JAEPR, 3(*1*),

APPLICATION OF KNOWLEDGE

The Science of Learning: Practical Applications for Transferring Learning in the K-12 and Higher Education Settings

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The fourth Key Question posed in the Deans for Impact report (2015) asks, "How does learning transfer to new situations in or outside of the classroom?" DFI (2015) propose two cognitive principles addressing the question. This article briefly summarizes what current research says in regard to each cognitive principle and provides practical application suggestions for what each principle might look like in the K-12 and Higher Education settings. Though the practical applications provided are specific, the underlying concepts can be used as guidance for instruction that fosters students' ability to transfer learning to novel problems.

Keywords: transfer, novel problems, instructional methods

The fourth question posed in the Deans for Impact report (DFI, 2015) asks, "How does learning transfer to new situations in or outside of the classroom?" DFI (2015) propose two cognitive principles addressing this question:

1. The transfer of knowledge or skills to a novel problem requires both knowledge of the problem's context and a deep understanding of the problem's underlying structure.
2. We understand new ideas via examples, but it's often hard to see the unifying underlying concepts in different examples.

This article will briefly summarize what current research says in regard to each cognitive principle and then provide educators with practical suggestions for what the application of each principle might look like in the K-12 and higher education settings to accomplish the ultimate goal of education -- the transfer of learning.

COGNITIVE PRINCIPLE 1

The first cognitive principle can be divided into two distinct components -- contextual knowledge and structural knowledge. According to the DFI report (2015), learners must possess these in order to transfer skills or knowledge to novel problems. In the classroom, contextual understanding can be accessed via prior knowledge or constructed through learning opportunities that build background knowledge. These experiences must couple a richness of information that allows the learner to isolate relevant details with a strong conceptual vision that enables the learner to apply the information across domains. When students develop conceptually sound mental models through deep initial learning, they are better able to understand the underlying principles of novel problems, and they can more efficiently transfer knowledge or skills to novel problems. With appropriate and carefully planned learning experiences, educators can foster the development of both components of this principle in practical ways.

Knowledge of Problem's Context

K-12 practical application: Reading workshop instructional framework (Calkins & Tolan, 2010). There are three components of this framework of instruction: the mini-lesson, independent and guided practices with conferences, and sharing out. The mini-lesson, which lasts no more than 20 minutes, begins with a connection where the teacher makes learning meaningful by making a real-life connection to the teaching point for the day. The teaching point, or objective for the lesson, is reiterated throughout the lesson and includes a skill that students must transfer to their reading and a strategy they can employ to do the skill. Teachers explicitly model and scaffold the skill and strategy for students, and students are allowed to practice during active engagement. Finally, the teacher makes a link between the content of the mini-lesson and when students will apply it in their independent practice.

For example, when a teacher is teaching students how to use diagrams in non-fiction text, she begins the lesson by telling students an anecdote about a time she found a diagram helpful. The teacher then explains and models how to use a diagram in non-fiction reading. Next, students practice with a common text the class has read. Finally, students practice while reading an authentic text independently, in this case, their own non-fiction books. They document their practice on sticky notes, and at the end of independent reading, the students reconvene to discuss their findings in their own books.

Higher education practical application: Labs, supplemental instruction, and recitation. This framework of instruction in the higher education setting can be seen in a majority of the STEM field courses. This framework focuses on the support provided outside of the course lecture including supplemental instruction, labs, and recitation. The original concept or "problem" is introduced during the class lecture. Further context and application of the concept or problem is offered during supplemental instruction, labs, and recitation. Labs, typically mandated, provide an opportunity for students to begin building context of the problem through practical applications or confirming concepts through experimentation. Peer-led supplemental instruction (SI) sessions are used to reiterate the original concept through more examples, further topic discussion, and strategies for problem solving. Recitation is similar to supplemental instruction, but is typically lead by graduate teaching assistants or the professor. Both SI sessions and recitation are optional resources. These three resources provide opportunities for the learner to view the concept or problem through multiple lenses and connect to practical application.

For example, this framework supports the instruction for many of the STEM field courses such as Physics I. A physics course typically consists of a lecture-based class and a mandatory laboratory to emphasize a new learned concept and provide practical application. The laboratory is held weekly and coincides with the class material presented during the lecture. SI sessions and recitations are optional and provide students with further opportunities to reinforce concepts learned through problem solving strategies. Students control the types of reinforcement needed for knowledge transfer throughout the course.

