Building Theory: Thinking Rightly Through Acts of Making

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INTRODUCTION

> Information is knowledge which is merely acquired and stored up; wisdom is knowledge operating in the direction of powers to the better living of life.
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> J. Dewey, How We Think, 52

In How We Think, author John Dewey postulates that all thought is made up of five essential layers of activity, each of which must be successfully engaged to produce a complete thought. Dewey's hypothesis bears special relevance within today's rapidly evolving age of information, when wisdom is often lost for knowledge and knowledge hidden by data. Within this world, education is less a matter of incorporating current technologies than it is of creating students who are capable of intelligently responding to technologies that have yet to be seen.

To offer a path to this end, this paper evolves Dewey's insight to create four new knowledge types which are then used to analyze current practices and uncover new methodologies. The resulting hypotheses are subsequently tested through a series of projects that systematically evolve the relationship between the students and the content of their course. In Project I, students **use** the given material to offer new approaches to concrete, which are then tested by constructing a concrete seat. In Project II, students **uncover** the innate properties of brick through the creation of a visual condenser. In Project III, students **elaborate** upon the properties of wood highlighted within the text through the construction of a fount of light. In the last two projects, students are asked to **confront** the given by using the chapters covering cladding and interior finishes to create first a vessel that will decay and then a wall that indefinitely delays the moment of spatial division.

The hope behind these exercises is to establish a new relationship between students and their course content. Although admittedly a messy process, this reformulation is absolutely necessary if they are to succeed within the rapidly shifting landscape created by technological innovation. Students can no longer be judged by their ability to recite what is known, for the known is ever-changing. Rather, students must be taught to activate their knowledge base and possess what is in their mind.

The era of memorization is at a close.

The era of experimentation and lateral thinking is upon us.

CONTEXT

> The need of thinking to accomplish something beyond thinking is more potent than thinking for its own sake.
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> J. Dewey, How We Think, 41

To begin this discussion, let us assume that a teacher asks four students to solve the following riddle:

Two hikers walk through a wood. After about an hour, they come to a cabin next to a small stream. Peering through one of the broken windows, the hikers discover several people strapped to chairs. A quick investigation

determines that all of the people have recently died. How did these people die?

The first student, who has little interest in the given puzzle, simply shrugs his shoulders and states that he has no idea.

The second student, who has a bit more interest in the riddle, reviews the given facts: two hikers, a wood, an hour walk, a cabin, several people strapped to chairs, broken windows. Finding no help within these facts, he too shrugs his shoulders and declares that he has no idea.

The third student follows a similar approach and reviews the given facts. As no solution is immediately apparent, he determines that additional information is needed. So, he cross-references the given data with his previous experience to find new parallels. From this exercise, he is able to hypothesize that because the victims were strapped to their chairs (and people seldom do such an activity willingly), foul play must be involved. Satisfied with his findings, he declares that the dead were victims of murder.

The fourth student follows this logic to a point. He too weighs the given facts, uses his previous experience to draw new parallels and attempts to uncover a viable hypothesis. However, in the end, he disagrees with the assessment of his peer. His reasoning: if this problem was a riddle, as his teacher said, then surely the answer must take into account more of the available information. His colleague's suggestion does not take into account the wood, the walk, or the broken windows. Pondering this last item, the student wonders what would cause all of the windows to break and comes to the following conclusions: either they broke over time, an unlikely scenario given the recent deaths of the occupants and the fact that people seldom spend much time in cabins without windows, or they broke suddenly. If the latter is true, then a sudden impact or series of impacts had to be involved. Although many natural phenomenon could cause such destruction (tornado, earthquake, hurricane), they would end up accounting for fewer facts than the third student's guess, making for a poor riddle indeed. So, the student continues to think. After a time, he begins to question the nature of the givens: What kind of hikers? Why an hour? What kind of wood? Finding no solution within these questions, he finally turns his attention to the nature of cabin and remembers that the inside of a plane is also called a cabin. He checks his new hypothesis with the available facts and discovers that a plane crash would explain all aspects of the riddle. He raises his hand, confident that he has the best answer.

