Making Connections:

Prescriptions for Constructivist Based Course Construction

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Introduction

As a technology specialist in my school, I am interested in utilizing digital technologies for instruction. Before designing any instruction that would utilize digital technologies, it is important to identify the philosophical approach employed.

Philosophical Approach

As a professional, to me learning has always been about making inroads to a learner’s pre-existing internal framework. The responsibility of the learner and the challenge for the instructor is to connect what is new to what is known.

Piaget’s Three Processes of Development

Piaget’s development theory contends that children move through a number of developmental stages as they mature cognitively. He also “considered three
processes as being critical to development: assimilation, accommodation and equilibration” (Driscoll, 2005, p. 198). Central to each of these processes is the connection made between what is believed to be known and what is recently learned.

Assimilation is the process of connecting new information to existing schemes, accommodation is the process of modifying existing schemes to accurately connect new information, and equilibration is the process of restructuring existing schemes to account for discrepancies in thinking that cause the creation of connections through assimilation and accommodation to be logically impossible. It is the “master developmental process” (Driscoll, 2005, p. 199) of equilibration that moves learners from stage to stage.

The connecting of what is new to what is known is central to cognitive maturation in Piaget’s developmental theory.

Meaningful Learning Theory, Schema Theory and Schema Connection

Though Ausubel’s meaningful learning theory and Schema theory differ on the nature of schema, they agree on the need for anchoring new information to
existing schema. Ausubel asserted that schema were hierarchical structures that learners used for cognitive organization. Learners connect new information to existing schemata utilizing subsumption, superordinate learning and combinatorial learning (Driscoll, 2005).

Schema theory identifies a schema as “a data structure for representing the generic concepts stored in memory” (Driscoll, 2005, p. 129). These data structures use schema instantiation or the input of values (schemata) into the variables of the data structure, when applied to specific situations. Through the processes of accretion (the adding of new acceptable values to certain data structures), tuning (the evolving of data structures to accommodate experience) and restructuring (the creation of new data structures to accommodate experience), new information is connected to pre-existing schema structures (Driscoll, 2005, p. 135-6)

Both theories rely on connecting new information to pre-existing schema, either through linking that information to anchoring ideas or by inputting new information into relevant data structures through the process of instantiation. In both theories, it is this connection of new to old that facilitates learning.
"Adherents of the CIP model ... explain how the environment modifies human behavior ... [assuming] an intervening variable between environment and behavior. That variable is the information processing system of the learner" (Driscoll, 2005, p. 74). The CIP model is concerned with the processing or flow of information through the stages of memory - sensory memory, working memory and long-term memory - and the successful retention of information within the long-term memory.

Similar to Piaget’s processes of development and schema theory that stress the connection of new information to existing schemata, the CIP model also emphasizes the making of these meaningful connections. In the CIP model this is accomplished by providing “a meaningful sequence or structure to the material a learner must encode” (Almaguer, n.d.b, ¶ 2). Through signaling what information is important and drawing attention to specific features instruction can “facilitate selective attention and appropriate pattern recognition” (Driscoll, 2005, p. 104) and by that the assimilation of new information. The CIP model explains how to assist learners in making cognitive connections to new information and also illustrates the importance of connecting the new to the known as a fundamental principle in learning.
Constructivism

It is this fundamental principle of connecting the new to the known echoed in numerous learning theories that has drawn me to the constructivist model of instruction. Our current technology-laden society requires a new way of teaching. "The ways of obtaining knowledge in our 21st century ... have changed drastically ... yet the process of teaching and learning has not changed" (Switzer, 2004, p. 89). Unlike the instructivist classroom, "how to think through the way the existing knowledge fits with the rest of the world" (Switzer, 2004, p. 89). The organizational principles of the constructivist classroom provides both a working model of instruction reliant on making connections and the required changes to the processes of teaching and learning needed in our 21st century classrooms.

