Proceedings of the

Drawing Research Network 2013 Conference / Thinking Through Drawing Seminar

Teachers College - Columbia University + The Metropolitan Museum of Art

Contents

Alaluusua – Sketchbooks and their private and public dimensions	1
Anderson | Isomorphology: Drawing Research and Methodology	4
Cabral | Sketching and Slow Travelling	6
Dawkins + Pable | Sketching at the Speed of Thought: Weaving Expertise Theory with Drawing Automaticity	7
Dawson | Drawing with Holoshop	17
Dos Santos | TRANSLATIONS 4a/b.2013	27
Downs | Emergent Drawing: the drawing as a complex adaptive system	36
Graham | Point, Mark, Line, Outline: Thinking Through the Drawn Line	43
Hannibal | The Digital Dilemma: Product versus Process in Architectural Education	53
Hastings | Drawing as Design Thinking: Teaching design students to think and research through drawing	58
Imperatore | Seeing More-or-Less: Drawing as Disposition of Perception	67
Justice & Williams | Motion, Light, and Space: Gesture in the Digital Age	85
Kane + Walton | Re-purposing Drawing in Textile Design Education: research and practice shaping pedagogy	94
Kot | Doodling: Space, Self, Culture and Understanding	100
Lee Weider | Frederick Froebel's Influences on Drawing Education:	111
Magalhães + Providência Dreamed Gestures: A Case of Architectural Design Communication through Drawing.	116
Netter | Models for sketching in design education	122
Pelayo + Lopes | Architecting through freehand drawing	137
Price | Gesture, affect and the pursuit of the authentic.	140
Samuel | Drawing as Thinking in Chaos Theory	151
Schneckloth | Relational Gestures: Three experiments in collaborative drawing	156
Simões | Research, through and from the drawing in learning context	164
Strucke | Embodying Symbiosis: A Philosophy of Mind in Drawing	170
Wright | Exchanges between Medicine and Drawing Practice – an example of interdisciplinary dialogue	178

Dawkins + Pable | Sketching at the Speed of Thought: Weaving Expertise Theory with Drawing Automaticity

Abstract

Design instructors and students can benefit from viewing and assessing their sketching skill level through the lens of expertise theory. Instructors that possess 'automatic'-level skills in quick sketching as classified by expertise theorists may be best positioned to assist students in their own sketching success.

Expertise theory identifies five levels of proficiency in tasks. The highest level describes an 'automatic' state in which a person successively relies on intuitive understanding rather than calculative rationality (Dreyfus & Dreyfus, 2005, p. 789). In this stage a person can sketch a scene while engaged in another task such as verbal explanation or listening without loss of sketching speed or accuracy. The person is sufficiently fluid in their sketching cognition where there is no longer a need to think about the physical act of sketching, allowing attention to other active tasks such as designing, or directing others through talking.

An instructor's automatic sketching skill expertise may have benefits for students. For example, instructors can simultaneously demonstrate and explain sketching actions to a student while modeling highly successful actions that can limit the learner's random trials to the more promising strategies (Dreyfus & Dreyfus, 2005). Importantly, instructors can also fully engage consciously with a student's situation while simultaneously explaining it in drawn fashion.

Biography

Jim Dawkins is an assistant professor of Interior Design at The Florida State University where he serves as an instructor in both undergraduate and graduate studios. He is a registered architect in several states, having earned his BA in Design and Master of Architecture degrees from Clemson University prior to practicing for twenty years as an architect, designer and corporate officer with design firms in Atlanta, GA and Vail, CO. Dawkins' research interest focuses on graphic facilitation, communication, and mediation of ideas through hand-drawing techniques and their realization in hybrid forms of computer aided design.

Jill Pable, FIDEC, ASID is an associate professor of Interior Design at Florida State University and directs the graduate program. She has B.S. and M.F.A. degrees in Interior Design and a Ph.D. degree in Instructional Technology with specialization in architecture. She served as national president of the Interior Design Educators Council in 2009. She is the author of Sketching Interiors at the Speed of Thought and co-author of Interior Design: Practical Strategies for Teaching and Learning with Katherine Ankerson. Her research focuses on the design of environments for the underprivileged and she believes that design can make life more interesting, fulfilling and humane.

The Florida State University

jdawkins@fsu.edu, jpable@fsu.edu

Introduction

Among the many skills that interior designers and architects must possess is the ability to visually communicate ideas effectively. Often this means imparting ideas to others quickly and accurately so that intent is conveyed well. Information can range from an abstract idea of adjacencies of spaces for a designer's own consumption to an on-the-fly perspective that communicates the look and feel of an unbuilt interior space for a client. Thus, quick graphic sketching is a skill that has utility for designers and consequently, has long been taught in design curricula.

This paper will advocate that design instructors could benefit from thinking about teaching sketching skills through the cognitive framework of expertise theory (Dreyfus & Dreyfus, 2005). Doing so may help them better understand their student's successes and failures as they practice sketching, and may help them adjust their classroom strategies to better ensure sketching practice success in their students.

Expertise theory took off in the mid to late-1970's and since that time has been the subject of continual examination by educational psychologists and researchers (Simon & Chase, 1973; de Groot, 1946/1978; Feigenbaum & McCorduck, 1983; Ericsson & Smith, 1991). It has been examined in the context of many different types of tasks including accounting computations, music conducting and piano playing (Bloom, 1986). Dreyfus & Dreyfus developed a framework of expertise theory that identifies five levels of proficiency in tasks (2005: 779-792). The highest level describes an 'automatic' state in which a person successively relies on intuitive understanding rather than calculative rationality (Dreyfus & Dreyfus, 2005: 789). In this stage, a person engages with a task while engaged in another task such as verbal explanation or listening without loss of task speed or accuracy. The person is sufficiently fluid in their cognition where there is no longer a need to think about the physical act of doing the task, allowing attention to other active tasks such as talking or listening. Persons at this level enter a realm where unconscious 'doing' supports the freedom of complex thinking, and they can more freely engage in metacognition about their skills to positive effect.

The application of expertise theory to architectural sketching has been only topically explored (Gobert, 1994; Pable, 2000; Chen, 2004). Expertise theory may explain why people who are experts in sketching can do so fluidly and without loss of speed or accuracy while they engage in a second task simultaneously, such as explaining the scene they are drawing to someone else. It may also help explain how experts in sketching engage in this act without actively thinking about it to communicate an idea. These are positive traits in that they seamlessly integrate sketching into their overall design process, enabling a powerful visioning tool to assist and influence design decision-making and communication.

In contrast to expert behaviors, students often struggle to sketch quickly and accurately. The majority of design student's previous experiences with drawing typically include depictions of still life scenes created in an art class, doodles in school notebooks, and perhaps some cartooning for class projects or notes to friends. These sketch images and objects are constructed independent of formal rules or guidelines – they are drawn as presented to them both physically and in their mind's eye. While the sketches may represent the student's ideas, they can often suffer in their success with regard to accuracy, scale, depth, and context. The student lacks the requisite skills to adequately describe his or her own thoughts. As a result, students can develop an anxiety about sketching, or convince themselves they will never learn this skill.

