Instructional Design and eLearning: A Discussion of Pedagogical Content Knowledge as a Missing Construct

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Abstract

With the increasing use of instructional designers as pedagogical experts for eLearning activities within institutions of higher education, it is important we learn as much as possible about designing and developing effective instructional design across the disciplines. When instructional designers are employed as pedagogical experts but not content experts—and the instructors are content experts but not pedagogical experts—the result is a bifurcation of content and pedagogy. Connections of these two domains should not be neglected. This discussion paper makes the case for why pedagogical content knowledge should: (1) become integrated within the roles and functions of instructional designers; (2) be a requisite component within programmes of instructional design, and; (3) a primary focus of further research.

Keywords: instructional design; pedagogical content knowledge; higher education; eLearning

Introduction

Most universities today offer some form of eLearning (Palloff & Pratt 2001). While explorations of eLearning activities at the postsecondary level have been ongoing for about two decades (e.g., Feenberg, 1989; Hiltz 1984; Hiltz & Johnson, 1989; Hiltz, et al., 1986; Hiltz & Turoff, 1978, 1981, 1985; Kerr & Hiltz, 1982), eLearning is still considered to be a relatively new phenomenon for the majority of educators within higher education. Although definitions of eLearning in the literature are diverse, there is general consensus that eLearning in some way involves the use of Internet communication technologies to enhance and/or support learning activities. At present, learning management systems (LMS) (i.e., FirstClass, Blackboard, WebCT, Moodle, Lotus Notes) are the dominate Internet communication system for eLearning activities. eLearning can also take many forms, ranging from supplementing an on-campus course with LMS resources and a web-based course outline to fully online, distance delivered courses. Within traditional institutions of higher education, fully distance delivered eLearning courses remain limited, whereas blended eLearning courses have become prevalent (CERI, 2005). Blended eLearning requires students to participate in online activities (e.g., computer conferencing discussions, collaborative group projects/presentations, access course notes) as part of the course load and replacing part(s) of the face-to-face activities. Frequently cited reasons for the use of blended eLearning in higher education are varied, often including: cost savings, the removal of access barriers, student demand, enhanced quality of the learning transactions, and the ability to facilitate critical thinking (Garrison, 2002; Saundercook & Cooper, 2003; Twigg, 2003). Though, it should be noted that research investigating these claims has been mixed with overall results that are inconclusive (e.g., Kanuka, 2005). At best, it would appear that these benefits can be achieved under certain circumstances.

Nevertheless, persuasive arguments by technological advocates continue to be put forward and blended eLearning offerings within the higher education sector continue to experience growth. Perhaps the most compelling line of reasoning put forward, arguing for an increased use of eLearning, is based on the claim that because there is greater visibility in the eLearning classroom (e.g., the permanent record of classroom activities in text-based communication), there is, in turn, a greater need for accountability and the necessity to work with a team of instructional designers (Bates 2005). When working with instructional designers who use instructional systems design models (i.e., Dick, et al., 2005) there is accountability for not only what is being taught, but also what is being learned.

Early literature on the use of instructional design for eLearning maintained that eLearning's success was largely due to the link that programmes of instructional design have made between the design of learning materials embedded in learning theory and the effective selection and use of technology. More recent work by Bates (2005) in the area of eLearning concludes that without a team of instructional design experts, facilitation of effective eLearning is highly unlikely. For example, given the wide variety of Internet communication technologies and social software available (i.e., computer conferencing, podcasting, blogs, learning management systems, audio/video technologies, email, instant messaging, social bookmarking, peer-to-peer networks, non-immersive virtual reality, etc.), most academics will need to consult with instructional designers to ensure that the technologies they choose and use will teach the concepts effectively and meet their students' needs. In addition, many of the problems and concerns that have been identified in the literature related to eLearning—such as, for example, low rates of participation, learner resistance, high non-completion rates, poor learner performance (Bates, 2005; Kanuka et al., 2006)—can be addressed by working with a team of instructional design experts. Recent research by Twigg (2003) provides additional examples of the benefits of effective technology applications and effective instructional design.