After some preliminary research several articles and studies on designing a constructivist-learning environment provided foundational principles for curricular organization because they summarized and elucidated the generally accepted principles common among the differing constructivist theories and suggested particular application of these principles based on strong correlative research.
Supporting Literature


Summary

In this article, Switzer defines constructivism as a teaching approach that encourages students to seek answers for themselves, while the instructor acts as a guide and facilitator. He cites two separate articles in support of his claim that our technology-laden societies require a new way of teaching because the ways of obtaining knowledge have changed in recent years. His proposed answer to these current demands on education is the constructivist approach. Switzer outlines the key components of constructivism by drawing from the literature by Honebein (1996), Savery (1995), Jonassen (1991), and Wilson and Cole (1991). He also outlines how he incorporated these components into the delivery of a university course on computer-mediated visual communication.
Critique

Switzer clearly researched and organized his key components of Constructivism making certain to draw these components from previous research and study and thus provided a well thought out list of the key constructivist features required in curricular implementation, yet he made no effort to report on the data collected regarding his implementation of these components. Evidenced in his conclusion through references to the evaluation forms and final grades, it was apparent that at least some data was collected to inform on practice. It is disappointing that this University instructor did not provide any evidence for the conclusions provided and thus reducing them to conjecture or at best respectable opinion. In addition, no information is given about the sources employed in drawing these conclusions; references are provided but no detailed abstracts or critiques.

Even still, I found this article particularly pertinent as it researched and proposed application of the salient points of the constructivist approach to an instructional situation. In particular, Switzer’s ten principles for constructivist design provide excellent guidance for the development of units that utilize digital technologies as tools for constructivist based instruction.
Switzer’s observation that the skills emphasized in the traditional instructivist approach, those of memorizing and test taking, are not skills required outside of the instructivist classroom, is confirmed by the conclusions of the other researchers found to support the constructivist model. It is the constructivist classroom that not only meets the demands required by technology-laden environments but also emphasizes the skills of problem-solving, information gathering, analysis and knowledge construction that rely on learner centered connections necessary for meaningful learning.

The Development of Metacognition in Primary School Learning Environments

Summary

In the context of teacher uncertainty with the effectiveness of constructivist instruction to teach metacognition, de Jager, Jansen and Reezigt examined the adequacy of a questionnaire to measure metacognition and whether different degrees of teacher structuring would yield different effects on metacognition. While the researchers found significant difference between the control group that received no explicit metacognitive instruction and the two experimental groups
that did, there was no significant difference in enhanced student metacognition between the direct instruction experimental group (traditional) and the cognitive apprenticeship experimental group (constructivist).

In their study, de Jager et al obtained a non-random sampling of 20 seventh grade teachers and their classrooms (287 students) that were voluntarily selected from 83 Dutch seventh grade teachers in the northern part of The Netherlands. Each of these teachers employed a particular reading curriculum (“I Know What I Read”) that paid special attention to the development of metacognition. Teachers and their classrooms were divided amongst a control group (7 teachers and 97 students), a Direct Instruction group (5 teachers and 72 students) and a Cognitive Apprenticeship group (8 teachers and 118 students) where assignment to the groups was voluntary and non-random.

Characteristics such as IQ, gender, ethnicity, and socio-economic status (SES), were checked for systematic differences between the groups but the only significant difference found was the SES between the two experimental groups. Despite this, only the intelligence measure and initial achievement levels were used in the subsequent analysis as a covariate, the authors citing a fear of overcorrection as the reason for not adjusting for the SES.
At the beginning and the end of the 1998/1999 school year, students were administered a 25-item questionnaire (17 multiple choice items and 8 dichotomously scored two-choice items) that was carefully scrutinized for its internal reliability in measuring meta-cognitive skills and knowledge. The researchers utilized OPLM-analysis (One Parameter Logistic Model) to identify the adequacy of a questionnaire to measure metacognition. Items that discriminated poorly were removed from the questionnaire leaving only the administered 25 from the original 34-item questionnaire.

After careful examination of the questionnaire de Jager et al concluded that, although a questionnaire may not be the optimal instrument to measure metacognition, they had created an adequate measure of student metacognition that they could apply to relatively large samples for pragmatic reasons.

De Jager et al also concluded the expected mean scores for direct instruction and cognitive apprenticeship differed positively from the control group suggesting that explicit teacher training and specific attention of teachers for metacognition is needed in order to enhance student metacognition. They found no conclusive evidence for a systematic difference between cognitive apprenticeship and direct
instruction with regard to metacognition and concluded that both direct instruction and cognitive apprenticeship foster the development of metacognition.

Critique

De Jager et al effectively set their research questions within a context of current a concern shared by many of their colleagues in Denmark, as well as in a context of previous research in metacognition, direct instruction and constructivist instruction. The transparency of their research is exceptional making all aspects of sample selection and assessment explicitly apparent, and the internal validity the questionnaire tool employed was commendable.

