A COGNITIVE APPROACH TO RESEARCH AND EDUCATION

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Abstract
What do we mean by research? How could we explain it in terms of a semantic network? Do we need to make research to learn? Is it necessary for our own education as a researcher? Does it make a substantial contribution to educating ourselves? Do researchers need teaching to improve their research?

What kind of methods could we use for research and education? Can we use some methods for both?
Teaching is inter-activating your knowledge to make other minds learn; interactive reaction of learners can trigger an unexpected association between what you know and also yield new questions on that matter. Such as instructing, publishing papers and books, conferences, discussion forums, public debates, etc.

Research is going in depth with the subject matter at hand. It is accumulating knowledge about the issue at hand, and then representing it. Research requires description of the question at hand through a philosophical worldview and requires also methodologies beforehand. Nevertheless, research is, in a way, gaining specific knowledge about a specific case. Learning sorts are, among others, learning by discovery, analogy, research, design, instruction, being taught, experience, repeating, e-learning, etc.

Nonetheless, you test/measure your research by a learners group, when it is relevant. You can use learners also as participants since it is more economical and efficient.

Can we imagine research without education? Some researches are not directly relevant to education, for its being a specific matter outside of education, though the results also can be used as case examples for education. Eventually, education and research are inter-related. Nevertheless, they stimulate each other.

Could education without research be fruitful, at all? We can imagine it somehow only for a learner in the case of didactic teaching, though it might be even better if there exists research about that matter. Nevertheless, for the rest there is always a relationship between research and education.

Finally, the cognitive structure of education and research is interwoven. They cannot exist without each other, which supports issue-based learning that uses analogy which is a very creative cognitive attitude. Educators should exploit students’ entire capabilities. Creative education employs multiple mental skills.

Keywords - Cognition, learning, teaching, knowledge, research, creativity, analogy, methodology
1 KNOWLEDGE AND LEARNING

Education, I think, is an umbrella concept of knowledge, learning and teaching. We should then try to explain these components as clear as possible. I understand learning as gaining knowledge which is processed information. Knowledge is treated by diverse philosophers and cognitive scientists in different ways, through the history. I want to mention some of this relevant epistemologic issue, briefly.

I support, as Plato and Kant among others do, the idea of knowledge as “justified true belief”. Therefore, the components of knowledge are: justification (as evidence), truth (its being the case, how reality is and how things really are), and belief (someone psychologically must be related to a proposition) [1].

Some cognitive scientists and philosophers state that there are different kinds of knowledge; some of them are:

1- Declarative Knowledge, also called propositional (empirical-a posteriori and nonempirical-a priori) knowledge; both mean knowing what or that something is so. Stillings et al. describe two sub sorts of declarative knowledge: a-language like representations, b- image like representations),

2-Procedural Knowledge (knowing how),

3-Tacit Knowledge, also understood as non-propositional knowledge (some thing like implicit knowledge, knowledge by acquaintance or by direct awareness), and

4-Linguistic Knowledge, which is also a kind of tacit knowledge since even if we can not explain all rules of our native language, we still can use it and can be understood by people who use the same language as his own native one. [1], [9]

Even though it is not clear distinguish between declarative and procedural knowledge; yet my observation makes me believe much of our knowledge is declarative like Stilling et al. state it: “Traditional epistemology distinguishes between ‘knowing how’ and ‘knowing that’. Though this distinction is not the same as the one psychologists draw between procedural and declarative knowledge, the two are closely related. Much of our knowledge- that is probably encoded declaratively, since much of it is mobilized in controlled processes.” [9]