The authors are both experienced instructors that teach architectural sketching and have observed student behaviors that seemingly correspond to the five stages of expertise theory as outlined by Dreyfus & Dreyfus (2005: 779-792). This paper reports on these five expertise stages and links their characteristics to observed student perceptions, actions and skills. The comparison may prompt discussion and potentially help other instructors understand why students sometimes think and struggle the way they do with the complex cognitive task of sketching.

Stage 1: The Novice

Expertise Theory:

> The instruction process begins with the instructor decomposing the task environment into context-free features that the beginner can recognize without the desired skill. The beginner is then given rules for determining actions on the basis of these features, like a computer following a program (Dreyfus & Dreyfus, 2005: 782).

1. A Stage 1 student's experience of sketching:

John enrolls in a graphic techniques class at the start of his interior design school education. His goals are to develop quick sketching skills in order to begin visually illustrating, in two and three dimensions, design intents representing his studio projects. He has seen examples of previous classes drawings exhibited in the hallways and on the class's website and has an uneasy feeling, perhaps that borders on outright fear, of the gap between his current drawing knowledge and the quality of the drawings displayed. His first thoughts of "I'll never be able to do that" or "I'm just not that good" fuels his trepidation. He cannot fathom what it will take to grow from his loose doodles to more refined, accurate, and realistic imagery. His perception of the expertise needed to complete these kinds of drawings leads to his inability to relax and stay open-minded.

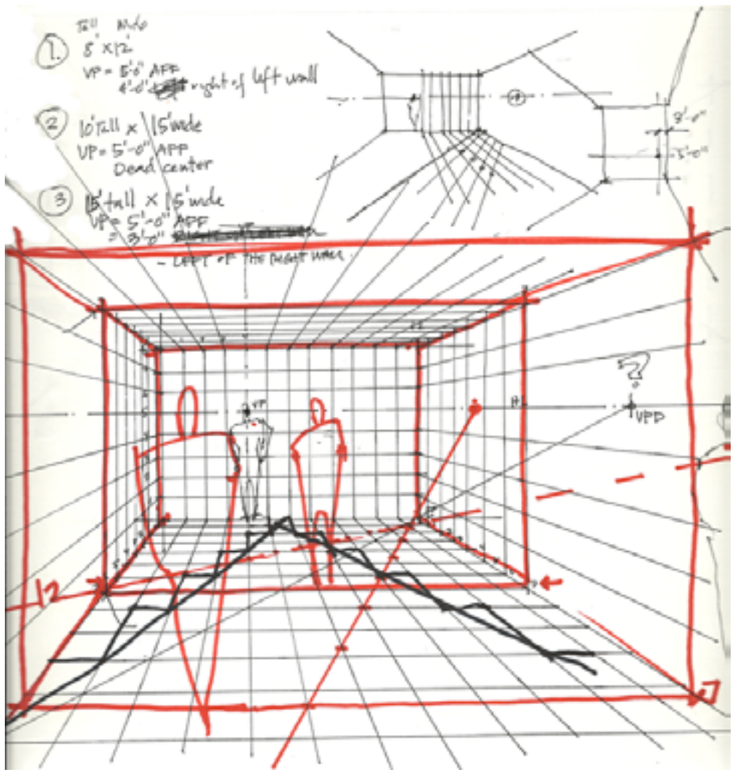
The instructor begins by describing the various components that make up the frameworks for one and two-point perspectives such as the horizon line, vanishing point(s), a true height component, and scalar elements such as scale figures. John starts drawing in a sequential fashion building up a framework of components leading to a gridded scene – a generic, three-dimensional construct simply containing a floor, two walls, and a ceiling. Within this grid, John is able to recognize the three-dimensional environment and within it begins to explore simple object construction. Seeing the measured path of drawing instruction set by the instructor, John loosens up, puts pen to paper, and calmly moves through the skills exercises.

1. An instructor's potential teaching approach for Stage 1 learners:

At this point, the instructor is simply introducing and defining the framework elements and rules of perspective drawing. Perspective construction can be taught in a multitude of ways as evidenced by the plethora of perspective instruction books, internet sites, and even mobile device apps. Most likely, the novice student will not be able to see beyond a collection of rules and parts. This is where the instructor has an opportunity to empathize with his or her class confirming that indeed, perspective construction can be laborious, slow and oftentimes confusing. A few basic instructional methods could include the following.

1. First and foremost, this is a critical time for the instructor to exhibit a healthy degree of excitement, energy, and enthusiasm for sketching. The instructor's confidence in their own expertise as well as their ability to develop those same skills in their students should be clearly expressed.

2. The instructor can present the perspective 'pieces' or components individually, define their usual positions, and instruct the students in their assemblage. This is similar to building a plastic model car where the builder arranges the pieces on a table, organizes them relative to their anticipated positioning, and then pieces the parts – according to series of assembly steps - together to form the car. For quick sketching techniques, those components would include a horizon line, vanishing point(s), true height component, and a scale figure. With sketching, the rules for constructing a perspective are explained and exampled by the instructor and then practiced by the students using a sequential fashion of applying one element after another until the perspective 'bones' of a scene are in place.



Dawkins-figure 1 – Basic perspective components of a perspective (Dawkins, J., 2012a)

3. The instructor can guide students through analyses of perspective scenes from magazines, books, and the instructor's own collection of perspective sketch drawings, deconstructing each scene into its various components such as the vanishing points and horizon lines along with where and how they are arranged to create the scene. (See overleaf. Fig. 2 Dawkins-figure 2 – Perspective and scene deconstruction (Dawkins, J., 2012b).)

Understanding the rules of sketching is good, but for the interior design student, it only works if the sketching activity has an intended application. Specifically, the interior design student "needs not only the facts but also an understanding of the context in which that information makes sense" (Dreyfus & Dreyfus, 2005: 783). That is, within the student's drawn constructs (their perspective grids), they can begin to see how the parts are organized to create the whole. The rules are tested through exercises aimed at integrating a drawing process into the student's design behavior. The discipline of setting up a sketching framework creates a measure of freedom for the instructor to point out subtle aspects of a student's sketch and then guide them into manipulating the rules in order to customize the scene.

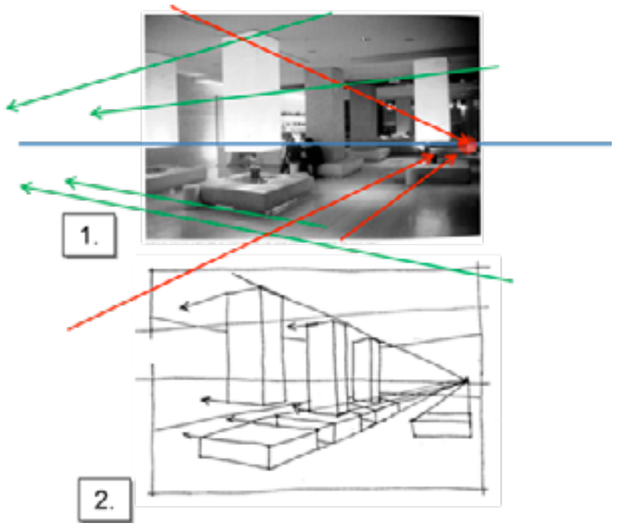
Stage 2: Advanced Beginner

Expertise theory:

> As the novice gains experience actually coping with real situations and begins to develop an understanding of the relevant context, he or she begins to note, or an instructor points out, perspicuous examples of meaningful additional aspects of the situation or domain. After seeing a sufficient number of examples, the student learns to recognize these new aspects. Instructional maxims can then refer to these new situational aspects, recognized on the basis of experience, as well as to the objectively defined non-situational features recognizable by the novice (Dreyfuss & Dreyfus, 2005: 782).