While the use of instructional designers with expertise in pedagogical strategies and technology is becoming wide-spread within institutions of higher education, careers in instructional design are not new. Programmes for instructional designers have been offered for approximately 40 years in North America—often at the masters or doctoral levels. Prior to the '8os, the role of the instructional designer was to design curricula for instructional books, manuals, and/or paper-based distance education materials. However, as computer technologies advanced so too did instructional design services. At present, the role of the instructional designer ranges from consultation on educational television, instructional video to development of computer-based instruction, printed media, curricular development and, more recently, eLearning. There is ample evidence to support the belief that instructional designers have been pivotal to the growth and success of eLearning offerings in higher education (Bates, 2005). Theory development and research in the field of instructional design has focused on needs analysis, learning objectives, task analysis, entry skills and characteristics, pedagogical strategies, media selection and evaluation and assessment—all of which has lead to more informed and effective design and development practices for eLearning.

Noticeably absent in this body of research, however, is the exploration of the relationship between content knowledge and instructional design models. Specifically, past research within the field of instructional design has tended not to explore the effects of pedagogical content knowledge on the learning design or vice versa. Rather, the research in instructional design has focused on measuring teaching practitioners' use of a general set of pedagogical practices under the assumption that these practices are effective, irrespective of the subject matter being taught and without regard for the pedagogical knowledge that teachers have of the content they are teaching. Unclear is why research on instructional design has not explored the possible impact that the disciplines might have on instructional design—in spite of existing research within the field of higher education that has revealed the importance of teachers' content knowledge on teaching practices and effective learning activities (e.g., Donald, 2002; Shulman, 1986; Ball & McDiarmid, 1990; Magnusson et al., 1999). This is a significant shortcoming of current research on instructional design.

This discussion paper will provide a brief overview of instructional design programmes, the roles and functions of instructional designers, and why instructional designers could benefit from research into the effects of pedagogical content knowledge on instructional design practices in higher education. The argument put forward in this paper centres on the view that pedagogical content knowledge should: (1) become integrated within the roles and functions of instructional designers; (2) be a requisite component within programmes of instructional design, and; (3) a principal focus of further research.

Instructional design described and defined

Providing a definition of instructional design can be challenging because the literature is replete with a wide range of descriptions. In its simplest sense, instructional design is the process of translating general principles of learning and instruction into plans for instructional materials and learning activities. The description by Seels and Richie (1994) is a commonly cited definition of instructional design in the literature. They describe instructional design as the theory and practice of design, development, utilization, management, and evaluation of processes and resources for learning. While such a description is useful to establish a common understanding of instructional design, it has been criticized because it does not reflect the complexities of the practice of instructional design. A closer look at the literature reveals instructional design has been described as a process, discipline, field of study, a science, and even a reality (e.g., Alessi & Trollip, 1991; Gentry, 1994; Kemp et al., 1996; Seels & Glasgow, 1998; Smith & Ragan, 1993). Making these kinds of distinctions in definitions of instructional design creates interesting fodder for academic discussions but does not provide useful insights as to what instructional design is. Broderick's (2001) description of instructional design provides a concise and encompassing articulation of the essence and practice of instructional design:

> Instructional Design is the art and science of creating an instructional environment and materials that will bring the learner from the state of not being able to accomplish certain tasks to the state of being able to accomplish those tasks. Instructional Design is based on theoretical and practical research in the areas of cognition, educational psychology, and problem solving. (¶ 1)

Most often the primary role of the instructional designer is described as a consultant in the instructional design process. The consulting activities commonly include communications, instructional strategies, editing, marketing, media development, evaluation and project management (Kenny et al., 2005). More recently the role of the instructional designer has had an important emphasis on eLearning development and/or technology integration into the instructional design process. Within institutions of higher education, instructional designers provide consulting to teaching faculty or academics (often referred to as subject matter experts, or SMEs) in the production of curriculum development for eLearning activities. This entails the undertaking of: (1) the analysis, design, development, implementation, and evaluation training and performance support solutions (ADDIE); (2) the development of course materials consistent with sound instructional design principles, and technological and pedagogical strategies; (3) the design and implementation of learning elements; and (4) the development of assessment and evaluation.