Implicit (or tacit) knowledge is very complicated; maybe we are not able to explain what we know, explicitly; nonetheless, it is very effective in thinking, as Holyoak and Thagard explain it: “Implicit knowledge often allows quicker reactions than does explicit knowledge and in some cases is actually more accurate. Moreover, even when explicit knowledge is being manipulated, the process that uses it may itself be implicit.” [7] Many people may confuse intuition with tacit knowledge; I believe intuition is a kind of ‘built-in’ form in our mind as an innate mental ability. It is, probably, a kind of cognitive capability that allows human’s first reaction to any kind of object or anything whatsoever, so that we operate on them, then we have explicit or implicit knowledge thereof. Implicit (or tacit) knowledge is expressed further by Stillings et al.: “There is a classical intellectualist suggestion: if an agent regularly employs rules in the integration of behavior, then if the agent is unable to report these rules, then it is necessarily true that the agent has tacit knowledge of them.” [9] Fig. 1 summarizes knowledge and its sorts:
Different minds cannot have exactly the same knowledge of anything they learn, I think. I believe all of us can not have the same representations of external (conceptual) objects. Probably, most of our cognitive mechanisms are alike, although different minds may have subjective differing personal representations of the same object, at hand; yet they do have also similar ones of them. Further, those differing subjective representations may also share some similarities among them which can be called as ‘intersubjectivity’. This issue can be represented by a scheme “Fig. 2”:

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**Fig. 1.** A sketch of schematic representation of knowledge [5].

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**Fig. 2.** A possible schematic representation of representational mind [5].
2 CREATIVITY IN EDUCATION AND RESEARCH

Creativity is a very complicated issue. We all mostly mention this concept in our daily life with varying content. Nevertheless, I perceive this concept as 'unusual, novel' mental act. It is a kind of intelligence in synthetic and analytic cognitive psychological process. We can also put it like: “Creativity is to find out some sets of direct relevancies and to combine them in order to reach some (well/ill-defined) ends, but again by using all the mental abilities” [5] mentioned (in the synthetic sense) within the scheme in Fig. 3. I think, in both analytic and synthetic sense, it is a kind of quick perception of data/unit of information- (i.e.: entities among others), and/ or data structures (i.e.: objects among others) in relation to their relevancies among each other.

‘Creativity’ concerns all mental activities like problem solving “to reach a solution by using all mental abilities; like defamiliarization, circumscribing, mental leaps, analogy, reasoning, intuition, explicit (declarative-procedural) and implicit (tacit) knowledge, etc.” [5] This is, of course, not an absolute formula or a receipt; it is rather a global cognitive structure of a possible ‘creative’ behavior. The scheme in Fig. 3 is not a rigid sequence, either; there may be some jumping within this ‘creative’ process. It is also recursive and iterative; thus, not linear. These mental abilities are represented in the scheme, anyhow; yet we should say something more about creative analogy which is not only one step process; it has rather many steps as Holyoak and Thagard put it so clearly: “The use of analogy typically involves several steps. Often a problem solver will select a source analog by retrieving information about it from memory (selection), map the source to the target and thereby generate inferences about the target (mapping), evaluate and adapt these inferences to take account of unique aspects of the target (evaluation), and finally learn something more general from the success or failure of the analogy (learning). Our theory is intended to apply to all four of these steps. We will see that the constraints of similarity, structure, and purpose apply to each step, but with varying degrees of relative importance.” [7]

Fig. 3. A possible schematic representation of ‘creativity’ [5].

Analogy may not be the only cognitive ability concerning creativity, yet it is very important mental act. It is the inseparable part of multi-facet ‘creative’ attitude. It is a powerful combination with aesthetical consideration and combinatorics as Holyoak and Thagard suggest: “Although we do not believe that analogy is the only cognitive mechanism involved in creative thinking, it does play an important role. It has often been suggested that creativity is based on some mental mechanism for combining and recombining ideas in novel ways, where the recognition of viable new combinations depends in part on a kind of aesthetic judgment that the juxtaposed ideas fit well together.” [7]
3 METHODS FOR EDUCATION AND RESEARCH

Research is described in Merriam-Webster as: “critical and exhaustive investigation or experimentation having for its aim the discovery of new facts and their correct interpretation, the revision of accepted conclusions, theories, or laws in the light of newly discovered facts, or the practical applications of such new or revised conclusions, theories, or laws” [8]. Research, thus, is a kind of gaining knowledge which concerns also basically the education.

