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A Framework for Preparing Students to Design Their Own Learning Strategies

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Abstract

Students often do not have a clear idea of what is expected of them when they study. They have an "ambiguity of purpose" problem, that is to say, they are not sure of the learning goals and the means to achieve them. A large amount of responsibility for analyzing content and selecting learning strategies falls upon the student and their skills in this area are in short supply. To formally assist students in developing these skills, this paper applies Merrill's Component Display Theory (Merrill, 1983), an instructional material classification methodology, to analyzing content. Instructional classifications can guide students study behavior just as they guide an instructional designer's design process.

Introduction

There are times when intelligent, earnest, and motivated students are not learning as much as expected. The usual suspects, ability, motivation, and time-on-task should be investigated; however, in many cases it is likely that the primary culprit is ineffective learning strategies (Ryan, 2000). Learning strategies are used by students to facilitate the acquisition of knowledge and skills (Smith & Ragan, 1999). Often students report, after a disappointing test or exam, that they "didn't expect a question like that," or that they "didn't know I would have to explain that," or even "I knew the material but I didn't know it that way," or "I studied the wrong thing." These types of comments indicate that the student may not have classified the material in ways that lead to the selection of appropriate learning strategies. They invested their time in studying, but didn't have a mechanism to detect the heterogeneous nature of academic material. By treating the material homogeneously, they were not able to apply tailored analysis to content that demanded separate and distinct strategies according to its content classification. These problems are deeper than test-taking inexperience or lack of skill; they reflect a fundamental lack of understanding of the structure and components of instructional content.

Effective learning strategies are often not formally taught (Ryan, 2000). There are many study guides, materials, and courses available that provide detailed advice on skills such as time management, note making, and test taking. Occasionally, a few brief suggestions on learning strategies are offered; however, details in these critical skills may be lacking (Ryan, 2000). Without specific guidance in the use of learning strategies students may not be able to focus their study behavior appropriately and will default to using familiar strategies, too often based on memorization or rote learning techniques. There is an intuitive and logical rationale to resorting to these techniques, particularly when a student's past experience has rewarded them for their mnemonic proficiency; "knowing" is associated with "repeating" in classroom after classroom.

The old adage, "When all you have is a hammer, everything looks like a nail" is an appropriate analogy to the problems students sometimes encounter; they don't have or know the broad range of learning strategies they need to confront specific academic content, and they don't seem to understand that text content isn't just a listing of words, but a set of meanings and relationships whose heterogeneous character define which learning strategies are most appropriate to build and confirm understanding.

Many students have taught themselves to memorize large quantities of information. This is a powerful skill, unfortunately, for even the most experienced mnemonotist, the number of items that could be memorized in an academic field will always outweigh the capacity to do so. Even if a student could do so they would be at a distinct disadvantage compared to their classmates who have learned to view the field categorically or conceptually (Bruner, 1966). Students with skills, in analyzing, classifying, and summarizing are better prepared than their counterparts to confront a changing world and to maximize the unique way in which our brains have evolved (Pinker, 1997). Many students' study strategies of choice simply do not take advantage of the uniquely human biological mental tool set.

When students are seen with flash-cards, mumbling to themselves the definitions of words and terms in a futile attempt to memorize by brute force, you may have intuitively inferred a problem; they are trying to learn by creating a one-to-one reproduction of words, a skill that is not supported, to any meaningful degree, by our mental hardware. Lucky students may find that this strategy was inadequate on test day and realize that there is a problem. Unlucky ones may occasionally do well on a test using this method and will be reinforced to continue using these unproductive strategies, and may find later on that they didn't learn anything meaningful and the clarity of their recall becomes hazier with each passing day.

The Instructional Design Lens

The answer may be in developing alternate and more appropriate learning strategies. It should be noted that, "When learning strategies are employed, the learners guide their own processing, rather having the processing guided or supplied by the instruction" (Smith & Ragan, 1999, p.231) One relatively untapped source for identifying specific learning strategies is from instructional design models and theory. Instructional designers (ID's) generally work with subject-matter experts when developing instruction because content experts often don't have knowledge or expertise in instructional design. The tools ID's use generally don't require the designer to be a content expert. However, the tools, techniques and strategies ID's can be used to consistently ensure quality instruction. The lens they use to interpret content produces a particular type of instructional analysis.