1. A Stage 2 student's experience of sketching:

Anne prepares herself to sketch a perspective scene for her interior design project. She recognizes the vanishing point as a necessary tool



Dawkins-figure 2 – Perspective and scene deconstruction (Dawkins, J., 2012b).

in constructing a one-point perspective. However, she is unable to effectively construct a perspective without the grid. With the grid constructed, Anne now has a visual reference whereby she can begin to analyze the various aspects of her intended scene. Class demonstration by the instructor shows her that moving the vanishing point to the left side reveals more of the right wall and vice-versa. Moving the horizon line up or down influences how much or little is seen of the ceiling and floor plane for 'birds-eye' and 'bug's-eye' views respectively. Anne's replication of the demonstrations shows that these point and horizon line manipulations work for her as well. However, she does not yet intuitively know that combining these two manipulations lends further good options for views.

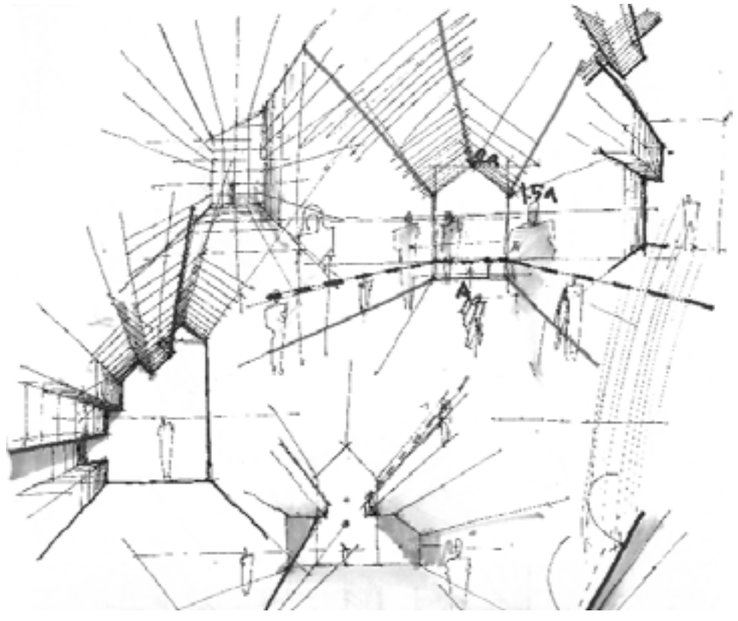
An instructor's potential teaching approach for Stage 2 learners:

Expertise theory suggests that the instructor should assume the role of coach at this stage to assist the student in pinpointing and recognizing relevant aspects such as vanishing points and horizon lines. Four tenets become important in Stage 2.

1. Class discussion should now organize and allow learners to simply 'get their arms around' the material. The emphasis at this point is for students to use the maxims that have been given to them (Dreyfus & Dreyfus, 2005: 783) while the instructor simultaneously points out certain aspects that are important or can be manipulated. Therefore, letting students experience first-hand the movement of vanishing points is key—not just observing the instructor doing this by him/herself.

2. Learning at this stage is necessarily detached and undertaken by the student in an analytic sort of way (Dreyfus & Dreyfus, 2005: 783). This is requisite at this stage because, in these authors' opinion, the learner is not sufficiently fluid with the cognitive load of the task that they can become more personally involved. This detachment makes a measure of repetition of elements such as scale figures, horizon line, vanishing point(s) a logical classroom inclusion for the instructor. This drill-style approach at this stage – constantly doing it again - can help reinforce fundamental skills, strengthening the learner's ability to make certain choices without thinking about them. As the learner progresses, the instructor can start to compound rules in an additive fashion, for example coupling a known element (such as manipulating the vanishing point left and right) with raising or lowering the horizon line.

Dawkins-figure 3 – Sketch perspective "do it again" drill and practice (Dawkins, J., 2012c).



3. The instructor can suggest that the student utilize tracing paper overlays when creating their gridded scenes, physically sifting through ideas that worked and trashing sketches that didn't. They do it again – over and over – all the while seeing which horizon line, set of vanishing points, scene viewpoint, or series of scalar elements work together to represent the student's desired sense of what it is they are trying to communicate. The student is able to define which features, aspects and processes over which they can exert control.

4. The notion of quick sketching relative to design process efficiency becomes important. In this stage, emphasis on speed can begin to enter the classroom conversation, coupled with the 'do it again' drill and practice approach.

5. The objective and analytic stance in this stage can also be applied to perspective scene composition – so that the learner can couple choices of view and the tools that create them with quality compositions (as long as the criteria for 'quality' is defined for them).

Overleaf: Dawkins-figure 4 – Analyzing the composition of a scene (Dawkins, J., 2012d).

Stage 3: Competence

Expertise theory:

> With more experience, the number of potentially relevant elements and procedures that the learner is able to recognize and follow becomes overwhelming. At this point, since a sense of what is important in any particular situation is missing, performance becomes nerve-racking and exhausting, and the student might well wonder how anybody ever masters the skill.
>
> To cope with this overload and to achieve competence, people learn, through instruction or experience, to devise a plan, or choose a perspective, that then determines which elements of the situation or domain must be treated as important and which ones can be ignored (Dreyfus & Dreyfus, 2005: 783).

A Stage 3 student's experience of sketching:

Eager to put his ideas on paper, Mark decides to pull up from is floor plan diagramming and start constructing the four sketches required of his class v project that illustrate the form and shape of his space. He is excited yet anxious to start 'seeing' his ideas come to life. His design involves an oblong lobby space with rows of columns, a two-story central atrium, and a monumental stair connecting the first, second, and third

Dawkins-figure 4 – Analyzing the composition of a scene (Dawkins, J., 2012d).

floors. Mark immediately constructs a two-point generic grid within which he wants to sketch the lobby. His grid turns out a bit flat and fails to convey the length of his lobby. He starts another grid that addresses the lobby length but doesn't adequately describe the rhythm of columns defining the central space leading to the stair and atrium.

An hour later, he creates a third grid constructed in one-point fashion that manages to illustrate the columns within the longitudinal direction of the lobby, but cuts off the atrium view. Mark scrambles to lower the horizon line in the grid to capture the atrium's volume but has lost valuable time in his schedule. And it still doesn't look quite as he had imagined! Moreover, he has yet to address any of the other sketches he has to produce. So many rules, all those component variables..... the anticipated joy in applying his design ideas is stymied by the anxiety of potentially getting it wrong while burning through his available time. Frustrated with the time loss and failure to establish a framework within which to sketch, Mark abandons the sketches and returns to his floor plan.

As the assigned scenes (or design scenarios) grow in quantity and complexity requiring the use of multiple rules and features in a variety of ways, the sketcher becomes overwhelmed. Overload occurs. Additionally, the speed at which they are expected to make appropriate decisions with accurate applications can make the process intimidating. Rules are missed, features left out, aspects of the sketch unrecognized or unheeded. Frustration sets in. The student's desire to get better and faster is beyond their ability to recognize the context and then apply the appropriate variable components. A much needed measure of control over the process becomes evident.

