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'Aha' Experiences in Object-Oriented Education: Searching for a Theoretical Foundation

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Abstract

The transition to object-oriented software development can be difficult because it represents a paradigm shift. This paper is based on the assumption that students may need to undergo one or more 'Aha' experiences in order to successfully make this transition. Literature which is relevant to research in this area is reviewed and a theoretical foundation is presented.

Introduction

This paper grew from a hypothesis of ours that certain revelations are required before one can make the paradigm shift to object-oriented (OO) thinking and that these revelations need to occur as 'Aha' experiences. Informal conversations with two teachers of OO and two students in OO classes confirmed that the hypothesis was worth pursuing. In fact, one of the two students pointed to the other and said, in essence, 'Yes, I haven't gotten them yet, but he has'. Once the initial concept was informally validated, the next step was collect information on both the 'Aha' experience and the teaching of OO. What follows is a description of our findings and their relevance to the study of 'Aha' in OO education.

Literature Review

'Aha' Experiences Defined: The first revelation on our part was that there are so many different words and phrases that are synonyms with the 'Aha' experience, including examples from everyday speech such as: eureka moment, sudden insight, sudden illumination, flash of insight; labels applied by scientists, such as: 'all or nothing' phenomenon, discrete vs. continuous cognitive processing and connectionist mechanisms; and labels used in Philosophy, such as: Gestalt, Existential moment and Teiresian Gift (from the mythological story of Teiresias). Each label captures one or more characteristics of 'Aha' experiences:

1. Suddenness - lack of understanding is quickly replaced by understanding
2. Connectivity - disparate thoughts are connected
3. Effortlessness - revelations are created in the unconscious and then seem to burst into the conscious mind

4. Surety - a feeling of confidence that the revelation is correct

'Aha' experiences are a phenomenon in the sense they are events that happen, but they also represent a process that produces the event. Those that have attempted to model this process have identified other noteworthy aspects of 'Aha' experiences:

1. they are preceded by a large degree of conscious effort which,
2. leads to an impasse and frustration that may,
3. cause an interruption from work, after which,
4. the 'Aha' experience suddenly occurs and,
5. the resulting solution is crystal clear, workable, and correct, thus allowing the work to progress smoothly, thereafter.

Referent Disciplines: The second revelation from the literature review was that the phenomenon had been discussed and/or investigated by people in several disciplines. In the arts and sciences, several people had noted the relationship between 'Aha' experiences and creative endeavors (scientific discovery/invention, artistic expression). In psychology, those studying cognition argue over whether thinking processes are discrete or continuous and they model and measure these processes. There are even some working to show that animals (wolves, birds and apes) are capable of 'Aha' experiences. Those on the therapeutic side of psychology focus more on what they call insight, which may or may not happen suddenly. Insight is defined as the degree of awareness a client has of his/her illness or the degree of awareness that the therapist has of the client's situation.

In the field of education, work is being done on using techniques to generate 'Aha' experiences in the classroom, so that learning is enhanced. Moreover, writers in education and therapy mention an additional concept; the fact that some people are more insightful than others. In education, these students are called 'gifted' though metacognitians have discovered that insightfulness may not be related to high IQ and strong deductive reasoning skills [Sternberg, 1988]. In the field of therapy, some patients are more capable of assessing their situation more accurately than others and this may be related to the individual's degree of creativity [Miller, 1992]

'Aha' and Object-Oriented Education: No literature was found that explicitly investigated this topic. There were, however, several papers that seemed relevant to explaining why research in this area is needed. Some authors contend that training in object-orientation requires the ability to think in objects which is only accomplished through 'shock therapy' [ex: Dodani, 1996]. If one applies the process of insight as described above to examine this idea further then shock therapy should include an immersion in problem-solving, a resultant frustration, followed by an 'Aha' experience and hence, object thinking. Research on 'Aha' experience in OO education could help identify what revelations are necessary and how best to make them happen.

On the other hand, others suggest a mechanism for teaching OO which avoids an abrupt paradigm shift [ex: Adams, 1996]. By investigating how people learn OO, we can determine if the paradigm shift can be made without 'Aha' experiences and then compare

the two techniques to see which is more effective. It may also be that some people are more insightful than others, and therefore, both techniques may be useful depending on the type of person.

If 'Aha' experiences involve linking seemingly unrelated ideas, then techniques which are oriented to making connections may be helpful for generating insight (used here in the sense of awareness, whether sudden or not). One author recommends using Window objects to teach object thinking without resorting to the study of algorithms within the objects [Reid, 1993]. This approach encourages connections to be made between the known and the unknown. Another author does this by having the students generate a quick solution which is critiqued and improved [Viswanathan, 1996]. This technique encourages students to connect the thought processes already employed to new problem solving techniques. If the initial solutions were preceded by hard work (effort) and frustration (impasse) then the subsequent instruction could be just the spark needed to generate an 'Aha' response. This is exactly the kind of hypothesis that this research project would hope to address.

Discussion

The literature search described above gives us a theoretical foundation for the study of 'Aha' experience or lack of it in OO education. In addition, each referent discipline contributes specific methodological tools for research and sheds insight (no pun intended) on what research questions should be addressed. This section presents some models which show how insight can be of use for generating certain outcomes (ex: better learning).

Theoretical Foundations: Figure 1 is a model of a process for generating insight. The model shows how an insight-generating technique might influence an outcome in therapy or education. The model itself is synthesized from literature in both disciplines. This diagram is useful for explaining how a therapist uses an intervention with a client. It also fits the way a works with a student.

This model can be used to explain how an intervention may also provide insight which is useful for the therapist and teacher. Therapists and teachers observe their clients/students in order to gain insight into how well they are doing. The model in Figure 2 on the next page, shows how this works in an educational setting.

On the other hand, if an intervention teaches a process whereby the probability of 'Aha' experiences increases, then the student becomes more insightful in general. Since system development is always an exercise in problem solving, then an insight building technique such as this would be extremely useful. The model below demonstrates how this process is different from the direct insight generating process.

These two models provide a theoretical foundation for the study of 'Aha' experience in OO education by explaining how the process of 'Aha' can influence important outcomes in the education process.

On the other hand, if an intervention teaches the individual how to use an insight-generating process (one that increases the probability of 'Aha' experiences), then the student become more insightful in general. Since system development is always an exercise in problem solving, then any insight building technique, such as this, would be extremely useful. Figure 3 demonstrates how this process is different from the direct insight generating process.

Conclusion

The above models provide a theoretical foundation for the study of 'Aha' experience in OO education by explaining how the process of 'Aha' can influence important outcomes in the education process. From this point, we can go on to create several research questions and search the referent disciplines for relevant research methodologies.

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