TYPES OF KNOWLEDGE

> Because their knowledge has been achieved in connection with the needs of specific situations, men of little book learning are often able to put to use every ounce of knowledge they possess; while men of vast erudition are often swamped by the bulk of their learning, because memory, rather than thinking, has been operative in obtaining it.
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> J. Dewey, How We Think, 53

The four students featured in this scenario represent four different levels of intellectual engagement. To the first student, who did not engage the problem at any level, the given facts remained **external passive knowledge.** Although the data existed, it was never internalized. Thus, when asked to find an answer, the student could only use previously internalized knowledge to construct a solution. Once this level of engagement proved inadequate, the student had only two choices: either attempt to add to their store of knowledge by reviewing the given facts or suspend their engagement.

The second student moved beyond this level of knowledge because he decided to engage the facts. He knew, to the same extent as the third and fourth students, all of the given information. However, he could not build upon this store of knowledge. For although he successfully internalized all the information, he did not internalize the logic behind these facts. Thus, left without the underlying rationale, he could not bring forth new knowledge. His store of data might thus be referred to as **internal passive knowledge.** As a body, this type of knowledge can be quite impressive. Students who hold it can often wield it with great dexterity, reciting even the most remote facts with speed and accuracy. Within the world of academia, students with an immense store of this type of knowledge are often thought to have great

intelligence. Yet, this intelligence is in service of a dormant form of knowledge. For although this store can be recited, it can never be evolved. This is due to the fact that students who have this type of knowledge cannot create judgments about their internalized data, for such assessments naturally require that the student create value judgments about their detached factoids. As such valuations cannot be made unless these facts are brought to bear upon one another, the student is simply unable to organize their facts or create hierarchies. This is why John Dewey observes that "men of little book-learning are often able to put to effective use every ounce of knowledge they possess; while men of vast erudition are often swamped by the mere bulk of their learning, because memory, rather than thinking, has been operative in obtaining it."[1] Because this form of knowledge is largely inert, once it becomes inadequate, students must either seek out new information or suspend their engagement until said facts are made available by someone else.

The third students chose to take the former route by cross-referencing the given data with that offered by his previous experience. In so doing, he translated facts into ideas.[2] No longer was he confined to accepting all aspects of the given problem equally. His previous experience, especially that related to hiking, woods, cabins, seats, and death, was thus brought to bear upon each other and the problem. He could now weigh the givens, assess the relative worth of previously internalized data and endeavor to find a useful link between the two. In the process, he forced himself to organize his stores of data in order to create useful hierarchies. These hierarchies, which inevitably express the relative worth of the information, prompted him to make judgments, which activated the students' store of knowledge, creating what can be called **internal active knowledge.** Once formed, this brand of knowledge, unlike its passive predecessor, can be evolved radically to create cycles of inquiry. Once this base of knowledge is inadequate, they will necessarily seek out new information. This information will prompt the evolution of the previously offered organization, correspondingly demanding new hierarchies, new valuations, new data. Thus, when confronted with a difficulty, students who are operating with this form of knowledge can either seek out new information and continue their cycle of inquiry or find ways to create new data.[3]

The fourth student in the above illustration chose to create new data by questioning the information offered by the given problem, the situation in which it was offered, as well as his previously internalized store of knowledge. This interrogation of the supposedly known allowed the student to translate internal active knowledge into **internal possessed knowledge.** The fact that he did so using lateral thinking as opposed to scientific method is relatively unimportant, as either method can be effectively used to create this translation. What is important is that this student refused to accept the assumed limits of the known. Instead, he interrogated these limits so as to create new paths of engagement. The first such interrogation involved moving beyond the riddle itself to the context in which it was given. This context led the student to determine that his teacher would most likely not give such a detailed riddle to describe something as common as a murder. This prompted him to reject not only the hypothesis of the third student, but also all future conclusions which did not adequately respond to situation at hand (tornadoes, earthquakes, and rocks thrown through the window of the cabin). The second such instance of active interrogation occurred when the student questioned the nature of the individual elements offered by the riddle. Although many of these inquiries were fruitless (the hikers were only hikers and an hour simply indicated that they were deep in the woods), one such inquiry actually proved to be the key to the entire problem. If this were not the case, the student would have simply continued to question the supposed given until an answer could be found. The resulting cycle of critical thought can be continued indefinitely, regardless of whether or not the student continues to use internal possessed knowledge. For this reason, once the fourth student had questioned the nature of cabin, he could then return to internal active knowledge and test his hypothesis by cross-referencing what he knew about planes against the scenario outlined by the riddle. To operate within this level of thought only requires that the student remain open to the possibility of interrogating the known.