This third stage of competence in sketching can be long drawn out process, and hence the extended length of the ensuing discussion here. The

design student's sketching growth typically moves through the rules and guidelines of the novice and advanced beginner stages with rapid progress. Over time, the repetitive nature of skills building exercises performed in a methodical sequence of procedures can build a foundation for both speed and accuracy in sketching. However, when, where, and how to use these basic skills takes time, and plenty of it, months, perhaps even years. As such, both student and instructor should anticipate an extended period of both instruction and practice in this stage.

An instructor's potential teaching approach for Stage 3 learners:

The student is responsible for illustrating their design thinking – drawing those conceptual 'things' that they can only see in their mind's eye. Yet, in their Stage 3 thinking, there is no reference point, no fully-baked components – just a feeling of what it should look like, of what they sense the space wants to be. Here the student should be encouraged to take a chance - "just draw it and see what it looks like" – and run with their choice and work the sketch to a point that it can be evaluated relative to the student's intent. However, as Dreyfus & Dreyfus (2005: 784) point out, "since at this stage, the result depends on the learner's choice of perspective, the learner feels responsible for his or her choice. Often, the choice leads to confusion and failure. But sometimes things work out well, and the competent student then experiences a kind of elation unknown to the beginner."

Bits and pieces of their sketches seem to capture a quality the student can only sense and feel. A well-drawn component confirms a good idea and generates further design thinking and consideration. Other aspects of the scene or object become apparent that may be subject to other drawing rules. A poorly used feature or rule fails to illustrate an aspect of the drawing accurately causing the student distress. Again, they search for a way to sketch at a pace that can keep time with their thought processes. The number of variables that can affect a sketch's outcome – choice of horizon line height, location of the station point, distance between vanishing points, size of scalar elements – challenge the student's skill to document them effectively and efficiently. Eager to quickly move ahead, the student looks for control over a seemingly limitless set of possibilities. Reckless speed can kill, but it can also induce a measure of exhilaration when controlled.

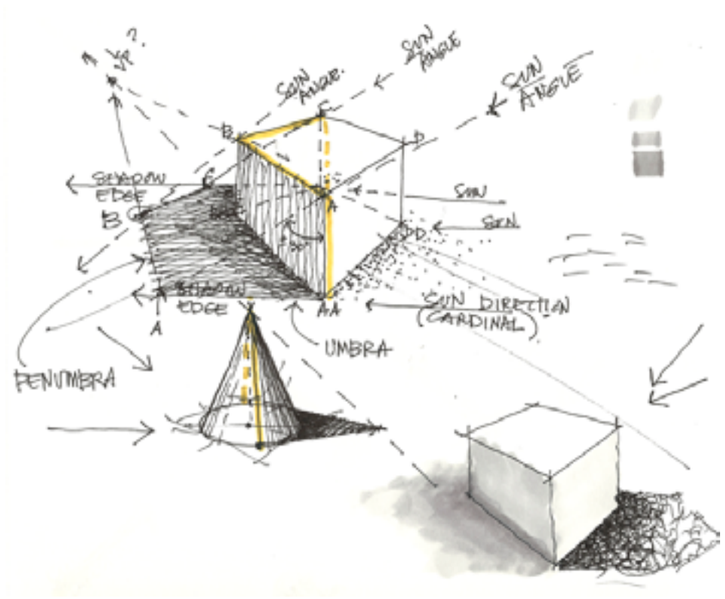
Stage 3 can be frustrating for students. In part, this is because reverting to sketching within a time-consuming constructed and static grid that demands adherence to rules fails to produce a sense of place or space or the essence of an object at the speed the students mind is racing. "It looks like a chair but not my chair." Additionally, if design thinking has to wait on drawing construction, then the student is in jeopardy of losing that "loving feeling"; the idea of what that chair needs to be that is at the forefront of their mind starts to fade. To ensure capturing the emotive quality of their design idea requires sketching at the speed of their own thought processes. They have to add and take away rules and features quickly in order to account for all the aspects unique to what it is they are designing and drawing. They need to be driving by looking at where they are going, not where they have been.

For the student, the chair needs to look and feel like the chair they have in mind – the scale and proportion they can sense will be appropriate to a person sitting in it and the space in which it occupies. Only then can the student accept success. Conversely, in a scenario devoid of feeling such as drawing within the digital construct of a computer, the computer is successful when it accurately interprets and displays points and lines based on the user's data input. The computer and its software do not care if the student is right or wrong in their drawing, only that it has followed the rules and produced a representation of an object, space or place. It does not care if it looks bad or doesn't 'feel right'. The computer is not aware that the chair seat looks too hard, that the back is too low, or that the legs are too fat or thin. It was successful in that it created something by following the rules. In this way, computer perspective construction may, in the opinion of these authors, be a different thought process for students than perspective construction on paper. While this topic is not addressed here, it is worthy of further consideration with regard to expertise theory.

In Stage 3 a student's drawing process needs direct supervision and mentoring. They will benefit from a verbal guide – the instructor – as well as a set of graphic guides – drawing frameworks - in order to make good decisions in quick order so they can maintain their design momentum. Reflecting on the plastic car model illustrated earlier, while the instructions initially appear to be clear in their description of how to build the car for a little boy, it may take his dad interpreting the entire assembly by bringing his own model-making skills to the fore before the boy can complete the car. The dad can instruct his son in how to arrange the parts on the worktable in anticipation of assembly sequencing, which hobby knife, piece of sandpaper, and type of glue to use for varying assemblies, and where two items can be assembled alongside each other thereby reducing the time required to complete the steps. The sketching instructor can perform in the same manner as the dad.

Several teaching strategies may assist Stage 3 learners:

1. The instructor can direct the student to devise a set of predetermined quick responses to anticipated drawing situations, using a playbook approach based on past drawing experiences that identifies successful approaches to solving problems. By having multiple preset



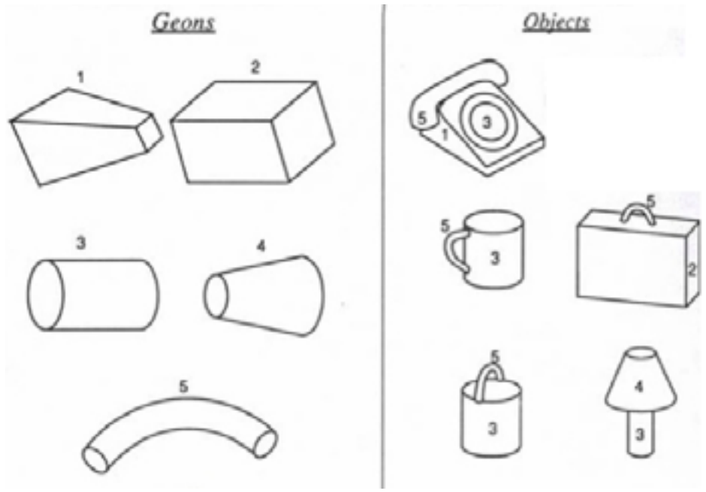
Dawkins-figure 5 – Predetermined responses to the construction, shading, and shadowing of a cube (Dawkins, J., 2012e).

solutions (such as a series of previously constructed perspective grids with a variety horizon lines, vanishing point spacing, scale allusions) the student can address scene selections quickly and with more confidence.