People have always been using methods for research and to reach their goals. These ends may vary like using methods to gain knowledge or to obtain some achievements, or for decision making and the like. Humans use methods for effectiveness and efficiency of our mental abilities in accordance with constraints of our cognitive capabilities. I mean by method as a way of handling the issue at hand, in the general sense and in that of educational like Creswell states it: “Research designs are plans and the procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis.” [3]

For the application of methods within the domain of education, first of all, the dominant underlying characteristics of all basic elements which play important roles in it, need to be understood. Regarding learning environment, either internal or external, as an example, let us analyze it well enough to adapt the methods to that. Research for methods in education requires a great deal of empirical data. We have knowledge of varying learning methods such as learning by being told, by being taught, by discovery, by analogy, by being instructed, etc.

We know that external conditions play important role in learners’ gaining knowledge. Gagne states that: “Instruction means arranging the conditions of learning that are external to the learner.” [4] Educative environment is fruitful if it operates interactively with learner’s mind to get internal learning processes activated. It is better if instructions are proper enough to trigger learning as Gagne says: “In the most general sense, instruction is intended to promote learning. This means that the external situation needs to be arranged to activate, support, and maintain the internal processing that constitutes each learning event.” [4]

We know that learning material can be transformed into knowledge if it is encoded into meaningful state. Knowable state can be obtained after information processing. Gagne explains it like this: “In order to enter and be stored in the long-term memory, the material of learning must be encoded. That is, it has to be transformed into a form that is semantic, or meaningful…Encoding, however, is the critical process by which incoming information is transformed into learned and memorable capabilities.” [4]

Our methods for education analyze precedents to gain structured knowledge to refer to and we use that analogically to reach ‘creative’ solutions. However, “precedent analysis” will be explained through some chosen methods, in the following pages.

Educators and researchers should have philosophical worldviews which shape their mental maps and those pervade into all scales of activities, as well. For example, Creswell states that there are three components involved in a design research for social problems: “Two important components in each definition are that the approach to research involves philosophical assumptions as well as distinct methods or procedures. Research design, which I refer to as the plan or proposal to conduct research, involves the intersection of philosophy, strategies of inquiry, and specific methods. A framework that I use to explain the interaction of these three components is seen in Figure 2 (here as Fig. 4). To reiterate, in planning a study, researchers need to think through the philosophical worldview assumptions that they bring to the study, the strategy of inquiry that is related to this worldview, and the specific methods or procedures of research that translate the approach into practice.” [3] Creswell delineates this matter by a scheme (Fig. 4):
Looking at the matter of education more in detail, we understand the necessity of philosophical worldviews, strategies and methods for research to construct a research program; though, depending on relevant domain types in terms of analysis and synthesis. We can make a research for education and vice versa through a worldview which gives way to both. Learning doesn’t begin with tabula rasa; it includes much of knowledge gained by research besides sensorial ones. All learning or teaching styles are related to research, one way or the other. Let us consider learning by discovery ‘by chance’; even if it seems a kind of learning without any intended research, yet it forces us to make more research about the discovered knowledge.

Research is, on the other hand, also interrelated with education. Considering an example of research which seems to be not relevant to education, at first: a researcher is busy with finding out if vitamin C is necessary for patients who lay down for a long time. We think first an experienced researcher doing this does not need any educational institution, whatsoever; he/she is capable of doing that by him/herself. First of all, that expert needs precedents which are recorded in the educational libraries or laboratories. There are also, probably, other ongoing researches on that matter within the educational institutions. Researchers need these also to check, test, and compare. We can give another example of research that seems irrelevant to education: an architect wants to know if there is enough of local natural material to realize his/her design to be built. I would say this is a typical naive rhetoric; because we are not treating research as being based on some single cases. This issue is a matter of domain, not that of single instances; it is, in fact, question of set of instances which refer again to domain. I can not imagine any learning domain without research; it seems to me research is intrinsic to it. Learning consists of, mostly, adding new knowledge or adapting old one to new one which much of it is obtained by research.
4 AN APPROACH TO SOME METHODS IN DESIGN EDUCATION

