Tech., Inst., Cognition and Learning, Vol. 3, pp. 105-113
Reprints available directly from the publisher
Photocopying permitted by license only

Supporting Self-Regulated Learning with gStudy Software: The Learning Kit Project**

PHILIP H. WINNE[1*], JOHN C. NESBIT[1], VIVE KUMAR[1],
ALLYSON F. HADWIN[2], SUSANNE P. LAJOIE[3],
ROGER AZEVEDO[4], NANCY E. PERRY[5]

[1] Simon Fraser University, Canada
[2] University of Victoria, Canada
[3] McGill University, Canada
[4] University of Maryland
[5] University of British Columbia

We assume learners mediate instruction and self-regulate learning. To gather fine-grained time-sequenced data that trace these processes, the Learning Kit Project is developing software, called gStudy. Using cognitive tools in gStudy, learners can make notes, create glossaries, label and index content, construct concept maps, search for information, chat and collaborate, and receive coaching. Each of gStudy's tools is designed on the basis of prior research to scaffold learning and help learners enhance self-regulated learning as they investigate study tactics and learning strategies. We describe the software's features and survey some of its foundations in research.

Keywords: Self-regulated learning, learning technologies, coaching, collaboration, trace data.

---

*Correspondence concerning this article should be addressed to Philip H. Winne, Faculty of Education, Simon Fraser University, Burnaby, British Columbia V5A 1S6, Canada. Electronic mail may be sent via Internet to winne@sfu.ca.
**Support for this work was provided by grants to Philip H. Winne from the Social Sciences and Humanities Research Council of Canada (410-2002-1787 and 512-2003-1012), the Canada Research Chair program, and Simon Fraser University.

SUPPORTING SELF-REGULATED LEARNING WITH gSTUDY SOFTWARE: THE LEARNING KIT PROJECT

The Learning Kit Project (LKP) is guided by the premise that two origins of knowledge and intelligence— instructors *and* learners—should be tapped to promote learning from instruction (Winne, 1989). Instructors build instructional designs in which they apply experience and, more or less, what they know about findings from empirical research that imply how features of instructional designs promote learning. Learners cognitively mediate these instructional design features (Winne & Marx, 1977; Winne, 2001). Learners apply knowledge and skills to choose whether and how to use features of instructional design to optimize achievements relative to *their* goals (Winne, 1995). That is, learners self-regulate learning. Under these premises, goals for R&D in LKP are to build and evaluate software that meets three needs:

1. Many instructors are uninformed about findings from research on instruction and the learning sciences that identify features of instructional design that improve learning on average. In response, LKP is developing software that will help instructors create materials and activities for instruction that put into practice and coordinate findings from this body of empirical research (see Chu, 2005).
2. All learners cognitively mediate features of instructional designs and many do so under constraints of undeveloped or weak skills for learning. In response, LKP is developing software that provides scaffolds for learners to develop expertise in study tactics and learning strategies that coordinate with features of instructional designs.
3. To test and improve learning from instruction over time, researchers, instructors and learners alike need data about the effects and the effectiveness of (a) features of instructional design as mediated by (b) learners' cognitive engagements with those features under (c) varying conditions of learning. In response, software being developed in LKP gathers, helps analyze and interpret data that meets these needs (see Hadwin, Nesbit, Jamieson-Noel, Winne, & Kumar, 2005).

In this article, we focus on the second and third of these goals in LKP.

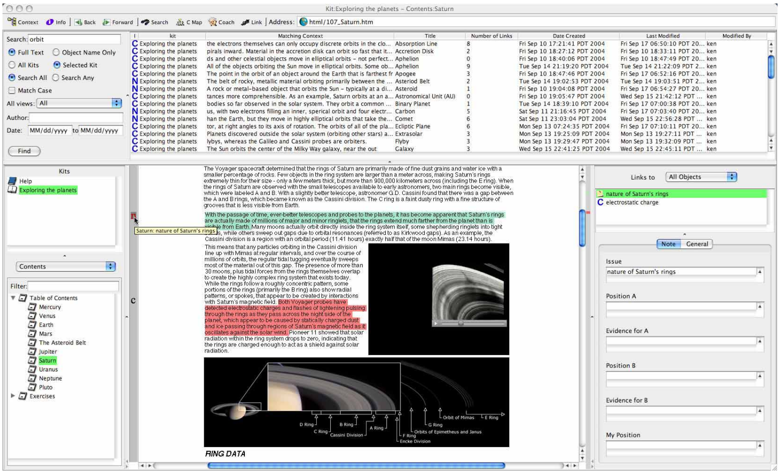

FIGURE 1
Screenshot of gStudy.