2. The instructor should introduce theoretical aspects of drawing cognition that can assist students in building their own notions of sketching processes. Biederman (1987: 116) suggests, the process of sketch development might be organized around the parts of the item being pictured, referencing the notion of "object recognition". That is, a sketch may start with the student constructing the components that make up the item and then assembling them accordingly. This could be a piece of furniture, a room or space made up of various "geometri-

cal ions or geons", a set of "primitive elements ....a modest number of simple geometric components—generally convex and volumetric—such as cylinders, blocks, wedges, and cones" that, combined in numerous configurations, produce the image (Biederman, 1987:115).

Dawkins-figure 6 – Geons and objects – components of object recognition (Geons and objects, 2012).



3. It may be that the instructor advocates that a piece of furniture or millwork always starts with a perspective cube or box that the student 'carves' into (reductive rather than additive). Spaces with large desks, counters, or specialty walls may start as a two-point perspective with an offset true height line to one side or the other. A corridor or hallway, a hall of columns, or a bilaterally symmetric furnished room might demand a lower horizon line but with a dead-center vanishing point. Whatever the case, the student develops a plan to address the situation and moves forward with it.

See below: Dawkins-figure 7 – Progressing through a sketch by 'carving' into an object (a cube) (Dawkins, J., 2012f.

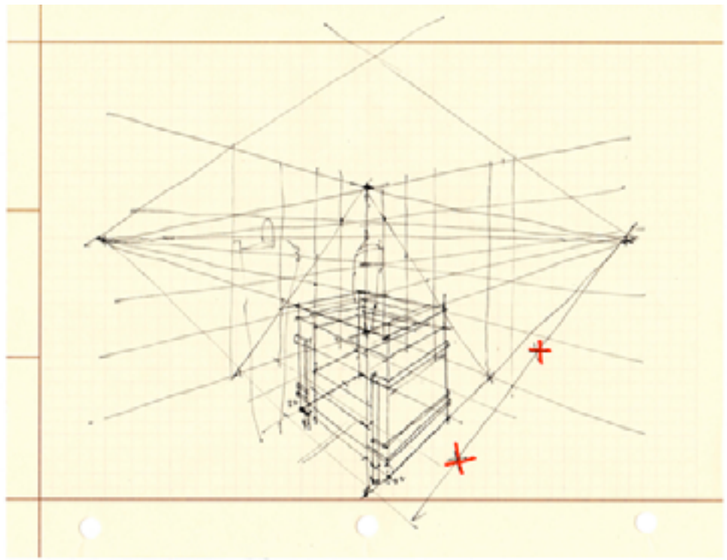
4. It is a good idea to keep the students 'juices' flowing by urging them to draw no matter what the student thinks of their work. The instructor can encourage the student to accept the chance that their sketch may not work out and just dive in and draw. Failure to express one's mental picture of a design can often lead to a degree of frustration. Rather than retard the speed and immediacy (and perhaps joy) of design thinking, drawing by rule and feature could take a back seat while searching for the means to illustrate their ideas, the need to communicate the fit and feel of an object or space or place. Students can get

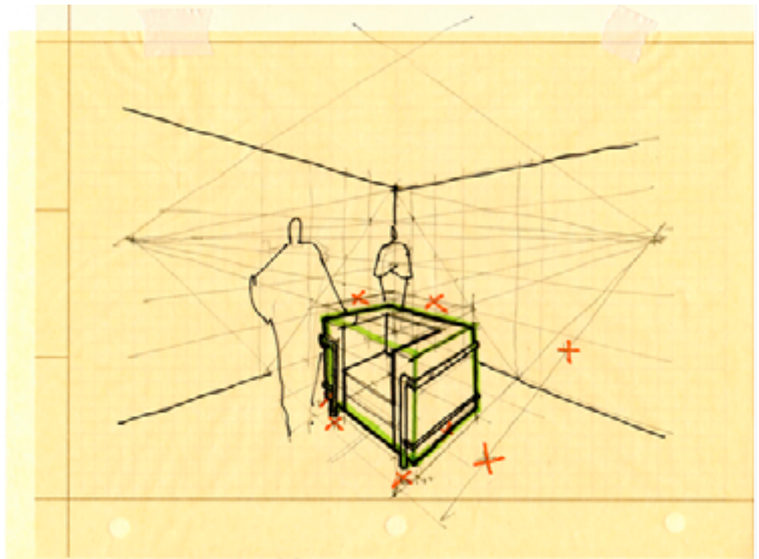
Dawkins-figure 7 – Progressing through a sketch by 'carving' into an object (a cube) (Dawkins, J., 2012f.

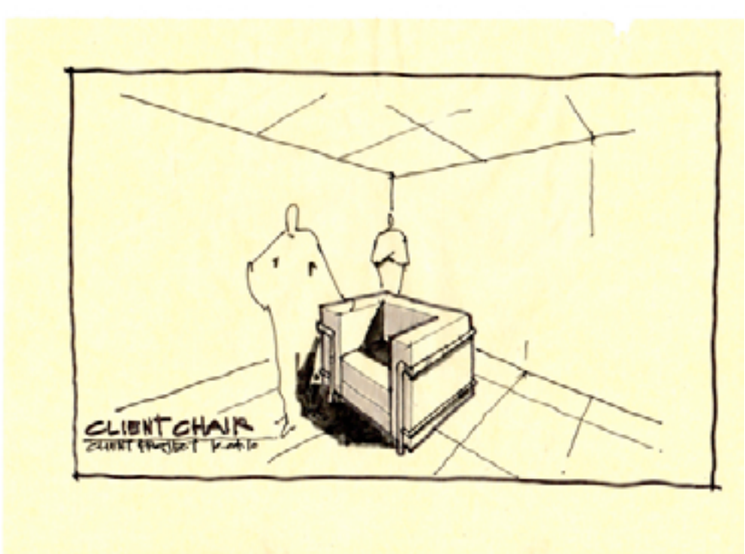
the idea down on paper and then start shaping it with the appropriate tools. Dreyfus & Dreyfus (2005: 785) observe that "failure to take risks leads to rigidity rather than the flexibility we associate with expertise."

5. The instructor should realize that "as the competent student becomes more and more emotionally involved in the task, it becomes increasingly difficult to draw back and adopt the detached maxim-following stance of the advanced beginner" (Dreyfus & Dreyfus, 2005: 785). Reverting to drawing within a perspective grid utilizing a pen, triangle, and hard-lined components with very specific rules results in scenes bound by the grid's construction. As long as the student draws within that gridded box and refuses to take risks by creatively interpreting the features of that grid and the rules that created it, he/she will have a more difficult time succeeding in communicating design ideas unique to their own personal thoughts and feelings. Dreyfus & Dreyfus' (2005: 785) research cautions that "in general, if one seeks to follow general rules one will not get beyond competence."