Situating Instructional Design: Past and Present

Until relatively recently, there was one philosophical orientation in instructional design, referred to as the *systems view, objectivism* or *instructivism* (Duffy & Jonassen, 1991; Roblyer, 2003). The systems view is based on the assumption that using an instructional systems design model (e.g., Dick et al., 2005)—which is based on learning theories closely tied to behaviorism (e.g., Gagné, 1965; Gagné et al., 1988; Merrill, 1983; Reigeluth & Stein,1983) and systems theory (e.g., Banathy, 1987)—is necessary for effective learning transactions. Specifically, the use of an instructional systems design model will identify what is to be taught, determine how it will be taught, and evaluate the instruction to determine what is necessary. It is a linear and cyclic, systematic and prescriptive approach to instructional design. These elements are essential if learning is to be effective under all conditions. Hence, when instruction is designed based on a systems instructional design model, the end result is effective instruction—regardless of who is teaching. Or, stated more directly: education that is 'teaching proof'.

Advocates for the systems design models argue that this approach to instructional design is effective because it forces educators to pay careful attention to what it is that is going to be learned (learning objectives) and what must already be known prior to the learning transactions (Dick et al., 2005; Morrison et al., 2004; Smith & Ragan, 2005). Once the learning objectives have been identified, they are progressively sequenced from lower order to higher order learning—often using Bloom's Taxonomy as a guide (Bloom et al., 1956). The key aspect of the systems view is the importance of using an instructional systems design model where the learning objectives are clearly identified and stated, and exist apart from the learner (Reeves & Reeves, 1997). Learning activities should be focused on the skills to be learned and presented under the best conditions for learning. The learner is assessed equitably with evaluation tools that measure the behaviours described in the stated objectives. The data from the evaluation are used to revise the instruction so that it will be even more effective with succeeding learners. Following an instructional systems design process encourages educators to focus on the needs and abilities of the individual learner resulting in the development of effective learning activities. The process is ongoing and cyclic. Supporters of the systems view argue that using a reliable and validated systems model is the most efficient and effective way of providing learning.

A more recent, polarized position, to the systems view of instructional design is *social constructivism* (Kenny et al., 2005). The social constructivist perspective is a branch of philosophy that tries to understand how we construct knowledge. Educators whose orientation is constructivism ask the following questions (Hofer & Pintrch, 1997; Jonasson, 1996): What does it mean to know something? How do we come to know it? How does this knowledge influence our thinking processes? Social constructivists argue that the structured process offered by the systems view is problematic. According to radical social constructivists, there is nothing systematic about how we learn or construct knowledge (Kanuka & Anderson, 1999). Rather, knowledge is constructed socially using language (Vygotsy, 1962). As no two individuals have exactly the same social experiences, there exist multiple realities of how the world works. Hence, constructing knowledge is a socio-linguistic process where there is gradual advancement of understandings built upon previous knowledge resulting in multiple dimensions of the truth (Spiro & Jehng, 1990; Sprio et al., 1991). If we accept the assumptions that there are multiple dimensions of what the truth must be and learning is based on prior knowledge, educators will need to acknowledge that they cannot assume that all their learners will understand new information in the same way (as instructional systems models assume). Based on this assumption, social constructivists argue that educators will need to understand that learners will require a variety of different experiences to advance to different kinds and levels of understanding. To achieve this, educators need to spend time understanding their learner's current perspectives and, based on this information, incorporate learning activities that have real world relevance for each learner.

Social constructivists have been most critical of the systems view for offering a quick and easy fix to very well defined problems in education, where the problem is defined as a gap between 'what is' and 'what should be'. Constructivists argue that educators are faced with an incessant onslaught of problems in a field that is constantly changing. As many educators feel a victim of this kind of instability, they look to the literature for guarantees for the right way and to justify what they are doing—for themselves, their learners, and their organizations. Educators often feel a need for exemplary teaching models (or 'best practices') that promise soundness with an enduring academic approval (Brookfield 1991)—which is what is offered in system design models. Unfortunately, according to constructivists, the promises inherent in systems models, along with the educator's desire to know what 'successfully works' corresponds with a disinclination for educators to think critically. Specifically, it is much easier for educators to follow an instructional systems design model and feel that it is right and good because the literature on it says so, than to grapple with the complexities of our ill-structured world in which we must function (Jonassen, 1997; Koschmann et al., 1994). A troublesome aspect of instructional system design models, then, is that it discounts the reality of the ambiguous, complex, and continually changing world in which we live. According to the constructivist perspective, the learning activities must be designed in ways that will reflect the complexity of the learners' environment in which they must function after the planned learning activities have occurred.