THE gSTUDY SOFTWARE

A major product of LKP is a software application called gStudy (Winne, Hadwin, Nesbit, Kumar, & Beaudoin, 2005). gStudy realizes suggestions Winne (1992) made about a system that is designed to pull up research on learning by its bootstraps. gStudy is a shell. It allows learners to study a learning kit about any topic. Topics can be presented using text, diagrams, photos, charts, tables, audio and video clips—any information format found in libraries and on the Internet. gStudy provides cognitive tools learners can use to engage with multimedia information in a learning kit including indexing, annotating, analyzing, classifying, organizing, evaluating, cross-referencing and searching it. Tools for studying information are designed, as much as possible, to apply findings that research demonstrates can positively influence solo and collaborative learning and problem solving. Figure 1, above, shows one of gStudy's views.

Space limits preclude a full description of each of gStudy's tools. Here, we sketch major features.

Notes. To make a note that annotates information in a learning kit, a learner selects information (a string of text, a region in a diagram, a frame in a video clip or any of the whole “information objects” that can be created in gStudy) and pops up a contextual menu using a keyboard combination. gStudy is pre-stocked with a variety of notes that provide a template (schema) according to which the learner can structure an annotation about the selected information (e.g., a debate note template has a 6-part schema: issue, position A, evidence for A, position B, evidence for B, my position). Such schema provide standards for metacognitively monitoring comprehension and for elaborating information in ways that enhance its retrievability (see Bruning, Schraw, Norby, & Ronning, 2004). Each selection and every note are instantiated as objects which gStudy automatically links to the selection where a note originated. Links allow learners to navigate from an object to any other objects linked to it. Learners (and instructional designers) can create new note templates at will by using a simple template editor, thereby generating an observable trace of self-regulated learning (see Winne, 2001).

Labels. Using the same method to initiate making a note, the learner can assign a label to a selection. Labels classify selections according to types of information (e.g., principle, key experiment), an action to be applied to the selection (review), or any other kind of label a learner may want to add to those pre-stocked in gStudy. If the learner wishes, a brief description can be added to elaborate the label which enhances retrievability (Winne, Hauck, & Moore, 1977). As with notes, gStudy links each entry in the list of labels to the multiple selections that share attributes of the label so learners can, with a single click, navigate back to the information that was labeled.

Glossary. Any key element in the domain of knowledge being studied in gStudy can be added to the glossary using the same method as making a note (select + keyboard combination → fill in a template). Like a note, each entry in the glossary can be elaborated by instantiating slots in a template the learner constructs or the instructional designer provides.

Index. gStudy also provides learners with a tool to index materials. The index also can be automatically populated with every term in the glossary, inviting learners to repeatedly rehearse key concepts in the domain of knowledge as they index information in the learning kit. Like all information objects in gStudy, an index term can be linked to any other information object, such as a note or a bookmark referring to a resource in the Internet.

Concept Maps. Concept maps are node-and-arc formats for displaying information. They enhance learning as media for viewing information and as representations of information learners build (Nesbit & Adesope, 2005).

All information objects in gStudy are automatically included in the concept map of a learning kit. Links that learners and content developers make among information objects define arcs in the concept map. As well, learners can make concept maps from scratch. As they do, they create notes and other information objects to be elaborated later. Concept maps are graphically sortable and filterable as a function of information contained in templates and given by metadata tags (author, date modified, etc.).

Search. Learners design a search query using a template where they enter data (e.g., “orbit” + “Saturn’s rings”), choose options from lists (e.g., specific collaborators, particular learning kits) and specify conditions (e.g., search only in notes, return only information objects with more than 0 linked objects). Upon executing a search query, its “design statement” becomes an information object and its results accumulate as successive rows in a search query table. Results of an executed query are displayed in a second sector of the same table with a wide range of information beyond merely the “hit.” gStudy returns data about the hit’s local context (± N words), location of the hit (e.g., title of kit: kind of information object: title of information object), dates created and modified, author, and other attributes. Selecting a particular result displays that result in the context where it is located.

Guided Chat and Structured Collaboration. Few learners ever receive instruction about how to collaborate productively. To guide their synchronous chats and asynchronous collaboration on projects, we build on several strands of research. For example, scripted collaboration/chat has been shown to benefit learning (O’Donnell, 1999). gStudy’s chat tool encourages learners to adopt one of several roles (e.g., critic, data analyst) and provides scaffolds in the form of conversational stems filtered to match the adopted role and articulated across roles. A concept map depicts the pattern of the participation structure relative to the roles learners adopt. A simple click on a stem copies it to the chat entry field and highlights the function of that conversational act within the pattern shown in the concept map. This design helps learners manage both fine-grained events and overall flow in the chat.