6. Imploring the student to continue drawing should be a basic tenet of the instructor's teaching behavior. It is necessary to understand that the physical act of drawing – of putting pen or pencil to paper by hand – cannot be passed over by either the student or instructor. The loss of an idea due to a rigid observance of rules and steps can be devastating to a design student. In an article describing the link

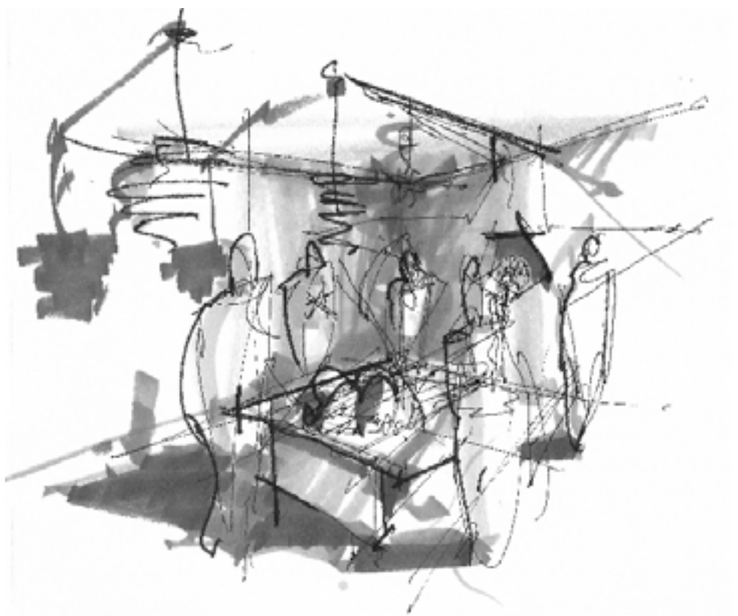






between handwriting and the brain, author Gwendolyn Bounds (2010) cites a 2008 study in the Journal of Cognitive Neuroscience wherein character recognition was tested. Researchers observed that adults in the study who wrote by hand exhibited "stronger and longer-lasting recognition of the characters' proper orientation, suggesting that the specific movements memorized when learning how to write aided the visual identification of graphic shapes (Bounds, 2010). Following this line of thinking, if the sketcher can plow ahead with the sketch, it may be that the practiced skills of perspective construction will eventually inform a more accurate graphic representation of their idea.

7. Instructors can reinforce the notion of quick sketching as part of a process and not a rendering or final product. They are the means to an end, not the deliverable (although they can be loosely used in that manner if circumstances such as quick instructor design critiques, intermediate and informal design presentations and regular reviews of design progress are needed). As such, the student should be encouraged to keep it simple, picking and choosing relevant features and aspects specific to the context of a contemplated scene or view. The goal is to quickly illustrate an idea (or multiple variations of an idea) so that it (they) can be evaluated relative to its design potential, not evaluated as a sketch in and of itself.



Dawkins-figure 8 – A simple sketch capturing the conceptual essence of a scene (Dawkins, J., 2012g.

In the studio, the instructor is able to guide the student to successful decision making by highlighting those choices made by the student that resulted in effective and efficient graphic communication as well as those that were not as successful. The instructor pushes the student to take chances with the rules, with line weights, scene composition, vanishing point widths, etc., suggesting all the time that practice will inevitably lead to faster and easier sketching techniques. This is a critical point in the learning process – here the instructor's own passion for drawing along with the mental and emotional energy they exhibit, can have a profound influence on the student's own excitement about drawing. The instructor needs to encourage, inspire, and drive the student.

An instructor's constructive criticism can lead the student to positive and expanded skills growth. This is the point where the student can "own it" and decide to make their work very personal, and willing to go through the ups and downs, successes and failures, of quick sketching as they seek to graphically communicate design ideas. It is here, "only at the level of competence is there an emotional investment in the choice of action" (Dreyfus & Dreyfus, 2005: 786). Chances are that if a student gets involved and takes measured risks with their sketching – takes ownership of and becomes accountable for their idea communication – they will be more inclined to 'do it again' until they get it right.

Dreyfus & Dreyfus (2005: 786) state that "the point, however, is not to analyze one's mistakes and insights, but just to let them sink in." Students should feel okay to be disappointed when a sketch misses the mark, but they need to respond with an 'oh well, live and learn, do it again," or "that was great – but what made this one work that didn't work for the other sketch(es)?" The student needs to get a 'feel' for what went right and what went wrong and why and constantly build on these conclusions, expanding the aspects of a sketch relative to the subtleties of the context it is in. The student can begin developing "adaptive control" over their drawing behavior, recognizing which actions can possibly influence desired outcomes based on the student's proficiency, but that still need a level of control to be considered adapted (Cleeremans, 2006: 413). Similar to driving a car in rush hour traffic, with repeated use a driver can learn to adapt their driving to the traffic flow, moderate speed effectively, prepare for upcoming lane changes, and anticipate other driver's.

Developing competency in drawing, specifically quick sketch graphics, requires the student to move beyond rules obedience and onto a level of intuitive action. What is in the back of one's mind (all those rules, features, aspects, etc.) subtly moves to the front of the mind in support of a sense of what the student is drawing (Barry, 2013). Much like the developing mountain biker, the techniques of balance, pedaling, and handlebar grip residing in the back of the mind come to the fore in order to support the biker's trek over rough outcroppings, through narrow passages, and down single-track paths. It is in developing a sketching intuition through a rigorous process of skills building, situational understanding, and emotional involvement that a student's sense of what to sketch and how to sketch it will lead them to quickly communicate design ideas at a proficient level.

Stage 4: Proficiency

Expertise Theory:

> Only if the detached, information-consuming stance of the novice, [and the] advanced beginner….is replaced by involvement, is the student set for further advancement. Then, the resulting positive and negative emotional experiences will strengthen successful responses and inhibit unsuccessful ones, and the performer's theory of the skill, as represented by rules and principles, will gradually be replaced by situational discriminations, accompanied by associated responses (Dreyfus & Dreyfus, 2005: 786).

A Stage 4 student's experience of sketching:

Mary is assigned the quick sketching duties for a team project brainstorming session with her fellow students. She is chosen because she is methodical in her sketch process and has developed enough skill through practice, analysis, and more practice to draw with speed. Initially, Mary interprets the ideas clearly and concisely. Her skills are on par with the pace of conversation. She senses that her sketching and the group's thinking are not distinctly separated. However, as the group's brainstorming intensifies and the ideas flow faster and more freely, Mary finds herself trailing their thoughts (as well as her own) with her sketches. The group's design thinking is outpacing her ability to capture the essence of the discussion, the subtleties of the variations expressed, and the fit and feel her sketches need to represent. Time is lost changing gears from one sketch to another and then another. She knows what she wants to draw, senses what it should look and feel like, but her sketching ultimately falls back on competencies based in a world of rules and guidelines. While Mary records the majority of the session effectively, it falls short of completely capturing the moment.

The expert grasps the bigger picture rather than having to move through all the steps to get there. However, for the proficient sketcher, the ability to react automatically with an appropriate response still needs development. Although the proficient sketcher must still decide what to do, they rely on their competencies to generate and develop sketches rather than falling back on the rules level of the novice and advanced beginner. At this point, the proficient sketcher cannot waste time by engaging in an analysis of their actions; rather they must proceed with a positively reinforced 'gut' feeling that leads to immediate decision making and pen to paper movement. The proficient sketcher must hit the ground running, replacing "reasoned responses" with "intuitive reactions" (Dreyfus & Dreyfus, 2005: 786).