EDUCATIONAL IMPLICATIONS

> "The trained mind is one that best grasps the degree of observation, forming of ideas, reasoning, and experimental testing required in any special case and that profits the most, in future thinking, by mistakes made in the past. What is important is that the mind should be sensitive to problems ands skilled in methods of attack and solution."
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> J. Dewey, How We Think, 78

It is important to note several points regarding the aforementioned types of knowledge. First, a felt difficulty is needed to prompt thought. To quote author Donald Schon, "It is such conjecture, in this case quite unanswerable, that produces rational, self-consciously problem-finding behavior so crucial to the growth of intellectual power."[4] However, not all problems are created equal. To prompt such thought, the stated problem must meet several conditions. First, it must be felt. If the student is disengaged or uninterested, then thought will not occur. If the problem appears irrelevant or unimportant, then thought will not occur. To quote John Dewey, "without an emergency (some crisis, slight or great) there is no call for judgment."[5] Within this context, the educator has two options: either define the problem in a way that is of interest to those who must solve it or force an obligatory response to the given quandary. Although either path will prompt engagement, only the former will be empowered by the interest of the student. Properly directed, this interest can lead the student willingly into ever-deepening patterns of engagement. Left without this internal drive, the student will most likely use the minimum type of knowledge required by the problem. Perhaps this is why John Dewey remarks that curiosity is the foundation of thought and that educational systems must be "based upon natural tendencies."[6] However, for this curiosity to be properly directed, the difficulty must be well defined. If the problem can be read at a glance, then students may apprehend, but will not judge. If the problem is too obscure, then it will be addressed as a blind mystery and no judgment will occur. In the above illustration, it was critical that the riddle appeared to have a definite solution that was outside of normative experience. This definiteness eventually prompted the fourth student to seek out the best solution.

Second, a student's ability to offer alternative solutions and ascertain the relative value of each hypothesis is impacted by their breadth of experience and knowledge base. The greater the store of knowledge, the greater the chance that the answer rests within their grasp.[7] This rule is especially true when operating within forms of knowledge that cannot be evolved. In this realm, running out of knowledge forces the student to suspend engagement. Yet, even when engaging the highest patterns of thought, a student's store of knowledge will have an impact upon their ability to offer new conclusions. The only difference is that once a student has created possessed knowledge, the impact of this base will be diminished because the student can now manufacture new knowledge. They are no longer confined by the facts at hand.

Third, as "learning is not wisdom" and "information does not guarantee good judgment," the usefulness of this knowledge base is directly tied to the length to which a student can apply it.[8] As demonstrated within the illustration, if the student can create plausible judgments related to any given fact's importance and use, then this knowledge becomes active and can readily fold in new data. If the student is capable of interrogating this knowledge, even to the point of contradiction, then they can create new knowledge. To be effective in this pursuit, the student must also be able to judge when their inquiry has produced a useful result. The fourth student could have continued their inquiry indefinitely, questioning every fact uncovered through his investigation. However, this student judged that, in light of the given facts, the epiphany reached by challenging the nature of cabin successfully answered the demands of the proposed problem. So he acted upon his belief. This act, anchored by critical inquiry, represents the fruit of his labor: adding to the available store of knowledge.[9]

Fourth, to gain this ability and engage higher levels of knowledge, students must be taught to continually entertain and suspend judgment. For the degree to which facts are held suspect will determine, to a large extent, the depth to which a system of thought is entertained. Knowledge that is fixed can only

produce passive patterns of thought. The student may be able to recite the facts, but they will never be able to apply this knowledge to a problem that is not covered within their book. On the other hand, knowledge that is held in abeyance until its implications and voracity can be ascertained will become first active, then possessed, allowing the student to draw conclusions that would otherwise not have been possible.[10] As this process involves "a constant tentative picking out of certain qualities to see what emphasis upon them would lead to; a willingness to hold the final selection in suspense; and to reject the factors entirely or relegate them to a different position in the evidential scheme if other features yield more solvent solutions," students who wish to operate in this realm must be taught to consistently exercise alertness, flexibility and curiosity. They must be able to improvise.[11]

Finally, the depth of the engagement is directly proportional to the challenge of the given problem. As stated above, to enter into thought, the student must be challenged by a felt difficulty. If this difficulty can be answered through passive forms of knowledge, then whatever knowledge was given to answer the problem will remain inert. If, however, this difficulty requires that the student activate or possess the given knowledge, then it will be translated. Traditional testing models, which can typically be answered by internal passive knowledge, will not prompt deeper engagement, unless the student is motivated to do so because of personal interest or compensation (extra credit, the good graces of their educator, etc.). Barring such stimuli, the student will, at best, memorize the given facts and recite them on command. Not until this knowledge is applied to answer a situation outside their book will the student understand the given information.

