ABSTRACT
Recent developments of situated cognition seem to be incompatible with traditional views of school based-
learning where abstract or generalized knowledge is emphasized. In this paper, we are advocating that
authenticity (as emphasized by situated cognitivists) and generalizibility (as advocated by cognitivists) are
compatible. From an instructional perspective, it should not be for one or the other, but rather the
scaffolding of the dialecticism between authenticity and generalizibility. In this paper, we first discuss the
problems relating to the radical view of situated cognition and cognitivist approaches to learning and
instruction. We then contend that authenticity and generalizibility are compatible and introduce the notion
of the Authenticity-Generalizibility (A-G) continuum, where from an instructional perspective, the
emphasis should be scaffolding within such a continuum. We hypothesize that learners would have richer
and deeper understandings of a subject or domain when they have opportunities to experience the full range
of learning activities within the A-G continuum. Finally, we proposed two kinds of IT scaffolds, one to
assist student moving towards the authenticity end of the continuum and the other vice versa.

Keywords
Authenticity, Generalizability, Scaffolding, Technology

Introduction
In recent years we have seen the proliferation of notions such as situated cognition, problem-based learning, and
similar trends of contextual learning where the key emphasis is on the authenticity of the learning environment
and tasks (Clancey 1997; Brown, Collins, and Duguid, 1989). This new trend seems competing with the more
traditional view of school based learning and instruction where the focus of learning abstract or generalized
knowledge is emphasized. The pitfalls of such a de-contextualized approach or generalizibility have been
criticized because of tendencies of students learning and memorizing abstract knowledge which they do not fully
comprehend (Barab & Landa, 1997).

However, we are advocating that authenticity and generalizibility are compatible. From an instructional
perspective, it should not be for one or the other, but rather the scaffolding of the dialecticism between
authenticity and generalizibility. In other words, both authenticity and generalizibility are necessary for richer
understandings in the learner.

In this paper, we first discuss the problems relating to radical view of situated cognition and cognitivist
approaches to learning and instruction. We then contend that authenticity and generalizibility are compatible and
introduce the notion of the Authenticity-Generalizibility (A-G) continuum, where from an instructional
perspective, the emphasis should be scaffolding within such a continuum. We hypothesize that learners would
have richer and deeper understandings of a subject or domain when they have opportunities to experience the full
range of learning activities within the A-G continuum. Finally, the implications to instructional technology are
discussed.

Authenticity versus Generalizibility
Situated cognition or situativity emphasizes the contextual dimensions of knowledge where meanings are
considered inseparable from its relations among situations and verbal or gestural actions (Bredo, 1994; Brown,
Collins, & Duguid, 1989). That is, meanings are perceived as inseparable from interpretation, and knowledge is linked to the relations of which it is a product. This view however, does not particularly consider how meanings can be generalized and how learning and knowledge can be transferred to new contexts. Bereiter (1997) scenically points to the notion that “no amount of situated cognition would get people to the moon and back” (p. 287).

The main argument of situativity when applied to school and learning contexts is that if the learning occurs exclusively in school based or classroom type situations there will continue to be a gap between schools and real-world applications (Barab & Landa, 1997). This is because the “separation of learning from authentic use creates a content-culture incongruity in which students are learning content implicitly framed in the culture of schools, but whose use and value is explicitly attributed to authentic communities of practice that are not directly in evidence” (Barab, Squire, & Dueber, 2000, p. 38).

In general, learning environments are considered authentic when there is a ‘similarity’ between what happens in school learning activities and some meaningful real-world context (Petraglia, 1998). In other words, what has predominately been adopted in schools as ‘authentic’ is to simulate or bring the real-world into the classroom. However, our argument here is that no matter how authentic a task may be in the school context, it is not the “real thing” – but rather an approximation to the “real thing”. The learning context is always conditioned by the constraints in the school where certain variables are controlled.

For example, since students are limited by logistical constraints of going out on a river trip (which may not always be feasible), schools adopt approaches such as the Jasper video-based “authentic” tasks (Cognition and Technology Group at Vanderbilt, 1993). One could argue that the scenarios presented in Jasper may not be personally authentic, however, the video captures the variables for the experience. Controlled variables in this instance could be the time spent on the trip – the video capture could possibly save the students’ time in going for a field trip. One may take situated cognition to an extreme and argue that if students do not experience the urgency of the time variable (e.g., getting back home before the sun sets), they may not be able to experience the authenticity of this problem or project. Again, authenticity when applied to schools is always an approximation of the real experience and not the real thing!