One cannot divorce the physical act of sketching from the more conceptual notion of 'feeling' one's way through a sketch. The physical contact of pen or pencil to the drawing surface and the sensation of touch, elicits numerous responses in the brain. In an article exploring the benefits of handwriting, Julie Deardorff (2013) cites research indicating that "handwriting increases brain activity" and "hones fine motor skills.... Handwriting aides memory. Handwriting proficiency inspires confidence." In Deardorff's article occupational therapist Katya Feder, an adjunct professor at the University of Ottawa School of Rehabilitation, explains that good handwriting "integrates motor pathways into the brain. When it becomes automatic or learned, there's almost a groove in the pathways" (Feder as cited by Deardorff, 2013).

Proficiency also allows the student to engage in a sort of pleasure principle for sketching. By discerning which applied skills lead to pleasing results and which ones end up as painful mistakes, students begin to develop a feel for their sketching. Additionally, as noted earlier, the physical act of good handwriting (or sketching in the context of the topic at hand here) can elicit feelings of pleasure. Writer Lynda Barry, in a radio interview discussing drawing and writing (Barry, 2012), pursued the notion of writing and pleasure in her writing workshops. She commented that "one of the reasons why this [writing] is so pleasurable, it's not just because the experience of writing and remembering is pleasurable, that's true. But it carries out into the world. When you're finished doing it, the world looks more alive." For the proficient hand sketcher, the same holds true. Good sketching – perspective accuracy, line weight variations, shading, shadowing, context representation – done quickly, can produce good feelings. Drawings look 'more alive', have character, and are able to express the sketcher's impressions of a conceptual idea or real scene. Physically manipulating the drawing instruments and media helps connect both types of 'feelings' – the physical and emotional.

An instructor's potential teaching approach for Stage 4 learners:

With quick sketching, the ensuing positive reinforcements of quick, fluent sketching coupled with the negative perception and effects of a slower, rules-based adherence to drawing exactitude prompt the student to develop a trained proficiency that becomes an innate part of their drawing behavior. Successful sketches feel good when the essence of their shape and form is communicated effectively. In addition, since good sketching can be a pleasurable experience, there is a better chance that students will seek to repeat that behavior. The instructor can nurture this growth in a number of ways.

1. The instructor can regularly affirm and reaffirm the student's successful sketching expeditions.

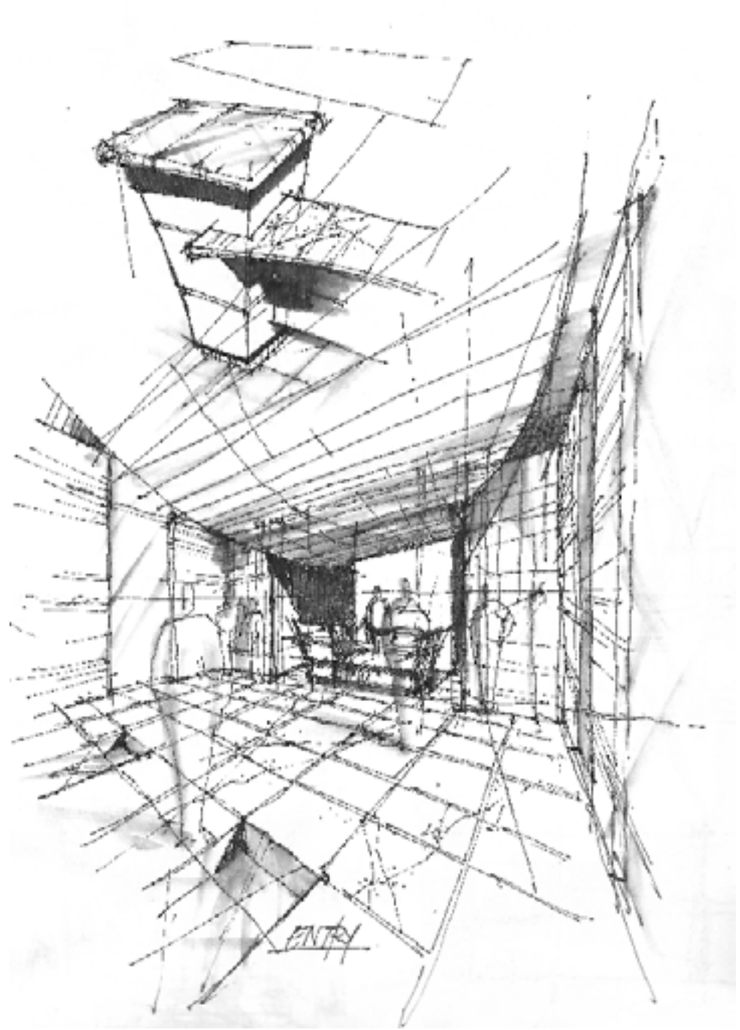
2. Engaging in one-on-one sketching with the student, the instructor can move back and forth with drawing responsibilities in repetitive drills that involve speed, urging the student to intuitively react to a sketch's progression rather than looking for and relying on the reasons that support its development. Additionally, the instructor should express their own pleasure in working through the sketching process, reveling in the creative energy that an expert experiences and exhibits when actions are lock-step with thoughts.

3. Due to their significant sketching experience, the instructor has the opportunity to evaluate the student's trials and errors from a perspective. That is, the instructor's experience over years of sketching development enables him/her to analyze a student's physical movements – pen/pencil grips, movements of the fingers, hand, and arm, placement and movement of the paper – as well as 'sense' the mental and emotional intricacies of the student's thinking while they are drawing. The instructor has a feel for the student's proficiencies and is able to more quickly advise and illustrate for the student more efficient and economical sketching actions.

4. An instructor can make sure the student is involved with their drawing and that they are 'in the moment', concentrated fully on expressing their ideas clearly and completely. To this end, the instructor needs to ensure that the classroom or studio is maintained in a manner where the student can reduce negative distractions (such as the need to multi-task with social media) and deal with positive distractions (such as the instructor talking about the student's ideas, other students expressing their opinions, etc.).

5. Providing rewards when successful risk taking is achieved can help motivate students. Similar to gaming systems where completion of one level of activity moves the player on to further levels of more complex and challenging (and usually more fun) tasks, the student can move to

Dawkins-figure 9– A more demanding sketch typical of the proficient sketcher, (Dawkins, J., 2012h.



more demanding sketch problems where the reward level increases as the student takes more risks with speed, accuracy, and technique.

As a proficient sketcher, the student moves into a behavior of 'doing' rather than 'thinking'. Dreyfus & Dreyfus (2005: 786) observe that "action becomes easier and less stressful as the learner simply sees what needs to be done rather than using a calculative procedure to select one of several possible alternatives." An overwhelming need to graphically express (emotionally) one's ideas, to visually articulate a feeling, takes the place of trying to describe it verbally. Here, design concepts for a student's project can only be conveyed by drawing them out. As elusive as a concept can be to define, it eventually has to have its meaning revealed and interpreted. Thoughts are fleeting, and one needs to seize them immediately in order not to lose the feeling they embody - the emotional significance of an idea's essence. The proficient sketcher "sees the question that needs to be answered but has to figure out what the answer is" (Dreyfus & Dreyfus, 2005: 786).

Stage 5: Expertise

Expertise theory:

> The expert not only sees what needs to be achieved; thanks to a vast repertoire of situational discriminations, he or she also sees immediately how to achieve the goal. The ability to make more subtle and refined discriminations is what distinguishes the expert from the proficient performer (Dreyfus & Dreyfus, 2005: 786).

