

Metacognition: Designing For Transfer

Judy Adkins
University of Saskatchewan

Abstract

Successful learners cultivate a repertoire of metacognitive strategies that they apply when and as required by different learning circumstances. Success hinges on the appropriate transfer of relevant strategies. Metacognitive strategy design must take into account this transfer and it is this relationship that is the subject of this paper. It looks briefly at what metacognition is, discusses transfer in the context of metacognition, and concludes with practical implications for instructional design.

Author

I received my Bachelor of Education from the University of Winnipeg. After teaching elementary school, and following a hiatus to raise a son and twin daughters, I returned to teaching in the field of adult education. Teaching computer applications courses and developing computer courseware sparked an interest in Instructional Design. As a result I am now pursuing a Master of Education degree in Educational Communications and Technology at the University of Saskatchewan. This electronic paper "Metacognition: Designing for Transfer" was prepared in partial fulfillment of the requirements for Edcmm 802.6, Historical and Theoretical Foundations of Educational Technology. My thanks to Dr. Richard A. Schwier, Professor.

METACOGNITION: DESIGNING FOR TRANSFER

Judy Akins
Graduate Student
Educational Communications and Technology
Department of Curriculum Studies
e-mail: jla643@mail.usask.ca

What Is Metacognition?
How Are Metacognitive Strategies Transferred?
Elements of Metacognition: What Is Transferred?
What Are the Implications for Instructional Design?
Related Sites
References

WHAT IS METACOGNITION?

Thinking ... Knowing ... Learning ... Control ...

Play with different combinations of these words and you'll be forming mental pictures of metacognition.

Thinking about knowing ...

Learning about thinking ...

Control of learning ...

Knowing about knowing ...

Thinking about thinking ...

While brief definitions like these abound and are helpful for a rudimentary understanding of metacognition, further exploration reveals two consistent themes appearing in literature on metacognition: knowledge and control.

These two aspects of metacognition are described in *Dimensions of Thinking* by Marzano et al. (1988). The authors expound on the view of Paris and Winograd (as cited in Marzano et al., 1988) which states that metacognition involves:

- _ knowledge and control of self
- _ knowledge and control of process

Knowledge and Control of Self

Successful students are aware of, monitor, and control their learning. Central to this knowledge of self and self-regulation are commitment, attitudes, and attention.

Commitment

Metacognition is at work in students who choose to commit themselves to tasks. In the words of Paris and Cross (1983) they align "skill with will" (Marzano et al., 1988, p. 10).

Attitudes

Attitudes play an important role in metacognitive self-control. Successful students attribute their success to their own efforts.

Attention

Conscious control of attention helps students understand that the level of attention required for a task varies with the task and that they can adjust the focus of their attention accordingly. This sense of personal control is related to the efficient performance of tasks.

Knowledge and Control of Process

Marzano et al. (1988) describe two elements of knowledge and control of process that are stressed by Paris, Lipson, and Wixson (1983): types of knowledge important in metacognition and executive control of behaviour.

Types of Knowledge

Knowledge may be declarative, procedural, or conditional. Declarative information is factual and involves knowing the concepts of a given task. Procedural knowledge refers to information about how to apply metacognitive strategies. Conditional knowledge is an awareness of when and why one strategy may be superior to another or more appropriate to use. Teachers who identify and teach these components of tasks are helping students to exert metacognitive control over a process.

Executive Control of Behaviour

Evaluation, planning, and regulation help students gain executive control of behaviour. These processes are the primary focus of many definitions of metacognition. Evaluation refers to students' ongoing assessments of their knowledge or understanding, resources, tasks, and goals. Planning involves the purposeful selection of strategies for specific tasks and is dependent on declarative and conditional knowledge. Regulation includes the monitoring and revision of progress toward goals. Evaluation, planning, and regulating should take place at before, during, and after stages of tasks.

“unless you know everything, what you need is thinking”

Edward de Bono (Maclure and Davies, 1991, p. xii)

Metacognition: Designing for Transfer

How Are Metacognitive Strategies Transferred?

Elements of Metacognition: What Is Transferred?

What Are the Implications for Instructional Design?