There is some question as to how transferable the results can be as the samples were all non-random, volunteer selected. In addition, the exclusion of the SES from the subsequent analysis as a covariate brings into question the internal validity of the results especially in relation to the identified significant difference found between the two experimental groups in SES. It would have been prudent to re-assess the raw data with this in mind as the underlying impetus behind the research questioned the effectiveness of constructivist strategy as compared to more a traditional strategy.
Even still the results from de Jager et al contribute significantly to the assertion that both constructivism and direct instruction are equally effective methods for instruction in relation to metacognition – a foundational tool employed in making cognitive connections. I would like to suggest that some amalgamation of these instructional strategies, however unlikely it may seem, would be an effective employment of instructional process that would enhance instructional delivery beyond each separate methodology.

**Effects of Instructional Support Within Constructivist Learning Environments for Elementary School Students’ Understanding of “Floating and Sinking”**

**Summary**

Employing a repeated measures design (pretest, posttest, 1-year follow-up) with 161 3rd-grade students, Hardy, Jonen, Moller and Stern compared 2 constructivist approaches to teaching floating and sinking that varied in instructional support with one group receiving minimal instructional support in keeping with commonly applied constructivist strategy and the other receiving
significant support.

Student selection was guided by a purposive sampling strategy where the eight participating classes (six experimental classrooms, two baseline classrooms) were selected because they were composed of students with mixed social background, they showed a high variance in students’ cognitive capabilities, and students had experienced discovery learning as well as traditional techniques in their instruction.

Hardy et al separated the sample into the 3 classroom High Instructional Support group (HIS), the 3 classroom Low Instructional Support group (LIS) and the 2 classroom control group which received no instruction.

To ensure consistency between groups the same instructor delivered the 8 separate lessons that differed only in the instructional support. Hardy et al conducted a pilot study where the lessons were fine-tuned and the teacher adequately trained in both methods.

The HIS group differed from the LIS group only through the added structure and the support of students’ reflective processes. Both groups received the same
investigation question but the HIS group received a pre-structured sequence of experimental activities moving from more basic concepts to more integrated concepts whereas the LIS group students could work on activities with various foci, researching a certain self-generated issue of investigation. With regards to the reflective processes, in the HIS group the teacher intentionally intervened more often by relating and contrasting ideas or hypotheses; identifying misconceptions; or by introducing a hypothesis or observation that the students themselves had not considered. In the LIS group discussions were much more student centered and the role of the teacher was closer to that of organizational supervision, with a lower frequency of content-related prompts to students’ reasoning processes.

Students were administered a 36 item test (3 free-response, 33 multiple choice) based on spontaneous explanations derived from interview data.

At the posttest, both constructivist groups showed significant improvement on understanding the concepts of density and buoyancy force as compared to a baseline group without instruction. However, one year later, the group of high instructional support was superior to the group of low instructional support on the reduction of misconceptions and the adoption of scientific explanations. Hardy et al conclude that high instructional support within constructivist learning
environments fostered elementary schoolchildren’s conceptual change in the domain of physics.

Critique

Hardy et al made all areas of their research transparent making explicit the testing procedure; the scoring procedures for both the testing and observations; and the makeup of the test employed. They took great care to ensure the internal validity of the study by conducting the pilot project, administering a test derived from previous interview data and using univariate analysis of variance to ensure that there were no pretest differences between the groups. Having the same instructor administer the lesson delivery and testing also contributed to the study’s internal validity.

They made effort to control variables like socio-economic status, cognitive distribution and previous experience but their non-random sampling reduced their ability to affect this area. Even so, Hardy et al were unable to control for gender differences because of the non-random sampling employed with the LIS group having significantly more boys (60% boys) than both the HIS group (53% boys) and the control group (47% boys).
Despite this, Hardy et al produced an extremely well articulated and well-delivered study that provided valuable evidence affirming the inclusion of high instructional support in constructivist instruction. Combining these findings with the findings of de Jager et al, it becomes apparent that incorporating high instructional support, often more attributed to direct instruction, in a constructivist environment will provide significant benefit for the learner and increase retention.

**Synthesis**

Constructivism, although widely employed in current educational practice is often much maligned for its lack of supporting research, yet de Jager et al provide support for constructivism and demonstrate its efficacy. In addition, they identify the equal effectiveness of direct instruction. But what is to be made of this apparent dichotomy?

In light of Hardy et al it becomes evident that an amalgamation of the both direct instruction and constructivism, through the employment of high instructional support, produces a superior constructivist environment for learning. Constructivism is not an abdication of instructor responsibility in the area of
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direction, just a shift in the purpose of learner direction. The instructor becomes a co-contributor in formulating learner direction with the intent of developing the best environment for connecting the new learning to old.