Within the rapidly shifting landscape of the information age, the usefulness of this type of knowledge is obviously quite limited. Knowing the facts of one's field is no guarantee of success, for the facts of today will inevitably become the trivia of tomorrow. To succeed within this milieu, students of design must be challenged to continually engage the highest types of knowledge in all their coursework. The problems set before them within every course must compel them to not only activate the given information, but to possess it. Laboratory work and lateral thinking must become a standard part of the educational experience. Courses must work to develop students who challenge the authority of the text and assume an active stance within their education. Otherwise, our graduates will be little more than vast storehouses of empty knowledge. They may be able to quote the gospel according to Ching, but they will not have the ability to evolve it.

APPLICATION

> ...the assumption that information which has been accumulated apart from use in the recognition and solution of a problem may later on be freely employed at will by thought is QUITE FALSE. The skill at the ready command of intelligence is the skill acquired with the aid of intelligence; the ONLY information which, otherwise than by accident, can be put to logical use is that acquired in the course of thinking.
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> J. Dewey, How We Think, 53

To illustrate these concepts, I offer a series of exercises designed for second year students of design. These exercises, which are offered as a part of a required series of courses focusing upon materials and methods of construction, are designed to gradually and systematically intensify the dialogue between students and the content of their studies. Each of the exercises is related to a specific part of the text, and each operates to the ends described above. In the first such exercise, students are asked to elaborate upon the information provided in their text by producing a series of experiments to see how the ingredients of concrete can be altered (gravel was replaced by glass beads; sand with crushed brick). Through these experiments, students drew new lines between the given information and previously internalized knowledge. Their final analysis of their experiments created new knowledge. These elaborations were continued as students performed a similar exercise related to the processes of concrete construction. After several weeks, these investigations were used to produce a concrete seat that weighed less than fifty pounds and fit within an 18" cube - requirements which forced a re-evaluation of their experiments. These requirements also compelled the students to find ways to lighten what is a very heavy

material. This confrontation of a given was further intensified by requiring that all seats promote at least two methods of occupation. The designs which followed worked diligently to make concrete, a material that is not well known for inviting a great deal of lifting or even physical contact, invite human interaction.

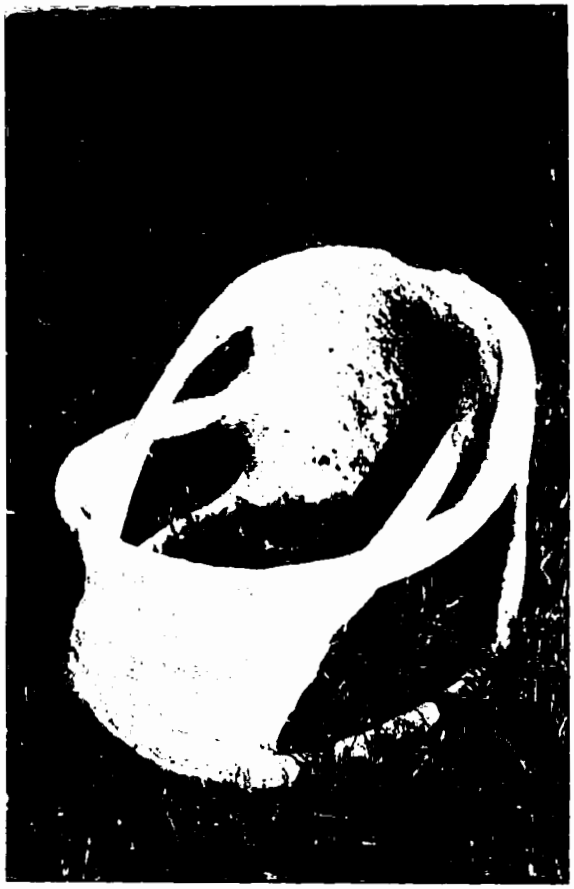

Figure 1. CONCRETE SEAT [Harold Young]

The second project focused upon brick. In this work, students were asked to create a filter of light using only stacked units of masonry. The prescribed attributes of brick - its mass, solidity, and opacity – were thus placed in service of an extremely delicate medium. This apparent paradox forced the students to wrestle with the information contained in the text. To help them come to terms with this problem, the class was divided into groups of five to six students and each group was given forty bricks to begin their play. Initially, the resulting proposals relied fairly heavily upon the information given by the text. However, by the end of the project, when all the groups were merged into one and the insight of the class was brought to bear upon 1000 bricks, their response relied much more upon their experiments with the medium and the possessed knowledge thereby created.