Deep Understanding of the Problem's Underlying Structure

K-12 practical application: Model drawing (Forsten, 2010). This strategy focuses on problem solving, creating equations, and developing algebraic thinking. It helps the learner to develop a deep understanding of the problem's underlying structure through an explicit step-by-step process to systematically analyze novel problems. Model drawing is the bridge between using concrete manipulatives and abstract symbols, thought, and algorithms, on the continuum of mathematical reasoning.

To ensure students are able to focus on the process versus computation, the teacher begins model drawing using concrete manipulatives such as unifix cubes or number chips to solve simple story problems. Students model problems by adding to or taking away from the group. Once students understand how to use the manipulatives, the teacher reinforces the concept of number bonds and the understanding that a whole is composed of parts. After that, students begin drawing discrete models where one square represents each object. Once students understand cardinality, they can move to the most complex form of model drawing -- the continuous model where the unit bar represents a group based on the number labeled on the bar.

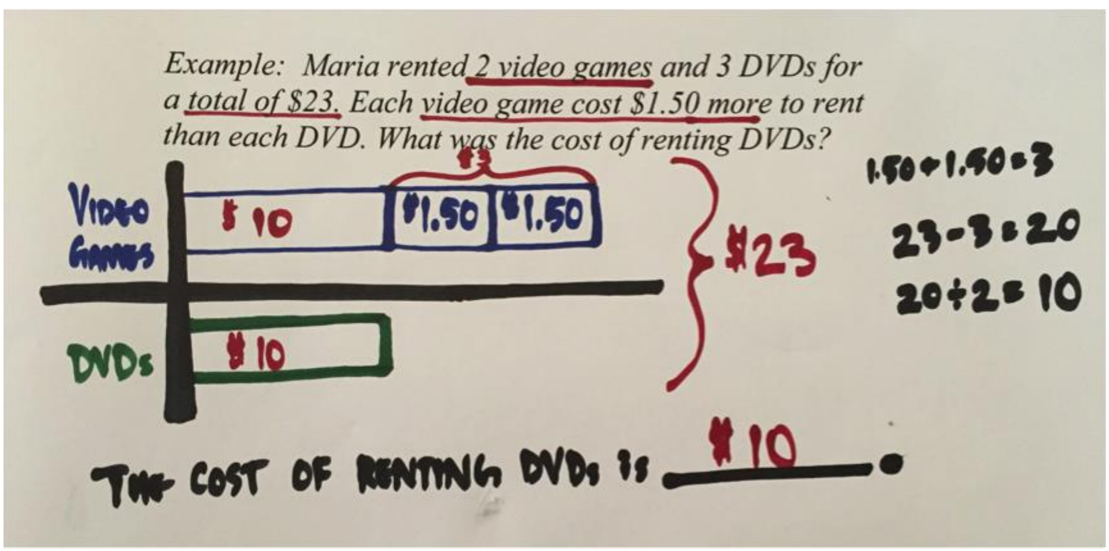

Figure 1. Model Drawing Example

Higher education practical application: Budget & Financial Training. Budget and financial training, such as concert funding education, is vital to student leadership development on college campuses. Concert funding can be complex, but understanding the model's structure is critical. This strategy revolves around the understanding of concert funding structure components such as budgeting, contract processing, technical needs, staffing plans, and determination of target audiences. Learning about all of the moving parts and structural components allow for the student leader to have a deeper understanding of the model. To ensure students are able to transfer their knowledge of the underlying structural components to the overall concept of concert funding, discussion of other examples are used to reinforce content knowledge. If the students gain mastery of each concept, then their overall understanding of the problem is strengthened and enhanced. Understanding concert funding through different lenses provides a richness of knowledge of the overall concept.

College programming board students can be responsible for managing and hosting concerts on campus. In order for concerts to be successful, the students must understand the concept of concert funding. Concert funding education starts with the understanding that there is a structure with multiple components. The structural components of production needs, artist needs, venue needs, timeline, ticket sales, and assessment all make up the structure of the problem. It is important for students to understand each of these underlying concepts to better understand concert funding and management.

COGNITIVE PRINCIPLE 2

The second cognitive principle can be divided into two distinct components -- new ideas via examples and underlying concepts in different examples. This principle proposes that the learner will understand new knowledge through examples and transfer can occur by understanding underlying concepts within the examples. Utilizing familiar sources for examples and mapping knowledge between examples is critical for learners. Transfer also can occur when the learner can recognize surface similarities between examples and by using cues and triggers to solve problems. Therefore, teachers should be cognizant of using examples with familiar sources and utilizing a combination of concrete and idealized formats to teach new concepts.