Learning “abstract- or principle-oriented” activities is strongly opposed by situated theorists without realizing that these activities are but “scenarios” with more controlled variables – that is more towards the generalized end of the Authenticity-Generalizibility continuum (see Figure 1). So, in essence, we cannot claim school-based learning to be truly “authentic”; but rather we are speaking of the degrees of authenticity.

![Figure 1. The Authenticity-Generalizibility (A-G) continuum](image)

On the other hand, learning that was increasingly abstract and less similar to real-world practice was considered to be more generalizable, precisely because of its lack of being tied to any specific instance. In other words, it was reckoned that generalizable learning must occur “out of context” if it is to be applied to multiple situations, and that only out of context learning can lead to abstraction, generalization, transferable knowledge, and cognitive efficacy in future life situations (Brown, Collins, and Duguid, 1989). The drawback with this school of thought is that students often lack in understanding the contextual underpinnings to such generalizable knowledge so much so that without seeing or perceiving the meanings surrounding the abstracted knowledge, they often apply the knowledge amiss.

To reiterate, we hope to draw an awareness that the argument of authenticity and generalizability from an instructional point of view should not be perceived in terms of the superiority of one to another. Instead, one
ought to recognize that the function of schooling is to develop the thinking processes of (scientific) inquiry with the intention of learning to transfer knowledge to generic situations and apply knowledge from principles to more real-life scenarios (Bereiter, 1997). Hence, it is important to recognize that for meaningful learning to occur, whether instruction occurs from authentic tasks or more generalized knowledge, the objective is always to provide students with experiences across the spectrum of authenticity and generalizability.

If abstract knowledge is used as a starting approach to instruction – that is with more controlled variables – then it is important for the teacher to ensure that what is learned is applied or transferred to as many other contextual situations as far as possible. On the other hand, if authentic situations are deemed a better starting point, then, the teacher(s) should gradually decrease the number of contextual variables to allow for abstraction and subsequent transfer of knowledge. Hence, as teachers, we need to know where the starting point is – whether the authentic or generalized end of the A-G continuum or anywhere in between. We suggest that depending on learners' ability and the complexity of knowledge, the teacher could decide whether he/she should start.

One possible scenario of starting from the more general end of the A-G continuum is the learning of the Euler theory on prime numbers. For many past decades, the learning of Euler’s theory in mathematics was taught predominantly in an abstracted manner – that is non-authentic – because there was no application of the theory until recently. Euler’s number theory was invented more than 200 years ago and only in recent times, the application of such a theory was useful to ‘cryptosystems’ or systems requiring encryption. That is, a university professor (before cryptosystems) had no other choice but to start from the generalizibility end of the continuum when teaching Euler’s theory and subsequently attempt to find application (if any) of the principles and concepts involved. The fact that this theorem still exists is probably because people who are mature in the mathematical community see potential patterns and that people learn this theorem with examples of higher authenticity, but not necessary as an application to real life.

In other words, the pedagogy of authenticity or generalizibility should be adjusted according to the learners’ current or prior knowledge. We suggest that if a task is within the learners’ zone of proximal development (Vygotsky, 1981), that is where the learner is able to acquire that knowledge through the assistance of a teacher or someone more knowledgeable, the task can be considered “authentic” enough. For these circumstances, there may not be a need to situate the learning on the authenticity end of the A-G continuum. For example, when teaching primary school students the concept of multiplication, there usually is a need to provide concrete examples (or authentic real-life situations) and perhaps manipulative blocks to help them understand. However, with the same content when teaching mathematically more advanced students, they may not need those concrete authentic examples because they can already operate at a higher (abstract) level. The contextual information of the learning problem though useful, may not add value to their learning. In fact, such additional contextual information could become distracting and trivial at times.

Thus, it is probably naïve to claim that all learning should begin with authentic tasks as so advocated by situativists. The choice of where to begin and at which point of the A-G continuum also depends on the availability of resources – for example, whether real-life authentic case studies and scenarios are accessible, and the competency of the teacher in teaching a concept or facilitating the learning by the learner. If the teacher is very skilled in illustrating difficult concepts, he or she would be able to begin at the generalizibility end and bring in concrete applications through which the concept can be understood.