Reflecting the increasing influence of social constructivist perspectives within the field of education, a number of constructivist instructional design models have emerged (e.g., Jonassen, 1999; Mayer, 1999; Willis, 2000). The growth of social constructivist perspectives within the field of education is based on the recognition of our increasingly complex societies. Educators within institutions of higher education are faced with the rise of information society and new technologies, the increasing diversity of students, new educational institutions, the increasing emphasis on learning over teaching, and the emergence of postmodern ways of knowing (Austin, 2002). An essential component to designing an effective learning environment is that it reflects all the complexities of the real world in which the learners will function after the planned learning activities. In particular, educators need to not only prepare their students for the necessary knowledge, skills and attitudes they will need to effectively function within their respective disciplines—but to also prepare them for the diverse and complex problems they will encounter within their professions. A key construct necessary to designing such a learning environment in higher education is *pedagogical content knowledge*.

Pedagogical Content Knowledge

The historical development of instructional design reveals why pedagogical content knowledge has tended not to be included in programmes of instructional design. Programmes of instructional design have their roots firmly established in theories of learning with research that has focused on the application of general pedagogical practices in the classroom. Instruction was designed for teacher-practitioners by instructional designers in ways that used subject matter experts for content input only. These early instructional systems design models had little or no room for resource adaptation, such as disciplinary contexts. The rationale for this was premised on the assumption that disciplinary related knowledge of pedagogy was personal and grounded in applied and anecdotal experiences, rather than informed theories of learning based on validated and reliable empirical data. Personal experiences and opinions of subject matter experts about the learning process were viewed as contributing little, if anything, to the understanding of the content for the learners.

And yet, while the theory and practice of instructional design is grounded in the 'science' of instructional design (e.g., the use of learning theories that have been empirically validated), Broderick (2001) points out that this has never guaranteed that the instruction will be both effective and engaging. Rather, the 'art' of instructional design is also required to achieve both effective and engaging learning environments. Likewise, as Kenny, et al. (2005) note, while implicitly prescriptive, models of instructional design are in fact conceptual frameworks for practice. The art of instructional design accounts for aspects such as how the material will be presented, which learning activities will be used, and what kinds of feedback will be provided. For example, when is classroom-based Socratic questioning better than small group discussions? When is it better to present the content based on authority, or evidence? When should a computer simulation be used and when should apprenticeship be used? At present, these kinds of decisions tend to be based on some form of recommendation with the subject matter expert and the instructional designer's tacit knowledge acquired through prior experience designing instruction. As subject matter experts in higher education are most often research and content experts, not pedagogical experts, they provide recommendations based on their own prior learning experiences providing them with 'gut instincts' as a basis for recommendations. Hence, the 'art' of instructional design actually relies on the instructional designers' tacit knowledge and subject matter experts' gut instincts.

Relying on gut instincts and tacit knowledge is an odd practice—especially when there is a body of research that has shown there are disciplinary practices about the nature of learning which guides instructional methods and the validation processes (e.g., Donald, 2002). Shulman (1986; 1987) has referred to this body of research as *pedagogical content knowledge.*

The dichotomy between teachers' subject matter knowledge and teachers' knowledge of pedagogy has been questioned due largely to the work of Shulman (1986; 1987; see also Grossman 1989; Gudmundsdottir, 1988; Wilson, et al., 1987). Recognizing the importance of both pedagogical knowledge and content knowledge, Shulman developed a theoretical framework for teacher education by introducing the concept of pedagogical content knowledge (PCK). Shulman argued that a distinctive form of teacher-practitioners' professional knowledge, which he referred to as PCK, exists and this knowledge builds upon, but is different from, subject matter knowledge. In Shulman's view, PCK is a form of practical knowledge that is used by teacher practitioners to guide their actions in highly contextualized classroom settings. This form of practical knowledge involves (a) an understanding of how to structure and present the subject matter to be learned, (b) an understanding of the common conceptions, misconceptions, and difficulties that learners encounter when learning particular subject matter, and (c) knowledge of the instructional strategies that are effective at addressing students' learning needs in particular classroom circumstances. According to Shulman, PCK builds on disciplinary knowledge and is, therefore, a critical constitutive element in the knowledge base of teaching within a specific discipline.