Research and education can share some methods. These twin lies in the core of our design education at our faculty of architecture. We teach students how to make research while designing. We stimulate them to reach their design solutions by adopting precedential structured knowledge to adapt to their design problems. I understand a research includes both “analysis” and “synthesis”, we call it ‘design by research’. In morphological analysis of precedents, we use Method Guney (four ways to precedent analysis) as four steps: a. Method Ching (as seen in Fig. 7 and Fig. 8) concerning spatial relationships and organizations, b. Method Clark&Pause treating the physical properties of artifacts and research for parti of them, c. Method Steadman involving topological and other dimensionless representations of designed or built artifacts; thus, precedents, d. Method FOP-POF (Guney/Tzonis) representing the cognitive structure of precedents. Some of them are explained below.

Before showing the schematic representations of the methods, I want to describe what “analysis” and “synthesis/design” mean by quoting this twin from my forthcoming book:

“Analysis: it is a kind of representation of breaking up a whole into its components on such a way that the elements do not have to be broken down into more ‘unnecessary’ (in accordance with some criteria) details; besides, the structural (syntactic) and semantic relations between components must be preserved and exposed. This “unnecessary details” will lead us to the term ‘morpheme (smallest meaningful unit of a domain)’ in morphological analysis of (architectural or any kind of) design,

Synthesis: bringing the ‘undividable’ (in accordance with some criteria of a domain- morpheme) components into a possible whole(s) within their mutual structural (syntactic) and semantic relationships. This is, of course, a very short explanation of synthesis in general. Later on I will, further, explain what possible combinable mutual structure and semantic are in (architectural or any kind of) compositions through their components or morphemes /and or: combination of morphemes (objects).”

[5] Fig. 5 displays these complementary processes:

At the end of this paper, there is an example of precedent analysis made by some of my students which delineates the four steps of it mentioned above.

This representation is a kind of semantic network shown in Fig. 6-Fig. 8; this “knowledge representation” is a kind of representation which relates data structures to each other as Winston puts it: “…a representation is a set of conventions about how to describe a class of things” [11] and it has four parts: a lexical, a structural, a procedural and a semantic [11] and “Semantic Net” is one of the representation techniques in which there are lexical, structural and semantic parts besides other ones which are: associational, structured object, formal logic based, procedural, common sense knowledge representations and other approaches. [2]

Analyzing precedents is a kind of research to find out the hidden principles which are not obvious unless we look for their underlying structures. This idea receives supporting explanation of Vosniadou: “For example, on the basis of readily accessible properties that can be seen, people presumably will not judge whales to be very similar to other mammals not fish, they will probably acknowledge that with respect to some important, although less accessible property or properties whales are similar to other mammals. This observation suggests that restricting oneself to relatively accessible properties may make it difficult to account for the perceived similarity of whales to other mammals. If one can not
appeal to “hidden” properties, it is difficult to explain the fact that people might recognize such similarities” [10].

![Fig. 6. A possible cognitive structure of (architectural) precedent analysis, compare with figure 7. [6]](image)

![Fig. 7. A schematic representation of the major units. [6]](image)
Fig. 8. A schematic representation of the minor units. [6]

Fig. 9. A possible cognitive structure of (architectural) design mechanism, compare with figure 6. [6]
Finally, I may conclude that research and education share some common methods as mentioned above. They use both similar instruments which have mostly common cognitive structures. I think it is plausible to state that this couple is interwoven with each other as if they were inherited from each other.
Fig. 11. An example of architectural precedent analysis through 4 methods by my students.
References