Fundamentally, the aim of the A-G continuum is in facilitating the learning process such that what is learned by the learner would not end up inert. By inert knowledge we mean the inability to apply concepts learned in schools to real-world applications. Thus, when learners have sufficient exposure of applying abstract concepts to real-world authentic situations (where often times the problem is surrounded by other kinds of ‘noises’), what they learn would become productive knowledge, regardless of where (on the continuum) instruction begins.

Bereiter (1997) viewed manipulations of abstracted knowledge as an important phenomena of human cognition. Due to human ability to manipulate symbols, we are able to compare and contrast abstracted meanings, integrate meanings and symbols, derive new knowledge through abstracted manipulation – all of which can be engaged through non-concrete applicational settings. However, Bereiter (1997) advised that students should be constantly engaged in the hypothetico-deductive method – dialectical interactions between real world and abstract concepts, thus always grounding abstract concepts in real world applications where possible.
Two types of scaffolding with IT

The above discussion seems to suggest that if the starting point of the instruction is more towards the concrete or authenticity end of the A-G continuum, the scaffolding would be in moving towards higher generalizibility. On the other hand, if the starting point of the instruction is more towards the generalizibility end of the continuum, the scaffolding should be towards the authenticity end. Such a two-prong scaffolding process is to provide students with learning experiences which span across the spectrum of both authenticity and generalizibility of meanings. Thus students are empowered to abstract situated knowledge and transfer to across contexts, and alternatively to contextualize abstract principles and apply them to real-life problems.

Scaffolding from generalizibility to authenticity – Removing controlled variables in simulations

Abstract principles are generally simplified representations of the real-world where contextual variables have been controlled. In order to scaffold students to the real-world authentic tasks, systematic staging – increase of complexity or removal of controlled variables – is needed.

In a computer-based simulation, the authenticity could be defined by the number of controllable variables. By controllable variables we refer to those crucial factors within a simulation program which the learner can manipulate. The number of controllable variables would largely dictate the degree of authenticity of the simulation application. In the real-world, almost all factors can vary and thus these factors have a bearing towards the outcomes and consequences. By fixing some of the variables constant in a simulation application, we are decreasing the complexity or authenticity of the system. Learning could be facilitated towards authenticity through learning environments and simulations if the applications provides sufficient number of controllable variables and a scaffolding (or staging) process where the control of the variables would be systematically reduced in order to increase the complexity or authenticity. Through the process students learn the relationships between those controllable variables and the outcomes and how different variables interact with one another. For example, in Sim City, learners can manipulate with different types of buildings and facilities, and frequencies of natural disasters, etc. Students could start from manipulating two variables (e.g., building houses and roads) and observe the outcome. After they have understood how the two variables interact with each other and the outcome, more variables (e.g., utility companies and supermarkets) are added into the simulation. By so doing, students are gradually moving towards the authenticity end of the continuum.

Thus, the principles for scaffolding are towards increasing complexity and increasing diversity of applications. When learners acquire concepts through abstract understanding, for example, learning formulae such as Pythagoras theorem, they should begin to apply this theorem in increasingly complex problems. These increasingly complex problems could be anchored in instructional videos such as the Jasper series (CTGV, 1993; 1996), and also in increasing diversity of problem applications. The Jasper series is one example of how video-based instructional technologies can be used to scaffold increasingly complexity and diversity in problem solving. Hypothetically, the Jasper series can be programmed in such a way where learners can manipulate upon the variables of complexity and diversity within the series, although currently it is pre-planned by the instructional designers.

Scaffolding from authenticity to generalizibility -- Cognitive and visualization tools