This framework was later developed as a broader perspective model for understanding teaching and learning with colleagues in the *Knowledge Growth in Teaching* project (Shulman & Colbert, 1988). Rather than viewing teacher education from the perspective of pedagogical knowledge versus content knowledge, Shulman argued that teacher education programs need to integrate these two knowledge bases to more effectively prepare educators.

While not directing the argument at instructional designers, Shulman's theory of PCK does have direct implications for instructional designers. According to Shulman, those who are involved in the development, design and facilitation of the learning process need to acquire knowledge about (a) content and (b) curricular development. Hence, in order to develop effective instructional design, instructional designers need to understand not only pedagogical strategies and learning theory, but also have some understanding about the subject matter being taught and the culture of the discipline. In particular, in order to select the most appropriate instructional methods, instructional designers need to see how ideas connect to the discipline and to everyday life as a professional. This kind of understanding provides a foundation for PCK that enables instructional designers to make ideas more accessible to those with whom they work with.

Drawing on prior literature of Bruner (1967), Shulman also argues that content knowledge encompasses the 'structure of knowledge' – or the theories, principles, and concepts of a particular discipline. Hence, the educator (e.g., teacher or instructional designer) must identify the ways in which each unique body of knowledge (or discipline) should be structured so that it can be more readily understood by the learners. Especially important, according to Shulman, is content knowledge that deals with the learning designs, including the most useful forms of representing and communicating content and how students best learn the specific concepts and topics of a subject. If instructional designers are to be effective, they must struggle with issues of both content and pedagogy. This means that instructional designers need to develop a repertoire of teaching strategies that reflect the uniqueness of each disciplinary culture.

Thus, instructional designers need several kinds of knowledge about learning across the disciplines. In higher education—and in particular research universities— pedagogical content knowledge is unique to teaching and separated. For example, a science teacher is distinctly different from a scientist. Cochran, King and DeRuiter (1991) explain it this way:

> Teachers differ from biologists, historians, writers, or educational researchers, not necessarily in the quality or quantity of their subject matter, but in how that knowledge is organized and used. For example, experienced science teachers' knowledge of science is structured from a teaching perspective and is used as a basis for helping students to understand specific concepts. A scientist's knowledge, on the other hand, is structured from a research perspective and is used as a basis for the construction of new knowledge in the field. (p. 5)

In higher education, selection of curriculum resources and technologies should connect the learning materials with sources of information and knowledge that facilitates learning activities that include exploration of ideas from a research perspective, the acquisition and synthesizing of information and frame and solve problems unique to the discipline. Making connections (explorations, synthesizing) necessitates an understanding of the unique problems faced in each discipline. This presents the intersection between learning how to teach the process of inquiry and understanding the unique ways of constructing knowledge through inquiry within each discipline. Inquiry is considered quintessential to an education within institutions of higher education, especially in research-intensive institutions. Too often, instructional designers make these connections based on a facile understanding of the discipline the students are learning and a cursory knowledge of the processes of inquiry unique to the discipline.

Building on what we know: Prior related research on PCK

Prior research has revealed some important insights on the intersection of disciplinary content and pedagogical knowledge. We know, for example, that trained teachers (e.g., content experts with a bachelor of education or certified teachers) approach problems within their disciplines differently than trained researchers (e.g., content experts with research training, such as a PhD) due to their understanding of the pedagogical implications of learning within their disciplines (e.g., Borko & Putnam, 1996; van Driel, et al., 1998). Studies have also examined the practical connections of PCK to the disciplines (Hashweh, 1987). These studies examined the value of attempting to teach this principle (the need to connect pedagogy to content) to prospective instructors. An overview of this literature reveals both support and change in educators as a result of developing pedagogical content knowledge. Noteworthy in the empirical research reviewed by Van Driel et al., (1998) is that there might be value to having disciplinary experts study subject matter from a teaching and learning perspective. Likewise, research has also shown the importance of PCK in teaching (e.g., Gess-Newsome, et al., 1993; Smith & Neale, 1989).

Perhaps the most noteworthy literature on this topic is the extensive research conducted by Donald (2002). Her research aimed to reach a deeper understanding of the thinking approaches taken in different disciplines and applying these approaches to student intellectual development. Results of Donald's seminal research reveal that there are significant differences in thinking, validation processes and learning activities between disciplines. The following table provides an example of these differences between disciplines.