Related Sites

References

HOW ARE METACOGNITIVE STRATEGIES TRANSFERRED?

The application of metacognitive strategies in contexts other than those in which they were learned is the primary goal of teaching thinking. Transfer is the educational term for this reuse of strategies. Research supports a positive correlation between instruction in metacognitive strategies and transfer. A distinction is usually made between near transfer and far transfer, the former being when learning is applied in circumstances similar to initial learning, and the latter occurring when connections are made to dissimilar contexts. In *If Minds Matter* Perkins and Salomon (1992) talk about the fuzziness of near-far transfer and the difficulty in measuring the extent of transfer. In reporting on research in metacognition in “Metacognition Research and Theory: Analysis and Implications for Instructional Design” Osman and Hannafin (1993) manage to defuzz the issue of transfer by classifying metacognitive training strategies into four types, each of which promote transfer somewhat differently. These additional benchmarks allow educational practitioners to gauge transfer more accurately and design instruction which exploits the transfer potential of different metacognitive strategies.

It is this classification scheme that has repeatedly drawn me back to this particular article, an article that at once clarifies both metacognition and transfer, and has practical application to instructional design. It is this perspective that serves as a backdrop for the remainder of this report, a report which presents my interpretation of this article.

As criteria for their classification of metacognitive training strategies Osman and Hannafin (1992) used “training approach” and “relationship to lesson content”. They describe metacognitive training strategies that may be *embedded*, or integrated within a criterion lesson and strategies which may be taught separately - *detached* - from academic subjects. With respect to the role of lesson content strategies may be dependent on, or independent of, content. *Content-dependent* strategies focus explicitly on concepts that promote learning of particular content. Conversely, *content-independent* strategies are content-free, general strategies not specific to particular academic subjects. The four resultant strategies are described below.

Embedded Content-Dependent Strategies

Embedded content-dependent strategies emphasize near transfer. They are useful in understanding unfamiliar lesson material. They are specific strategies that support particular content and as such require explicit manipulation of lesson content and structure.

Embedded Content-Independent Strategies

Embedded content-independent strategies are general strategies that support particular content but are transferable to content of other lessons. Specific

content is used to learn strategies but once learned executive control shifts from the lesson to the student.

Detached Content-Dependent Strategies

Detached content-dependent strategies are general strategies taught separately from content but meant to be applied within particular content. The intention is to improve facility with strategies before using them in context. They hold more potential for transfer than embedded content-dependent strategies

Detached Content-Independent Strategies

Detached content-independent strategies are taught separately from content and are generic in nature. As such they support a variety of learning tasks and academic subjects. They help students to manipulate lesson material as well as to develop and maintain learning strategies. These strategies often focus more on procedural than conditional knowledge but the goal is strategy generalization and promotion of independent learning. They provide the greatest potential for transfer, that of far transfer.

Metacognition: Designing for Transfer

What Is Metacognition?

Elements of Metacognition: What Is Transferred?

What Are the Implications for Instructional Design?

Related Sites

References

ELEMENTS OF METACOGNITION: WHAT IS TRANSFERRED?

When designing for transfer, knowledge of metacognitive training strategies alone is not enough. Successful transfer is dependent on students being able to effectively control and monitor their learning. This in turn is influenced by the elements of metacognition, some of which are:

- _ Metamemory
- _ Metacomprehension
- _ Self-regulation
- _ Schema Training

Metamemory

Metamemory refers to learner awareness of which strategies are used, and should be used, for certain tasks. It includes knowledge about memory systems and memory strategies. Research indicates that young students and novice

learners have difficulty accurately estimating their comprehension and that metamemory strategy instruction should focus on specific strategic knowledge. This may include knowing when, where, and how to use strategies. Variables related to person, and task and strategy should also be taken into consideration. Variables such as feeling of knowing or judgment of recall readiness relate to person while task variables include the perceived value of the task. Perceived self-efficacy is also a factor as students with low self-esteem or external locus of control will not likely invoke correction strategies.

Metacomprehension

Effective comprehension monitoring involves knowing when you don't understand and knowing how to take remedial action to ensure successful comprehension. Remedial action is more spontaneous when errors are detected in context as opposed to being detected in isolation. The use of specified local criteria to gauge understanding improves detection.