Jonassen (1993) presented a case study that suggested that students, acting as instructional designers building an expert system, learned far more about the content than those who eventually used the finished expert system. Jonassen argues that it was the constructive aspect of the activity that lead to the in-depth learning however, it could also be inferred that the special lens and analytical tools that designers use to organize, develop, and present their instructional artifacts may also be responsible for the depth of learning by the project team. Although, instructional design is a broad field with many types of disparate approaches there are some types of analysis, particularly the classification of knowledge, that are particularly appropriate for students to use in guiding their study behavior. The field has adopted a number of classification schemes that provide assistance in creating instructional experiences. The same skills used by designers can also be used directly by students to analyze content sources, categorize knowledge, and use those categories to guide their study behavior and substantially reduce feelings of uncertainty regarding course expectations.

The World of Knowledge

Higher education prepares students for an indeterminate future and builds its curriculum from the "World of Knowledge" instead of the "World of Work" (van Merrienboer, 1999). In the World of Knowledge, "a particular discipline or subject matter domain is analyzed and ordered…. the main output of the process is a highly structured description of the domain" (van Merrienboer, 1999, p.5). This "highly structured description of the domain" is a set of knowledge that needs to be learned and understood to begin to think like an engineer, historian, or psychologist and not to simply act in a narrow pre-determined manner. Paul and Elder (2001) emphatically stress this point when they state, "The first and most important insight necessary for deep learning of academic subjects is that everything you learn is, in the last analysis, nothing more nor less than a systematic way of thinking about a particular set of things" (p.10). Instructors can suffer from expert-blindness, a condition where their expertise hides many assumptions that directly lead to learning. This condition makes it difficult for instructors to offer guidance on many aspects of content analysis to students. A content classification scheme allows students to discriminate between classifications and subsequently apply appropriate learning strategies for each type of domain or category of learning.

The content of a course is expressed through its artifacts such as textbooks, assigned readings, lectures, and discussions. However, without further analysis of a student still has a daunting burden of determining the salient objectives within that domain; they need to determine for themselves what needs to be known and when they have achieved mastery. ID's use a classification schemes to qualitatively distinguish between different learning outcomes. For example, discriminating between a Frigate and a Schooner requires different learning strategies than applying Ohm's law of electricity; by labeling the content as "concept" learning or "principle" learning respectively, students will then be able to select from a smaller range of learning strategies. The use of a classification scheme, like Merrill's Component Display Theory, may answer questions such as what needs to be memorized, what needs to be discriminated, what needs to categorized, what sets can this information be arranged in, and what type of examples are needed to ensure a comprehensive understanding of the material at hand.

Knowledge Classification

Merrill (1983) has pointed out that, "there are different kinds of objectives and that each type of objective requires a unique set of conditions to promote optimal acquisition of the capabilities specified by the objective" (p.290) In other words, a variety of categories and classifications exist and these classifications are finite and discrete, which implies that each type of classification is a distinct means to a distinct end. If a student can classify a piece of information then they should consequently be able to apply a learning strategy appropriate for utilizing that classification. For example, if the term dog is classified as a "concept" then according to this classification structure, we know we have to engage in a particular type of study behavior that is specific to learning "concepts" (i.e., identify attributes: mammal, domestic, canine family, etc; examples: German Shepard, Labrador; and non-examples: cats, bears, pigs). Since there are a limited number of categories in this classification scheme the act of classification isn't so much an activity of invention as it is an act of selection, a much less intensive cognitive process (Merrill, 1983). In other words, the classification scheme reduces the effort required to identify what is meaningful and subsequently focuses effort by assisting in the selection of learning strategies likely to be implemented successfully.

There are a number of classification schemes that are used by instructional designers (Bloom 1956, Merrill 1983, Gagne 1977). These taxonomies represent an attempt to create a logical and comprehensive listing of the different types of classifications possible. When learners know the full range of possible knowledge categories that content from a lecture, or a discussion, or other source can be separated into, they should be able to guide their study behavior with a much greater sense of breadth and accuracy. To a large degree they have solved their "ambiguity of purpose" problem. They are no longer guessing in the dark about what content is important and what means are used for mastery; the classification should give them clear suggestions about assessment possibilities.

Applying the Component Display Theory Classifications

There are two primary steps in analyzing content; 1) identifying and classifying knowledge structures according to a classification scheme, and 2) following and mapping the structure of the content in the form of a logical line of reasoning or argument. Identifying and classifying knowledge structures ensures that a learner understands the pieces or components thoroughly while mapping the structure ensures the learner understands how those pieces or components are being used and for what purpose. These two steps combine to provide an independent learner a degree of mastery or understanding over an academic content.