The information objects learners create can be shared asynchronously. Before uploading an object so collaborators can access it, learners use templates to catalog each object. This communicates to collaborators what role the data plays in the collaborative enterprise. As with chats, concept maps depict the function of each type of information object relative other types and the way(s) in which each object advances progress toward the goal(s) of the collaboration.

These features directly scaffold learners' chats and collaborations. As well, gStudy preserves multiple artifacts. Saved chats, examinable properties of collaborators' roles, and traces of how roles articulated over the course of the collaboration are data that describe how collaboration unfolded. Examinable properties of information objects contributed and how they were articulated in the collaborative structure document what collaboration achieved. Learners and researchers both can use these data to analyze co-regulation of individual and group learning.

Coach. gStudy offers several methods to coach learners. One modeled after Eliza, the pseudo-Rogerian counseling program, is called gLiza. Its purpose is to expose a learner to study tactics and conditions that affect learning and collaboration that the learner otherwise would not likely have considered. A second coach is an expert system modeled after an intelligent help system (Greer, McCalla, Cooke, Collins, Kumar, Bishiop, & Vassileva, 2000). It will engage in quasi-conversation with the learner so that both its knowledge base and the learner's intelligence are brought to bear in diagnosing problems of learning and collaboration. When historical data about the learner and the expert system coach's knowledge base are jointly sufficient, the coach will advise the learner about alternative tactics and learning strategies that may remedy the learning problem.

Log Analyzer. As learners "do their work" to study, gStudy unobtrusively records all their interactions with information in the learning kit as well as all the tools they use to operate on that information. For example, when a learner highlights text or region in a diagram, gStudy records: that highlighting was applied, the information that was highlighted (or, in the case of a diagram, coordinates in the display that were marqueed plus metadata the instructional designer may have provided to describe the diagram), features describing the placement of the highlighted information within the larger information architecture of the learning kit (e.g., the section of a kit in which it occurs), and the time at which the learner highlighted this information. These data trace the cognitive operations with which learners process information and mediate instructional designs (Winne, 1982; Winne & Perry, 2000). With a log of trace data, we can reconstruct a complete time-referenced description of the observable actions that reflect *how* a learner studied. This includes the fine-grained activities that constitute learning, expressions of motivation, and the strategic patterns of these that constitute active and self-regulated learning.

Researchers and learners both will use the log analyzer tool to carry out their respective investigations about how learners study and to what effects.

Learners (and researchers) can ask: How often do I highlight? Do I recall what I highlight? How many notes do I take and which templates do I use or not use? Do I link notes to other information objects? How do these activities influence my subsequent studying? How do they affect my achievement? We are developing a variety of quantitative methods ranging from simple frequency counts to graph theory statistics that characterize patterns of study activities (see Winne, Gupta & Nesbit, 1995; Hadwin, Nesbit, Jamieson Noel, Winne & Kumar, 2005) to descriptions of learning based on Bayesian belief networks. Each offers a revealing vantage point for characterizing studying processes singly, their patterns, and condition-process-product relationships.

AIMS OF THE LEARNING KIT PROJECT

By carefully designing tools learners use in gStudy, we can develop warrants for our interpretations about learning events that heretofore have been available only by interrupting learners to participate in think-aloud protocols. For example, any note template can include a field where learners can make "journal" entries about why they create a note or why they link it to a particular information object. Templates also can provide a slider. If we label the slider, "How well do I know this?" learners can indicate how well they judge they have understood or learned information to which the note is linked. When the learner sets the slider unprompted other than by its display, gStudy has logged a trace (a) that the learner metacognitively monitored comprehension as well as (b) the value assigned by that judgment.

If the learner later uses gStudy's search tool to identify every note (and it's linked objects) that was rated for comprehension below some threshold, gStudy has traced key features of metacognitive monitoring, namely, the level of comprehension the learner believed to be a threshold for reviewing and when the learner elected to review. After gStudy returns all instances of information meeting the learner's search criteria, if the learner selects a particular note (or the information linked to the note) to review, gStudy has traced another standard for metacognitive monitoring, namely, the information for which the learner searched. These traces provide LKP with data unparalleled in detail and scope as we research the effects of instructional design variables on study tactics, learning strategies, and the ways learners cognitively mediate and self-regulate learning.