Research with children has been varied; however it seems likely that young learners lack metacomprehension strategies because of their limited opportunities to develop such skills. On the other hand, older and more knowledgeable learners have acquired skills through experience. It requires considerable effort to master metacognitive strategies; training should be in accord with ages and expert levels of learners. Initial training should be specific and embedded strategies must not overburden learners; in the likelihood of this happening it would be preferable to have learners develop strategies outside the lessons.

The aim of methods to empower learners is to automatize strategies. Learners should be helped to develop strategies based on independent and individual assessments of learning needs, thus gaining executive control. It seems however that many strategies are learned best if they are embedded in a lesson, so while strategies should facilitate learning of specific content they should also promote strategy use.

Self-Regulation

Self-regulation refers to metacognitive adjustments students make concerning errors. This may be as a result of inherent knowing, trial and error, or hypotheses formulation. Executive control may be transferred to students through modeling as they adapt modeled processes for their own use. Social interaction provides additional models while feedback from peers lets learners observe the comprehension strategies of others. Since many researchers express concerns about reliance on external prompts, self-regulation should strive to strike a complementary balance between external cueing and internal regulating mechanisms.

Schema Training

Schema training is important to meaningful learning because it helps learners

generate their own cognitive structures or frameworks for understanding information and experiences. Learners who are informed about the significance of the training and master strategies during training appear to use them independently and on a continuing basis. Individual schemas result in less reliance on external mechanisms and more reliance on internalized comprehension monitoring strategies.

Metacognition: Designing for Transfer

What Is Metacognition?

How Are Metacognitive Strategies Transferred?

What Are the Implications for Instructional Design?

Related Sites

References

WHAT ARE THE IMPLICATIONS FOR INSTRUCTIONAL DESIGN?

The discussion of the elements of metacognition and metacognitive strategy transfer begs the question “What are the implications for instructional design?” For the instructional designer the issue is “not leaving the learner adrift in a sea of content without the tools to be successful” (Schwier in Anglin, 1995, p. 123). The following suggestions derived from the foregoing discussion offer designers practical ways to maximize metacognitive strategy transfer and thus equip learners with the appropriate navigational tools to reach shore.

_ To minimize cognitive load and counter the argument that “Metacognition is open to the objection that thinking about thinking is a disruptive process because of excess cognitive load.” (Nisbet in Maclure & Davies, 1991, p184), designers should ensure that embedded strategies can be readily accommodated. If not, detached content-dependent strategies may be used and should be automatized before applying in context.

_ Metamemory strategy design should explicitly guide young or novice learners with deficient metamemory skills. Embedded content-dependent strategies incorporating manipulation of lesson content and structure are more effective than just knowing about strategies. Examples include chapter summaries, overviews, sequence and relationship cues, and study questions.

_ Metamemory strategy instruction should focus on person variables and perceived self-efficacy to foster the desire to invoke strategies independently.

_ Older and expert learners with more sophisticated metacomprehension skills benefit from integrative strategies employing implicit content manipulations. Design might include a rationale for use and indicate other potential applications. Embedded content-independent strategies that could be used include generative summaries and questions and generic self-monitoring checklists.

_ Designers interested in promoting far transfer should use detached content-independent strategies. Design should emphasize independent strategies without reference to specific tasks. Reciprocal teaching, paraphrasing, and analyzing ideas are useful. However, if strategies must be embedded designers should identify the strategies that can serve as models for use in other contexts.

_ To encourage high-road transfer, defined by Perkins and Salomon (Costa, Bellanca, & Fogarty, 1992) as the effortful, deliberate search, selection, and application of a principle, designers need to help students build or activate a schema in order to integrate new with existing knowledge. Embedded prompts requiring students to predict events may be used; alternately detached strategies may focus on establishing relationships.

_ To promote self-sufficiency, designers must inform learners about why, when, and how to use strategies. Metamemory skills are most likely to be maintained and transferred when learners are knowledgeable about their value and potential for use. The goal for the designer is to encourage independent activation of strategies.