The first step, identifying and classifying knowledge is an analytical one; in this case, using Merrill's (1983) Component Display Theory, the learner will need to classify subject matter into facts, concepts, procedures, and principles. These components have very specific definitions, each with its own attributes and characteristics, and each with its own indicators for mastery. Merrill further divides his classification scheme by the terms "remember, use, and find" however for the purposes of analyzing academic texts in higher education it is sufficient to use the classification generically or at the "use" level. There are other classification schemes that could also be used beneficially; Merrill's Component Display Theory was selected because of its easy application and wide spread adoption. Table 1 summarizes Merrill's Component Display Theory classification scheme.

Table 1

General Components of Merrill's Component Display Theory

Category	Definition	Example(s)
Facts	"Arbitrarily associated pieces of information such as a proper name, a date or an event, the name of a place or the symbols used to name particular objects or events" (Merrill, 1983, p.287). Additionally, descriptions of a state of affairs, such as quantitative or qualitative data, or an assertion of opinion or point of view should be considered as facts in this context.	In the mathematical relationship 7<9 the symbol < is associated with "less than." John Adams was the 2nd President of the United States of America. There were 5 students waiting outside my office at 5:00pm.
Concepts	"Groups of objects, events, or symbols that all share some common characteristic and that are identified by the same name. Most	Adverb Schooner Igneous Mammal

	of the words in any language identify concepts" (Merrill, 1983, p.287). Facts can often be conceptualized by turning nouns into adjectives to describe an era or type indicated by the fact.	TimeAcceleration
Procedure	"An ordered sequence of steps necessary to accomplish some goal, solve a particular class of problem, or produce some product" (Merrill, 1983, p.287). Procedures may be further classified as algorithmic indicating set sequence or heuristic indicating a suggested order for guidance (Landa, 1983).	To Bake a Cake 1) Buy Cake Mix 2) Pre-heat oven 3) Add water, oil and eggs to mix with blender 4) Pour into non-stick pan 5) Place in oven for 25 minutes
Principles	"Explanations or predictions of why things happen in the world. Principles are those cause-and-effect or co-relational relationships that are used to interpret events or circumstances" (Merrill, 1983, p.288).	The EFFECT waves, are CAUSED by the moon's gravitational pull on the earth.

To categorize content into these classifications students need to carefully examine and analyze the material. Many terms are difficult to classify and require a full awareness of the context for correct placement. To facilitate mastery of applying this classification scheme, teachers should provide a number of examples of content with the categories identified; two such examples are provided later in this article. Students should attempt to identify all instances of facts, concepts, procedures, and principles within a text sample and compare classifications with an experienced teacher. This process is often described as modeling.

Modeling helps students construct meaning by demonstrating how a diaphanous content source can be organized and processed (Bandura, 1986). Successful learning strategies require students to organize, elaborate, rehearse, and monitor their comprehension, (Weinstein and Mayer, 1986), but to learn these skills a student must have the process demonstrated. A teacher may choose to model a paragraph and subsequently have a student classify a following paragraph. As a student's responses become more consistent with the teacher's model responsibility gradually released to the student Pearson (1985). Modeling is a strategy that is consistent with learning under conditions that are uncertain, unique, and indeterminate (Schon, 1987) and thus is a teaching strategy appropriate for the task of knowledge classification. Modeling is stressed because this type of analysis is somewhat of a craft and is not amenable to a strict application of a technical procedure or algorithm. Classification in this system is often idiosyncratic. Practice under guidance is critical to the development of this skill.

Learning strategies have been correlated with these classifications to facilitate mastery. These correlations are summarized in Table 2, along with a list of verbs that a student may use to guide their selection of an appropriate learning strategy.

Table 2
Operations to assist mastery
(Smith and Ragan, 1999)

Category	Operations to facilitate mastery	Action for mastery
Facts	Fact mastery should reflect the ability of the learner to recall or summarize statements, associations, and propositions.	Recall, Remember, Associate
Concepts	Concept mastery should reflect the ability classify terms according to their attributes, provide examples and discriminate them from non-examples (concepts similar but slightly different than the one under consideration), and place them in super-ordinate, coordinate and sub-ordinate relationships with other concepts.	Discriminate, Classify, Relate,
Procedure	Procedural mastery should reflect a learner's ability to follow a procedural rule.	Follow, Implement
Principles	Principle mastery should reflect the learner's ability to use a principle to predict or explain phenomena.	Interpolate, Extrapolate, Predict, Explain

Each individual conducting this type of analysis would, of course, make classifications choices according to their own background and experience. One thing that should become immediately clear is that there is a lot missing from this type of analysis. The facts, concepts, principles, and procedures are important for building a foundation for understanding; however, they are inert without placing them in context of the authors' line of reasoning. Merrill (1983) suggests that, "It is only when a relationship between two or more concepts is discovered that a subject matter begins to emerge" (p.296). We need to know what was the author's argument, what evidence did he provide, what logical steps did he take to lead us, what anecdotes did he share, and what conclusions did he draw? That is the next step of understanding the content.