New Ideas via Examples

K-12 practical application: Anchor charts. More than merely wallpaper or decoration, the teacher and students co-create anchor charts based on the most important skills and strategies outlined in lessons. The anchor chart serves as an example created during a learning experience to which students can literally anchor their thinking. Once the anchor chart is created, the teacher hangs it in the room for students to reference in subsequent learning experiences or during independent practice. The teacher also references the anchor chart and may even add to the anchor chart in later lessons as appropriate. The anchor charts can also be arranged around the upper perimeter of the room in such a way that it creates a timeline of learning over the year. This strategy allows the class to track learning and build upon previous experiences and examples.

Higher education practical application: Student Leadership Development. Professional staff advisors of a college or university student programming board provide learning experiences through planning and implementation of campus-wide programs. These learning experiences outline the framework of student leadership development. This learning strategy is focused around the creation of core competencies to guide the educational and training process. In order to provide insight on the mastery of a competency or skill set, assessments are utilized to measure preset learning outcomes associated with each competency. Students are learning transferable skills and competencies that can apply to jobs beyond their leadership position. The core competencies are set around leadership development, financial management, risk management, collaboration, etc. Transfer of knowledge occurs as the student practices these concepts in various settings. These various settings or new examples will allow the student to reinforce their learning of new concepts through these various real-life examples.

The risk management process is cyclical in nature. The students learn through experiences or given examples to better understand the risk management process. The process begins when the risk is identified and the students then asseess the risk for its likelihood. Based on the assessment, a strategy to control the risk is determined. After the risk is mitigated, the students then review their strategies and determine its effectiveness for the future. Knowledge of risk management is further strengthened through the study and discussion of examples and future risky situations. Each time a student identifies another risk, this student can better apply useful strategies to reduce or avoid problems.

Seeing the Unifying Underlying Concepts in Different Examples

K-12 practical application: Teaching with analogies. K-12 classroom teachers can use analogies to help students see the unifying underlying concepts in different examples. Analogies require students to analyze relationships in one set, and then transfer that analysis to relationships of another set. Comparing and contrasting known concepts with new concepts can help the learner better understand new concepts. The Teaching with Analogies Model (Glynn, 2007) provides a 6-step framework for building understanding of new (target) and familiar (analog) concepts:

1. Introduce the target concept
2. Remind students of what they know of the analog concept
3. Identify relevant features of the target and analog concepts
4. Connect or map the similar features of the target and analog concepts
5. Indicate where the analogy between the target and analog concepts breaks down
6. Draw conclusions about the target concept (p. 53)

For instance, students can build a conceptual understanding of the parts of a cell by comparing them with other objects that do similar jobs such as mitochondria and power plants or chloroplasts and restaurants.

Higher education practical application: Case studies. This framework of instruction in the higher education setting can be seen in multiple academic disciplines as well as co-curricular leadership programs. Case studies are typically scenarios that are based on real events or a construction of events that could reasonably take place. The use of multiple case studies can connect underlying concepts through relevant background information. Case studies can serve as a basis for wide-ranging exploration and can assess the application of concepts to complex real world situations and assist with building analytic skills.

Case studies can be used to explain or connect certain concepts through multiple examples or cases. Case studies are prevalently used for student programming boards, especially around the concepts of risk management. The responsibility of managing perceived risks for certain events is vital to program management. Pinpointing and navigating risks can be complex, but recognizing certain risks through underlying concepts can help. Walking through different cases allow for the students to try and unify these complex concepts and can then be applied to future situations. Risk management can be difficult; however, staff advisors can utilize case studies to help reinforce techniques and strategies to solve problems that were previously taught.

CONCLUSION

The Deans for Impact report (DFI, 2015) asks, "How does learning transfer to new situations in or outside of the classroom?" While transfer of knowledge can vary from setting to setting, this article provided practical application suggestions of each cognitive principle for both K-12 and higher education settings. Limitations exist as there are multiple educational settings that are not addressed in this article. Though the practical applications provided are specific, the underlying concepts can be used as guidance for instruction. The hope is for educators to use the practical applications provided in this article to help instill abilities in learners that the Deans of Impact (2015) report suggests and reiterate the learning associated with each cognitive principle therein.

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