Alternatively, if we are to move from authenticity to generic principles, learners need the disposition and skill to observe similarities across different authentic situations. For example, in Hung (2000), students were solving mathematical problems where common variables were seen across different problems of similar orientations, and these common variables are the similar patterns that can be abstracted. Students need to see (a) similarities across contexts, (b) trends which lead to something or some concept, and (c) more relevant information from less relevant. Here, mind-cognitive tools (see Jonassen, 1996; Jonassen, Peck, & Wilson, 1999) such as concept maps, epistemic structures and outliners, spreadsheets, etc. are particularly useful. By teasing out the similarities, trends, relevant information by way of epistemic structures through IT-supported tools, students can easily manipulate the information, for example, by moving the data around, integrating with other information, performing calculations, depicting the information graphically, etc. IT-support tools such as spreadsheets are able to represent data in different forms for analysis and interpretation. Such a means enables learners to analysis data (e.g., from a database) at a deeper conceptual level for learning. By analyzing the data (through a spreadsheet), these questions can be asked: “Does the data sets relate to one another? What can be predicted based on the mean or average (or of the pattern formed)?” Learning occurs when students generate questions for
themselves and how the students use the mind-tools to represent their own answers and knowledge. Jonassen (1996) also argue forcefully that there is additional power in using mind-tools in collaborative learning environments.

In addition, students also need to test their abstractions, make conjecture, and possibly assess the pre-conditions or assumptions which they hold to. Simulations which allow students to test their preliminary hypotheses, based on their abstracted principles, would be useful. In the context of these skills and functions which students need to engage in, technologies and tools which enable students to abstract patterns through authentic cases and stories would be useful. Similar to mind-tools (as illustrated above) such as concept-mapping tools and spreadsheets, students can distill information relevant for analysis and draw interpretations and conjectures.

Moreover, tools should assist human cognition in taking care of the low level computations and allow students to concentrate on pattern recognition. Technology can also assist in modeling or visualization, thus allowing humans to visualize trends. These tools can assist in searching, enabling the learner to engage in categorizations or any other higher-order thinking. For example, students may collect weather forecast data from the Internet. A spreadsheet program can then be used to do further calculations such as average weekly or monthly temperatures. The calculated data can then be turned into graphs. These graphs will then enable students to make comparisons among weeks of a season or months of a year. The above search, visualization and calculation tools take care of the tedious data logging, computation and graphing tasks and thus enable students to focus on generalizing principles from authentic data.

In order for students to engage in generalizability once they have established understanding based on authentic situations, “what if” questions can be asked in order to test for transfer of meanings and understanding (CTGV, 1996). “What if” questions cause learners to see patterns (if they understood earlier cases and experiences) between earlier problems and newly posed ones. These questions facilitate the process where learners would have to search for common patterns or ‘denominators’ (Hung, 2000). This ability to engage in symbolic manipulations and extending towards new discoveries and knowledge (facilitated through IT tools) is a distinctive trait of human cognition. Generalizing from cases through case-based reasoning is one distinctive example of how human cognition works (Schank, Berman, & Macpherson, 1999). Expert systems can be designed to prompt for “what-if” scenarios or, alternatively, designed as procedural cues or facilitation cues in environments such as Knowledge Forum – a social constructivist collaboration tool (see Hung & Chen, in press).

In summary, we acknowledge that in practice – in particular when teachers are engaged in teaching or facilitating the learning of concepts (K-12), most of the content areas would fall into the middle range of the A-G continuum. Many of these concepts could be either taught or learned from the authentic or generalized side of the continuum, for example, the concept of mathematical ratios. Due to the difficulty or constraints of developing authentic tasks, teachers could get students to create stories (or authentic accounts) of how such a concept can be applied to learner’s real life contexts (see Lampert’s method of getting children to create stories around mathematical concepts situating the learning in real authentic contexts (in Brown, Collins, and Duguid, 1989). The fundamental essence in our proposal is in creating meaningful indexes to learners’ memory of learning experiences where knowledge would not be inert – that is inapplicable to real-life contexts.

Conclusion

In this paper we have argued that learning should result with richer understandings of concepts and knowledge. Such a process in our argument can be facilitated through moving or scaffolding students along the A-G (Authenticity-Generalizibility) continuum. By exposing students to the varied situations and principles of any particular concept requires that students practice the applications of concepts across manifold problems, cases, situations, etc. As a result, students would acquire productive knowledge useful for maximizing their time spent in learning. IT can play a supporting role in helping to scaffold students moving along the A-G continuum. Tools supporting students moving from generalizability to authenticity include technology-enabled simulations with staging capabilities (controlling of variables). Technologies supporting students moving from authenticity to generalizability include cognitive tools, simulations with experimentation capabilities, and modeling or visualization tools. We hope that this paper has provided insights into how and where pedagogy of instruction should be focused upon rather than the “chicken and egg” issue of starting points of learning – authentic or abstracted knowledge.
References