_ Metacomprehension strategies are improved when supported by guidelines indicating what is to be comprehended and how to assess comprehension. Designers must always beware of the cognitive load placed on learners. If it cannot be minimized, detach the teaching.

_ External prompts such as analogies and generation of hypotheses serve to promote self-regulation and help learners monitor methods and depth of processing. The designer must help learners acquire not only skills but also autonomous control of skills such that few, if any, external prompts are needed. To wean students from external cues designers can help learners identify appropriate activities and invoke relevant metacomprehension strategies.

_ Design should encourage social interaction. Procedures such as reciprocal teaching may promote self-regulation through natural dialogue employing embedded summaries, questioning, or predicting.

_ Detached content-independent strategies may be adapted to support local content and still teach highly transferable strategies.

Examples of instructional methods supporting metacognitive strategy transfer were given in the above implications for design. The scope of this paper did not permit a more exhaustive look at this area. Osman and Hannafin (1992) offer further examples and numerous others were encountered in the course of research. Two books, practical in nature, for designers, educators, and learners are:

_ *Becoming a Master Student* (Ellis, 1991).

– *Self-Talk for Teachers and Students* (Manning and Payne, 1996).

In summary, it's clear that for effective transfer metacognitive strategies must be taught. Instructional designers need to be cognizant of what is being transferred, in what way, to what extent, and most of all, how to effect *all of the above*. It's time to let go of the notion that transfer is a side-effect of teaching, what Perkins and Salomon refer to as the Little Bo Peep model (Costa, Bellanca, & Fogarty, 1992).

“No more is there an excuse for letting knowledge accumulate in isolated puddles within students' minds.”

David Perkins and Gavriel Salomon (Costa, Bellanca, & Fogarty, 1992, p. 208)

Metacognition: Designing for Transfer

What Is Metacognition?

How Are Metacognitive Strategies Transferred?

Elements of Metacognition: What Is Transferred?

Related Sites

References

RELATED SITES

MegaMath

<http://www.cs.uidaho.edu/~casey931/mega-math/index.html>

Metacognition and Reading to Learn

http://www.indiana.edu/~eric_rec/ieo/digests/d96.html

Personal Efficacy

<http://www.ncrel.org/sdrs/areas/issues/students/learning/lr200.htm>

Strategies for developing metacognitive behaviors

<http://www.valdosta.peachnet.edu/~whuitt/psy702/digests/metacogn.dig>

Teaching Thinking: an Introduction to the Research Literature

<http://www.ed.ac.uk/~webscre/Spotlight26.html>

Teaching Thinking Skills

<http://www.nwrel.org/scpd/sirs/6/cu11.html>

Metacognition: Designing for Transfer

What Is Metacognition?

How Are Metacognitive Strategies Transferred?

Elements of Metacognition: What Is Transferred?

What Are the Implications for Instructional Design?

References

REFERENCES

Anglin, G.J. (Ed.). (1995). Instructional Technology Past, Present, and Future. Englewood, CO: Libraries Unlimited.

Costa, A., Bellanca, J., & Fogarty, R. (Eds.). (1992). If Minds Matter A Foreword to the Future Volume One. Palatine, Illinois: Skylight Publishing.

Ellis, D.B. (1991). Becoming a Master Student. Rapid City, SD: College Survival, Inc.

Maclure, S., & Davies, P. (Eds.). (1991). Learning To think: thinking To Learn. Oxford: Pergamon Press.

Manning, B.H., & Payne, B.D. (1996). Self-Talk for Teachers and Students Needham Heights, MA: Allyn and Bacon.

Marzano, R.J., Brandt, R.S., Hughes, C.S., Jones, B.F., Presseisen, B.Z., Rankin, S.C., & Suhor, C. (1988). Dimensions of Thinking. Alexandria, VA: Association for Supervision and Curriculum Development. pp. 9-16.

Osman, M.E., & Hannafin, M.J. (1992). Metacognition Research and Theory: Analysis and Implications for Instructional Design. Educational Technology Research and Development, 40 (2), 83-99.

Metacognition: Designing for Transfer
What Is Metacognition?
How Are Metacognitive Strategies Transferred?
Elements of Metacognition: What Is Transferred?
What Are the Implications for Instructional Design?
Related Sites