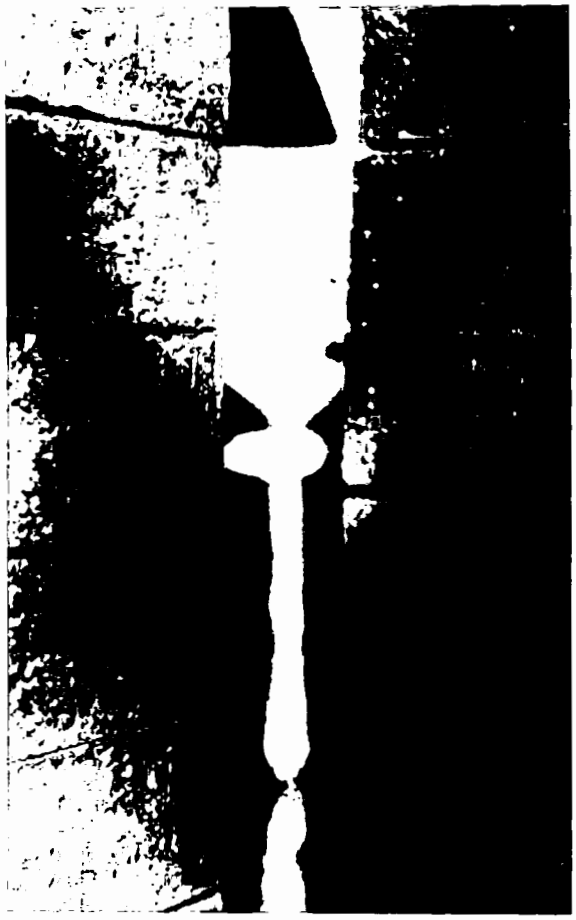

Figure 2. VISUAL CONDENSOR [installation]

The third project continued this procession by asking students to select one of several given works of architecture and analyze how the designer used the expressive potential of wood in new or unexpected ways. The insight uncovered through this investigation was then re-represented through a series of two- and three-dimensional mappings which spoke less to the appearance of the piece than its intent. Armed with this insight and the information contained within the text, the students set out to create a fount of wood that was capable of magnifying the presence of a single tea candle. The final submissions for this project clearly demonstrated a maturity that was not present within either of the previous projects. Most likely, this maturation was a result of two factors. First, by allowing the students to use the momentum of their selected

precedent to energize their work, the project brief insured at least some of their investigations would be motivated by more than compulsion (grade). Second, because the students had already experienced higher forms of knowledge, they were simply more able to deploy them within this project.

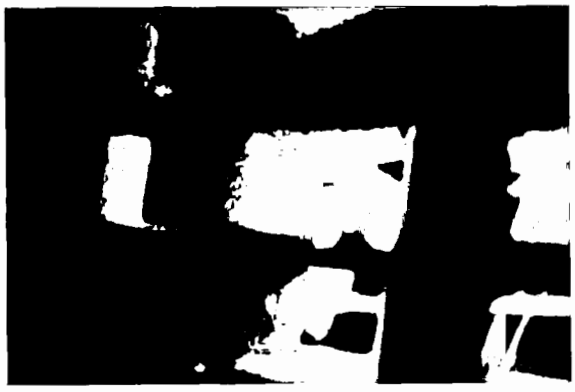

Figure 3. A FOUNT OF WOOD AND LIGHT [D. Rousseau]

In the fourth project, the students were asked to use the chapters on cladding to create a vessel would decay over time and create a more powerful expression with age. As this brief was a direct challenge to the text, which asserts that decay is something to be avoided at all costs, the students were placed between opposing authorities (text and educator). Not surprisingly, this shift tested the confidence of the students, prompting many to revert back to more established patterns of exploration. Instead of conducting experiments, the students made models of experiments. The resulting work, although formally rich, lacked the conviction of previous submissions. It is interesting to note that this reversion occurred despite the fact that the thought required to pull of this challenge is no deeper than that required for the previous projects – a situation which would seem to indicate that one's ability to possess knowledge as at least partially tied to the conviction with which it is offered. Apparently, in the mind of the student, it is one thing to possess knowledge that is an elaboration of a given text, it is entirely something else to possess knowledge that is a direct challenge to this authority. Fortunately, once this deficiency was highlighted, the students quickly realized their error and sought to uncover find new avenues for exploration. These explorations produced possessed knowledge, allowing the students to mount a compelling challenge to their text.