Software development is ongoing and will continue for approximately another year. We have carried out two large sample studies investigating relations among study tactics, several individual differences that are prominent in educational psychology (e.g., goal orientation), and achievement. A large and diverse program of further research is planned to address two main questions: What works? How can learners be supported in self-regulating learning to amplify what works on average? A major emphasis in the latter area is to investigate methods for feeding back to students data about how they study to learn. Providing and researching the recursive effects of process feedback alongside conventional knowledge-of-results feedback (Butler & Winne, 1995) is, to our knowledge, novel in the broad field of research on learning software.

A noteworthy feature of gStudy and the Learning Kit Project is potential to massively expand the scope for researching learning. Because gStudy is not bound to any particular subject matter, it supports research across all areas of the curriculum for learners of any age above that at which they are beginning to read. Its client-server architecture provides means for large scale studies involving diverse participants throughout the Internet. Installing content in gStudy is simple because its display method is primarily HTML. To the extent we can involve hosts of researchers in widespread use of the system, gStudy offers considerable promise to provide means for generating a huge volume of detailed descriptive data that can feed scientific curiosity and advance the learning sciences.

REFERENCES

Bruning, R. H., Schraw, G. J., Norby, M. M., & Ronning, R. R. (2004). *Cognitive psychology and instruction.* Upper Saddle River, NJ: Pearson Education.

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, *65*, 245-281.

Chu, S. T. L. (2005, April). *Bridging the gap between research and practice: Educational psychology-based instructional design for developing online content.* American Educational Research Association, Montreal.

Greer, J., McCalla, G., Cooke, J., Collins, J., Kumar, V., Bishop, A., &Vassileva, J. (2000). Integrating cognitive tools for peer help: The intelligent intranet peer help-desk project. In S. P. Lajoie (Ed.)., *Computers as cognitive tools, volume two: No more walls* (pp. 69-96). Mahwah, NJ: Lawrence Erlbaum.

Hadwin, A. F., Nesbit, J. C., Jamieson-Noel, D., Winne, P. H., & Kumar, V. (2005, April). *Tracing self-regulated learning in an e-learning environment.* American Educational Research Association, Montreal.

Nesbit, J. C., & Adesope, O. O. (2005). *Effects of concept and knowledge maps: A meta-analysis*. Manuscript submitted for publication.

O'Donnell, A. M. (1999). Structuring dyadic interaction through scripted cooperation. In A. M. O'Donnell and A. King (Ed.), *Cognitive perspectives on peer learning* (pp. 179-196). Mahwah, NJ: Lawrence Erlbaum.

Winne, P. H. (1982). Minimizing the black box problem to enhance the validity of theories about instructional effects. *Instructional Science*, *11*, 13-28.

Winne, P. H. (1989). Theories of instruction and of intelligence for designing artificially intelligent tutoring systems. *Educational Psychologist*, *24*, 229-259.

Winne, P. H. (1992). State-of-the-art instructional computing systems that afford instruction and bootstrap research. In M. Jones and P. H. Winne (Eds.), *Adaptive learning environments: Foundations and frontiers* (pp. 349-380). Berlin: Springer-Verlag.

Winne, P. H. (1995). Inherent details in self-regulated learning. *Educational Psychologist*, *30*, 173-187.

Winne, P. H. (2001). Self-regulated learning viewed from models of information processing. In B. J. Zimmerman and D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theoretical perspectives* (2nd ed, pp. 153-189). Mahwah, NJ: Lawrence Erlbaum Associates.

Winne, P. H., Gupta, L., & Nesbit, J. C. (1994). Exploring individual differences in studying strategies using graph theoretic statistics. *Alberta Journal of Educational Research*, *40*, 177-193.

Winne, P. H., Hadwin, A. F., Nesbit, J. C., Kumar, V., & Beaudoin, L. (2005). *gStudy: A toolkit for developing computer-supported tutorials and researching learning strategies and instruction* (version 2.0) [computer program]. Simon Fraser University, Burnaby, BC.

Winne, P. H., Hauck, W. E., & Moore, J. W. (1975). The efficiency of implicit repetition and cognitive restructuring. *Journal of Educational Psychology*, *67*, 770-775.

Winne, P. H., & Marx, R. W. (1977). Reconceptualizing research on teaching. *Journal of Educational Psychology*, *69*, 668-678.

Winne, P. H. & Perry, N. E. (2000). Measuring self-regulated learning. In P. Pintrich, M. Boekaerts, & M. Zeidner (Eds.), *Handbook of self-regulation* (p. 531-566). Orlando, FL: Academic Press.