University of Florida  
P.O. Box 117048  
Gainesville, Fl 32611-7048  
(352) 392-9191 ext. 264  
cswain@coe.ufl.edu

Dr. Colleen Swain, an assistant professor in the School of Teaching and Learning at the University of Florida, teaches undergraduate and graduate courses dealing with the infusion of technology into the daily learning environment. Prior to teaching at the university level, Dr. Swain taught middle school for 3 years and high school for 4 years.

**Jennifer Greer**  
University of Florida  
P.O. Box 117048  
Gainesville, Fl 32611-7048  
(352) 392-9191 ext. 278  
jgreer@coe.ufl.edu

Ms. Jennifer Greer, a doctoral student in Social Studies Education at the University of Florida, taught middle school for 8 years. Ms. Greer currently teaches undergraduate courses for the School of Teaching and Learning.

**Stephanie van Hover**  
University of Florida  
P.O. Box 117048  
Gainesville, Fl 32611-7048  
(352) 392-9191 ext. 278  
svanhover@coe.ufl.edu

Ms. Stephanie van Hover, a doctoral candidate in Social Studies Education at the University of Florida, taught 7th grade geography for 2 years. Ms. van Hover currently teaches undergraduate courses for the School of Teaching and Learning.
References