Each proposition from a content source is interrelated in some manner, in some logical and intelligible system (Elder & Paul, 2001).

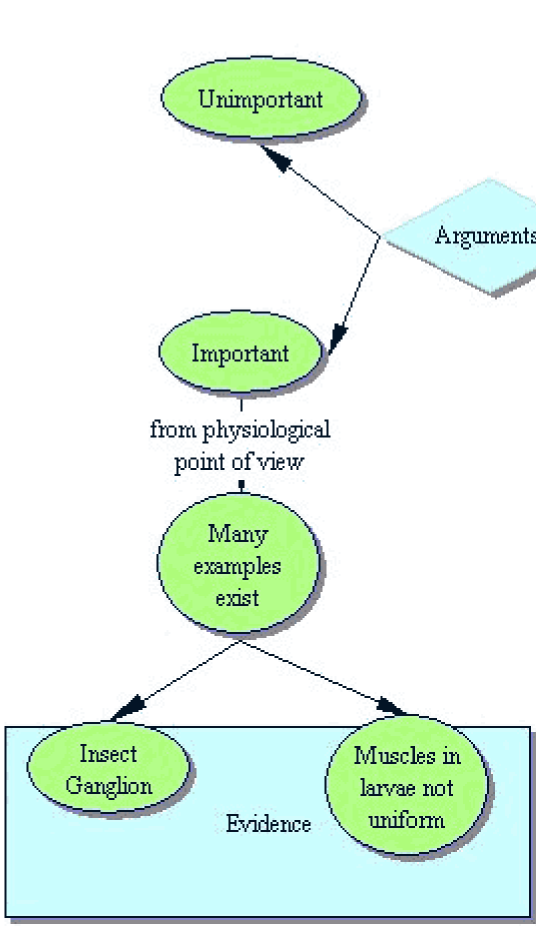
With some investigation, analysis and practice the structure of the author's argument is more often than not discernable. Once one can identify the line of reasoning one then has some level of confidence that they know what the author or lecturer thought was important. An efficient method of addressing this second step is to create a visual map of the content. For example, the passage in Table 3 has the following primary argument, that natural selection is a principle that depends on the accumulation of differences and these differences accumulate in physiological important ways that lead to speciation. Visualization can be a productive tool in analyzing and displaying a line of reasoning (Novak & Govin, 1999). Figure 1 displays Darwin's argument graphically. Student should be encouraged not only to identify an author's line of reasoning but to represent it visually and concretely (Novak & Govin, 1999).

Table 3
Individual Differences
Darwin (1856)

The many slight differences which appear in the offspring from the same parents, or which it may be presumed have thus arisen, from being observed in the individuals of the same species inhabiting the same confined locality, may be called individual differences. No one supposes that all the individuals of the same species are cast in the same actual mould. These individual differences are of the highest importance for us, for they are often inherited, as must be familiar to every one; and they thus afford materials for natural selection to act on and accumulate, in the same manner as man accumulates in any given direction individual differences in his domesticated productions. These individual differences generally affect what naturalists consider unimportant parts; but I could show by a long catalogue of facts, that parts which must be called important, whether viewed under a physiological or classificatory point of view, sometimes vary in the individuals of the same species. I am convinced that the most experienced naturalist would be surprised at the number of the cases of variability, even in important parts of structure, which he could collect on good authority, as I have collected, during a course of years. It should be remembered that systematists are far from being pleased at finding variability in important characters, and that there are not many men who will laboriously examine internal and important organs, and compare them in many specimens of the same species. It would never have been expected that the branching of the main nerves close to the great central ganglion of an insect would have been variable in the same species; it might have been thought that changes of this nature could have been effected only by slow degrees; yet Sir J. Lubbock has shown a degree of variability in these main nerves in Coccus, which may almost be compared to the irregular branching of a stem of a tree. This philosophical naturalist, I may add, has also shown that the muscles in the larvae of certain insects are far from uniform. Authors sometimes argue in a circle when they state that important organs never vary; for these same authors practically rank those parts as important (as some few naturalists have honestly

> confessed) which do not vary; and, under this point of view, no instance will ever be found of an important part varying; but under any other point of view many instances assuredly can be given.

Figure 1 **Graphical depiction of individual differences**



Conclusion

The two step technique outlined in this article is powerful in that it offers a specific system for analyzing knowledge and guiding study behavior. By combining the analytical methods from a classification scheme with the synthetical methods from documenting an argument the student can independently construct an understandings directly from subject matter content. The specific classification scheme provided by the Component Display Theory (Merrill, 1983) is important because it tells students what to look for and how to confirm mastery of the material. A deficiency in this critical "knowledge of knowledge" often only becomes apparent following a test or formal evaluation. And the reasons for the lack of mastery may never be revealed and might be attributed to lack of motivation or some other deficiency in attitude or aptitude.