[table 1]

These kinds of knowledge structures are constellations of beliefs that incorporate "values, techniques, and so on shared by the members of a given community" (Kuhn, 1970, p. 175). These shared knowledge structures within disciplines also include notions of research traditions, a common ontology and research methodologies with "facts and values interwoven in the fabric of our educational lives and intellectual development" (Gudmundsdottir, 1991, p. 45).

Based on the findings of these studies, the assumption that pedagogy takes precedent over content is misguided. Prior research reveals content has direct implications for the everyday practice of instructional designers whose functions are the design and the development of eLearning activities within and across the disciplines.

Conclusions and need for further research

With the increasing use of instructional designers for eLearning activities within institutions of higher education, it is important we learn as much as possible about designing and developing effective instructional design across the disciplines. One area of instructional design that has been a missing construct is PCK. It is essential we gain further understanding on how values and culture, embedded within the disciplines, cement pedagogy and content to create practical and powerful pedagogical content knowledge (Gudmundsdottir, 1991).

When instructional designers are pedagogical experts but not content experts—and the instructors are content and research experts but not pedagogical experts—the result is a bifurcation of content and pedagogy. Connections of these two domains should not be neglected. Programmes of instructional design have tended to fail to recognize that the design and development of effective classroom experiences requires deep understanding of the content and culture within each discipline. Specifically, technological and pedagogical expertise that instructional designers have cannot be applied, *carte blanch*, across the disciplines. Mainstream research and training programmes within the field of instructional design needs to move beyond the search for pedagogical truisms that can be generalized across the disciplines. Rather, research needs to move toward exploration into the specific forms of pedagogical and content knowledge that effective teacher practitioners and subject matter experts bring when teaching specific disciplinary content to their students. Hence, further research is needed to gain greater understandings on the assumptions and beliefs that are unique to each discipline and shared by members of the discipline. In turn, this knowledge will enable instructional designers to gain greater awareness of the ways of knowing unique to each discipline.

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Table 1. Differences in thinking and validation processes between disciplines

	Descriptors of thinking	Examples of thinking	Examples of validation	Examples of learning activities
Physics	Problem solving Analysis Synthesis Visualization Deductive logic	Experimentation Scientific explanation What if?	Matching evidence to systematic theorizing A reasonable answer Plausible Within expected limits	Working groups Wrap-up discussions Active testing Collaborative Debate of findings
Engineering	Problem solving Design Mathematical modeling of physical systems	Problem solving where all the needed information is not known Using procedural knowledge	Does it work? Approximate or within certain limits	Student centres Project work Workshop courses Self assessment Open ended projects
Chemistry	Deductive and inductive problem solving	Transforming a non-routine problem Guided inquiry	Experiment—range of methods of analysis Match varying levels of specificity	Lecture and lab Content reduction Microscopic representation of problems Concept maps Structured cooperative learning Quizzes
Biology	Inductive Phenomenological	Varied consequences of various hypotheses	Questioning results and conclusions	Integrating principles that make learning

	Inferential Use of powerful metaphors	Regulatory networks		meaningful Problem based learning Community of learners
Psychology	Sceptical investigation Experimental techniques Understanding oneself Analytic reasoning	Writing reports Evaluating previous research Identifying problems to be investigated Question assumptions in an argument	Inter-rater reliability Empirical testing	Meta-principles Global concepts Gradual introduction Script for doing research
Law	Thinking like a lawyer Solving puzzles Analysis using syllogism and analogy Factual investigation	Analyze facts Factual nuances Conclusions in light of doctrines	Human authority Evolving tradition Legal evidence Witnesses Logic versus value	Case studies Modeling through simulations
Education	Pedagogical reasoning Expert processes Transforming text Evaluating Reflecting	Analogies or metaphors Specific problem solving	Practical judgements Comparing options Triangulating evidence Authenticity Utility Ecological	Active questioning of beliefs Long-term process Interviewing

			validity	
English literature	Hermeneutics Interpretation Literary analysis-criticism Imagination Rhetoric	Close reading Taking meaning from text Bridging gaps and integrating textual elements Analysing the organising principle that unifies a work	Critique of others' claims Rhetorical reflexivity weakens validity Peer review, credibility and plausibility Testing the parts against the whole	Legitimate text Demonstrating effectiveness of competing theories Imagining Training in sensibility

Adapted from Donald (2002)