Figure 4. VESSELS OF DECAY [H. Breaux]

In the final work, the students were asked to pair the chapters covering interior finish materials with a project that refused to declare a singular moment of division. Each student was given an area eighteen inches wide, twelve inches deep and seventy-two inches high to explore the nuances of this mission. Light, material, and perception were thus married into a work that questioned a central bias of the given text. Having already participated in a work of similar intent, the students pursued their confrontation with great aplomb. The resulting process, unlike that used in the initial phases of project four, was wholly informed by open-eyed acts of experimentation. Accidental occurrences and intentional discoveries received equal attention. The final work, which was hung as an assembly within a local art gallery, produced created a compelling vision of what a wall could be, not what it was.

Figure 5. SUSPENDED LIGHT [installation]

Notes

[1] "Because their knowledge has been achieved in connection with the needs of a specific situation, men of little book-learning are often able to put to effective use every ounce of knowledge they possess; while men of vast erudition are often swamped by the mere bulk of their learning, because memory, rather than thinking, has been operative in obtaining it." John Dewey, How We Think (Mineola, New York: Dover, 1997) 53.

[2] "Ideas are not then genuine ideas unless they are tools in a reflective examination which tends to solve a problem." Dewey,109.

[3] "To be a good judge is to have a sense of the relative indicative or signifying values of the various features of the perplexing situation; to know what to let go as of no account; what to eliminate as irrelevant; what to retain as conducive to outcome; what to emphasize as a clue to the difficulty. Insight, discernment...In part it is instinctive or inborn; but it also REPRESENTS THE FUNDED OUTCOME OF LONG FAMILIARITY WITH LIKE OPERATIONS IN THE PAST." Dewey, 104.

[4] "It is such conjecture, in this case quite unanswerable, that produces rational, self-consciously problem-finding behavior so crucial to the growth of intellectual power." Donald Schon, Educating the Reflective Practitioner (New York: Jossey-Bass, 1990) 159.

Dewey supports this assertion through his definition of problem solving: ""the discovery of intervening terms which, which inserted between the remoter end and the given means, will harmonize them with each other" or to "bind together otherwise incompatible traits." Dewey,72-3.

[5] Dewey, 107.

[6] Dewey contrasts the curious mind with an inert mind that "waits for facts to be thrust upon it." Such a mind may, in rare cases, naturally exist or it may be created by an educator who fails to base their methods upon the experiences and interests of their students. For, in the words of Dewey, "effective appeal of this kind is impossible unless the teacher has insight into existing habits and tendencies, the natural resources with which he has to align himself." (Dewey, 29-30)

[7] "...something must be already understood, the mind must be in possession of some meaning which it has already mastered, or else thinking is impossible." Dewey, 119.

[8] Dewey, 107.

[9] "The judgment when formed is a decision; it closes (or concludes) the question at issue." Dewey 107 Taken merely as a doubt, an idea would paralyze inquiry. Taken merely as a certainty, it would arrest inquiry. Taken as a doubtful possibility, it affords a standpoint, a platform, a method of inquiry." Dewey, 108-9.

[10] "If this meaning is at once accepted, there is no reflective thinking, no genuine judgment. Thought is cut short uncritically, dogmatic belief, with all its attendant risks takes place. But, if the meaning suggested is held in suspense, pending examination and inquiry, there is true judgment. WE STOP AND THINK, WE DE-FER CONCLUSION IN ORDER TO IN-FER MORE THOROUGHLY." Dewey, 108.

[11] "a constant tentative picking out of certain qualities to see what emphasis upon them would lead to; a willingness to hold the final selection in suspense; and to reject the factors entirely or relegate them to a different position in the evidential scheme if other features yield more solvent solutions." Alertness, flexibility, curiosity, are the essentials; dogmatism, rigidity, prejudice, caprice, arising from routine, passion and flippancy are fatal." Dewey, 105-6.