Teaching students to classify content according to the

Component Display Theory is difficult. It is not uncommon for student's classifications to differ somewhat from their teacher's, as well as their fellow student's categories. However, by using modeling techniques that utilize a number of examples from different content sources students should be able to learn this instructional design craft The degree of correlation between learners and experts in this process is left for future investigations, however what is important is that this process of analyzing text in this manner provides at least some guidance for content decomposition and analysis. By using the Component Display Theory students can begin to classify the material in texts and other instructional sources in ways to guide their study behavior. The classification provides guidance on what operations need to be done to ensure that a particular category of knowledge is mastered according to its inherent structure. By following these methods students will be able to engage with subject matter with specific goals in mind.

This approach provides a framework for building students skill in selecting and implementing appropriate learning strategies. There are many empirical questions that could be addressed to further illuminate the nature of the this approach including,

- the amount of preparation and practice required to master the classification theory,
- the differences in classification between novice learners and expert practitioners and instructors,
- the correlation of classification between students,
- the ability to identify secondary sources that may assist the creation of operations for a particular classification,
- the use and adoption of different classification schemes by students,
- and the habitual nature of this type of analysis.

All of suggestions are among possible research questions that could be investigated relating to this paper's propositions. The answers to these questions will further assist students' ability to implement appropriate learning strategies.

References

Anderson, L.W., & Krathwohl D.R. (2001). A taxonomy for learning and teaching and assessing, New York: Longman.

Bandura, Albert. (1986). Social foundations of thought and action. Englewood Cliffs, NJ: Prentice Hall.

Bloom, B.S. (Ed.) (1956). Taxonomy of educational objectives: Cognitive domain. New York: David Mckay.

Bruner, J.S. (1966). Towards a theory of instruction. Cambridge, MA: Belknap.

Darwin, C. (1859). On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life. Retrieved October 15, 2003, from the University of Virginia e-text center website: http://etext.lib.virginia.edu/toc/modeng/public/DarOrig.html

Gagne, R.M. (1977) The conditions of learning (3rd. ed.). New York: Holt, Rinehart & Winston.

Jonassen, D.H., & Reeves, T.C. (1996). Learning with technology: using computers as cognitive tools, In D.H. Jonassen (Ed.), handbook of research for educational communications and technology, New York: Simon and Schuster Macmillan.

Jonassen, D.H, Wilson, B.G., & Wang, S., (1993). Constructivist uses of expert systems to support learning. Journal of Computer-Based Instruction. v. 20 (Summer '93) p. 86-94.

Krugman, P.R., & Obstfeld, M. (1988). International economics theory and policy, Glenview IL.: Scott, Foresman and Company.

Landa, L.N. (1983). The algo-heuristic theory of instruction. In C.M Reigluth (Ed.) Instructional design theories and model: An overview of their current status. Hillsdale NJ: Lawrence Erlbaum Associates, Publishers.

Merrill, M.D. (1983). Component Display Theory. In C.M Reigluth (Ed.) Instructional design theories and model: An overview of their current status. Hillsdale NJ: Lawrence Erlbaum Associates, Publishers.

Novak, J.D. & Govin, D.B. (1999). Learning how to learn, Cambridge: Cambridge University Press.

Paul, R. & Elder L., (2001). How to study & learn a discipline, Dillon Beach, CA: The Foundation for critical thinking.

Pearson, P.D. (1985). Changing the face of reading comprehension instruction. The Reading Teacher, 38, 724-738.

Pinker, S. (1997). How the mind works. New York: W.W. Norton and Company.

Ryan, M.P. (2001, October). Creating expert learners by modifying naïve learning practices, Presentation at the annual conference of the PODNetwork, St. Louis.

Schon, D.A. (1987). Educating the Reflective Practitioner. San Francisco: Josey-Bass Publishers.

Smith P.A., & Ragan, J.T. (1999). Instructional Design (2nd Edition), Hoboken NJ: John Wiley and Sons.

Van Merrienboer J.J.G. (1999). Cognition and multimedia design for complex learning, Inaugural address, Open University of the Netherlands, July 1, 1999.

Weintstein, C.E., & Mayer, R.E. (1986). The teaching of learning strategies. In M.C. Wittrock (Ed.), Handbook of research on teaching (3rd ed.) (pp.315-327). New York: Macmillan.
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