Hardy et al’s high instructional support included (i) pre-structured sequenced activities, moving from basic concepts to more integrated concepts and (ii) increased facilitator intervention for the purpose of relating and contrasting ideas or hypotheses, identifying misconceptions, or by introducing a hypothesis or observation not considered by learners. For a constructivist environment to benefit from the correlated success of Hardy et al’s research, these two prescriptions must be employed.

In addition to these, Switzer's ten principles of constructivist design provide a good starting point for laying a constructivist foundation because they summarize and elucidate the generally accepted principles common among the differing constructivist theories and are based on previous research and study.

These principles are:

1. Anchor all learning activities to a larger task or problem.
2. Create real-world environments that employ the context in which learning is
relevant.

3. The instructor is a coach and analyzer of the strategies used to solve these problems.

4. Provide for authentic versus academic context for learning.

5. Stress conceptual interrelatedness, providing multiple representations or perspectives on the content.

6. Instructional goals and objectives should be negotiated and not imposed.

7. Learning should be internally controlled and mediated by the learner.

8. Support collaborative construction of knowledge through social negotiation.

9. Encourage ownership and voice in the learning process.

10. Provide opportunity for and support reflection on both the content learned and the learning process.  

   (Switzer, 2004. P. 90-91)

After closer examination, these ten principles can be summarized under four major prescriptions for constructivist design. These are:

i. Create real-world, authentic activities and contexts for learning. (1, 2, 4)

ii. Encourage ownership of the learning process by allowing the learner to direct, control and mediate their learning. (3, 6, 7, 9)

iii. Socially mediate the learning process. (3, 5, 8)
iv. Provide opportunity for and support of reflection on both the content learned and the learning process (10)

In conjunction with Switzer’s foundational principles of design, it will be desirable to employ Driver and Oldham’s key processes of constructivist teaching practice as identified in Matthews (1994) because of the clarity in lesson sequence and delivery that these processes supply. Through the processes of Orientation, Elicitation, Restructuring of Ideas, Application and Review (1994, p. 143) the constructivist approach is easily employed in each component lesson of a unit of study. These key processes of constructivist teaching practice can be summed up in the Constructivist Instructional Model (CIM).

a. Identify learners' views and ideas (prior knowledge);

b. Create opportunities for the learners to explore their ideas and test their robustness in explaining phenomena, accounting for events and making predictions;

c. Provide stimuli for students to develop, modify and where necessary, change their ideas and views;

d. Support their attempts to rethink and reconstruct their ideas and views.
Accounting for overlap, the four summarized prescriptions of Switzer’s ten principles and the four key processes of the Constructivist Instructional Model when combined create seven essential recommendations for the effective implementation of constructivist design.

These are:

1. **Authentic Learning**: Create real-world, authentic activities and contexts for learning. (i)

2. **Learner Self-Direction**: Encourage ownership of the learning process by allowing the learner to direct, control and mediate their learning. (ii)

3. **Social Mediation**: Socially mediate the learning process. (iii)

4. **Accessing Prior Knowledge**: Identify learners' views and ideas (prior knowledge); (a)

5. **Stimulate Restructuring**: Provide stimuli for students to develop, modify and where necessary, change their ideas and views; (iv, c)

6. **Apply Learning**: Create opportunities for the learners to explore their ideas and test their robustness in explaining phenomena, accounting for events and
making predictions; (ivb)

7. **Self-Assessment**: Provide opportunity for and support of reflection on both the content learned and the learning process (iv, d)

Adding the prescriptions endorsed by Hardy et al provides nine prescriptions for constructivist design.

8. **Pre-structure Sequenced Activities**: Provide activities that have both structure and sequence so that learners can engage in constructivist based learning tasks moving from basic concepts to more integrated concepts

9. **Increase Facilitator Intervention**: for the purpose of relating and contrasting ideas or hypotheses, identifying misconceptions, or by introducing a hypothesis or observation not considered by learners

**Conclusion**

Based on the research examined and the philosophical approach of connecting the new to the known, the nine prescriptions for constructivist design identified here, if incorporated in digitally enhanced instruction, promise to
improve the learning environment. By thoughtfully employing increased
instructional support to the constructivist environment and yet still remaining true
to constructivist learner-centered ideals, a learner-centered yet instructionally
supported approach to course design is provided.
References

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