A Stage 5 student's experience of sketching:

The design development stage of Sam's new class project begins with an assignment requiring him to create several quick sketches to convince his client (a second student in this role playing exercise) that his design concept can be realized in the building's interior architecture, furnishings, and finishes. Sam prepares a number of quick sketches to be used in discussions with his client. As the meeting progresses, Sam finds himself drawing within and on top of his original drawings as he and the client trade comments about the design. The sketching moves at a rapid pace with lines, shapes, and forms responding immediately to verbal suggestions and directions. In Sam's mind, he cannot distinguish his thinking and talking from his sketching – they are one in the same. The solutions are immediately clear, and his uninhibited intuitions are free to guide his decision-making.

An instructor's potential teaching approach at Stage 5:

At this stage, the instructor focuses on directing the student to fine tune specific drawing behaviors.

1. Instruction is 'real-time' – as the student sketches a line or roughs out a composition, the instructor quickly points out nuances of the sketch or the student's technique that the student may not be considering. The instructor engages in drawing with the student. At this point, it is easier for the instructor to teach by drawing rather than speaking – the action of drawing the instructions is faster than verbally giving directions. A successful instructional moment has two minds working as one with the student channelling the instructor's expertise into their own sketching actions without the need for physically duplicating efforts. The student learns to sense the instructor's next move or comment. The two together draw as one – the student driving and the instructor giving directions while traveling at a high rate of speed.

2. Instruction takes place with the direct transfer of expertise – telling (verbally) and showing (graphically) the student those techniques and decisions that will more often than not lead to success or failure. Rather than having to actually experience all the scenarios and drawing situations the instructor has been through, the student can listen and apply what is being taught immediately. There is no wasted time in going through those experiences at that moment, as the student just applies the information and moves on. The expert instructor is not an expert at teaching the rules but rather the expert in how to use them.

3. The instructor can moderate metacognitive discussions about the automaticity of drawing. He or she also has automatic responses to intuitive reactions. The expert has trained for it. They have done it a thousand times. They have done it right and wrong a thousand times. Per Dreyfus & Dreyfus (2005: 788), "no amount of rules and facts can capture the knowledge an expert has when he or she has stored experience of the actual outcomes of tens of thousands of situations." They know what works and what doesn't in any given situation. They have a good feel for sketching. There is an emotional attachment to and recollection of successful quick sketching. The expert "does not calculate, or solve problems, or even think. He or she just does what normally works and, of course, it normally works" (Dreyfus & Dreyfus, 2005: 788).

Conclusion

As noted earlier, effective graphic communication through quick sketching requires one to be "in the moment" – similar to a jazz or blues musician's adlibs based on a feeling or "vibe" they are getting from the music being played and how the various parts of the band start merging into one whole. Adaptation and improvisation characterize the response. For the sketching design student, on-the-fly decision making is achieved through an unconscious trust in the discipline of drawing learned at the novice and advanced beginner stages. Action takes place within milliseconds of thinking. For the expert, thinking and acting are literally happening at the same time.

Similar to a multilingual expert such as a translator speaking in several languages with numerous persons all at the same time, the expert sketcher speaks fluently in 'drawing' – there is no mental translation required to concurrently think about how to draw and the act of drawing itself. For the expert, "what must be done, simply is done" (Dreyfus & Dreyfus, 2005: 788). Sketching at the speed of thought, one can ill afford to slow down and think about what one is doing. Expertise for the design student is in seeing (by sketching) the problem's solution(s) and not in the rules by which it will be solved. Trust and confidence in one's risk taking is rewarded with speed and accuracy. Sketching is no longer a calculated gamble, but a guaranteed winning bet.

It is clear that to instruct others in the act of sketching is to wrestle with complex cognitive stages of understanding, action, and ultimately the ability to take effective action without thinking. It may be helpful to consider the stages of expertise to help answer the questions of why students think the way they do, make mistakes they are prone to make, and encounter the mental roadblocks that populate the journey toward sketching proficiency. Similarly, taking instruction action that is mindful of the stages of expertise may be supportive of meeting students where they are, and best assisting them to the next stage of their understanding.

Images (A sample of DRN Subsection title)

Dawkins, J. 2012a. *Untitled*. [sketch] (Author's own collection).

Dawkins, J. 2012b. *Untitled*. [sketch] (Author's own collection).

Dawkins, J. 2012c. *Untitled*. [sketch] (Author's own collection).

Dawkins, J. 2012d. *Untitled*. [sketch] (Author's own collection).

Dawkins, J. 2012e. *Untitled*. [sketch] (Author's own collection).

Dawkins, J. 2012f. *Untitled*. [sketch] (Author's own collection).

Dawkins, J. 2012g. *Untitled*. [sketch] (Author's own collection).

Dawkins, J. 2012h. *Untitled*. [sketch] (Author's own collection).

[*Geons and objects*] 2010 [image online] Available at: < http://www.blog.theteamw.com/wp-content/uploads/legacy/2010/12/geons.jpg> [Accessed 27 August 2012].

Bibliography (A sample of DRN Section titles)

Barry, L., 2012. Interview on TTBook Writing the Unthinkable *Interviewed by Anne Strainchamps* [radio] Wisconsin Public Radio, 25 November 2012, 12:45.

Biederman, I.,1987. Recognition-by-components: a theory of human image understanding. *Psychological Studies*, 94, pp.115-147.

Bloom, B., 1986. The hands and feet of genius: automaticity. *Educational Leadership*, 43(5), pp.70-77.

Bounds, G., 2010. *How handwriting trains the brain*. [online] Wall Street Journal. Available at: <http://online.wsj.com/article/SB10001424052748704631504575531932754922518.html> [Accessed 19 August 2013].

Chen, L., 2004. *Architectural visualization: An analysis from human visual cognition process*. Unpublished paper. Monash University.

Cleeremans, A., 2006. Conscious and unconscious cognition: a graded, dynamic perspective. *Progress in Psychological Science Around the World. Neural, Cognitive and Developmental Issues*, I, pp.401-418.

Deardorf, J., 2013. The many health perks of good handwriting. *Los Angeles Times*, [online] Available at: http://www.latimes.com/health/boostershots/sc-health-0615-child-health-handwriti20110615,0,360921.story [Accessed 19 August 2013].

Dreyfus, H. & Dreyfus, S., 2005. Peripheral Vision: Expertise in Real World Contexts. *Organization Studies*. 26(5), pp.779-792.

de Groot, A., 1978. *Thought and choice in chess*. The Hague: Mouton. (Original work published 1946).

Ericsson, K. & Smith, J., 1991. *Toward a general theory of expertise*. New York:

Cambridge University Press.

Feigenbaum, E. & Mccorduck, P., 1983. *The fifth generation: artificial intelligence and Japan's computer challenge to the world.* Reading: Addison-Wesley.

Gobert, J., 1994. *Expertise in the comprehension of architectural plans: contribution of representation and domain knowledge*. Ph.D. University of Toronto.

Kavakli, M., Scrivener, S., & Ball, L., 1998. Structure in idea sketching behaviour. *Design Studies*. 19(4), pp. 485-517.

Pable, J., 2000. *A description of students' experiences with a studio-based quick sketching course using traditional and computer-based instruction practice strategies*. Ph.D. University of South Florida.

Simon, H. & Chase, W., 1973. Skill in chess. *American Scientist*. 61, pp. 394-403.