Introduction

Quality educational programs grow from careful observation of the local culture and the specific students under the care of qualified and interested staff. These observations lead to the construction of local practices that become a framework for the specific school districts programs. To better understand and improve on these local practices it is necessary to disseminate the specifics of these practices thus creating a space for feedback and criticism. However, these program do not originate exclusively with the local educators, rather they are a part of a large network of students, theorist and practitioners.

The mind map shown here is a model showing the way a group of students understood themselves and their relationships with others and their worldview. This is a momentary snapshot drawn from a research project conducted with Viterbo students several years ago. Within limits this model is an indication of the educational milieu of the student. The mind map may be helpful to the readers as they think about the school environment as well as the before/after school programs and clubs that are a part of the CCLC programs.

Like the mind map much of the knowledge and information about educational practices comes from ideas that are “in the air” but whose particulars are unknown to the educators who apply them. Other ideas presented in this report are gleaned from the literature regarding best
practices and other research findings. Directions and steers from state departments of education and university based teaching programs also contribute to the knowledge and application presented here.

As local educators make what they find public, it becomes easier for them to access and apply research and practices in other parts of the country and the world. The reason for the increased access to new ideas is partly due to processing “what works” in the local setting and to the evaluators feedback on these programs.
Program Descriptions

for CCLC

Allamakee Community School District (ACSD) and Retired Senior Volunteer Program (RSVP), along with the neighboring school district, Postville Community School District (PCSD) will provide after-school programming for three hours and summer. Additionally, ACSD will have one hour before school and selected Saturdays. Community Connections (CC) works closely with more than 125 other partners to combat the issue of (1) poverty, language barriers, and the relationships to the student achievement gap in math and reading, (2) at-risk behaviors, and (3) family literacy.

The Allamakee Community School District’s Community Connection Learning Center (CCLC) provides after school and summer programs in three centers: East, West, and Waterville Elementary Schools. Programming includes academic enrichment activities, integrated technology, social skills training, and family literacy programs. This report covers CCLC programs in the following areas: (1) ongoing CCLC programs, (2) Summer programming (3) CCLC goal 3 (To have a safe and drug free learning environment), and CCLC Goal 4 (All partners in the community including parents and youth have strong relationships working toward common goals).

Community Connections had its start in 1998 when the three school districts in Allamakee County; Allamakee, Eastern Allamakee, and Postville, obtained an Iowa School-Based Youth Services Grant. It has changed focus over the years as grant money and program services changed. Currently Community Connections is funded through two 21st Century Learning Center Grants and serves youth in the Allamakee and Postville school districts with after school and summer programs. However, the goal of the
program, which is for students to be successful as a result of participating in these after-school activities, remains unchanged.

Additional support in the past year has come from grants through the Allamakee County Community Foundation and Dollar General. Donations can now be given through the Allamakee County Fund for After School Programs as well as general donations to Community Connections.

The goals of these programs taken collectively are to (1) Improve student achievement through hands-on experiential learning and increased adult/youth interaction, (2) use physical literacy clubs, music clubs, the arts, dream clubs, theater, service learning, leadership club, and mentoring as tools for the development of youth assets and decreasing risk factors, and (3) expand school hours, parent nights, ESL for adults, FAFSA nights, technology clubs, Shoulder to Shoulder - Raising teens together (See Glossary) and Newcomers classes. Classroom teachers and other support staff provided provide professional development training to after school staff aid in linking tutoring curriculum standards with after school tutoring, homework assistance, and academic achievement activities.

**Allamakee Junior High**

The Allamakee Junior High program is held before and after school for students to use the Internet to get homework done, get caught up on homework if they missed lessons, to work together on projects, to form study tables to study for a test, or to participate in Academic Enrichment Clubs. The program is called "Tenth Period" and runs from 7:10 am to 8:10 am before school and after school from 3:30 PM to 6:30 pm on regular school days. Those involved in extra curricular events can participate before school or after their activity. Nathan Todd is the site coordinator for this program. Current clubs include: Construction and Bridge Building. Future clubs may be Cooking, Photography, Chess, etc. Clubs are created based on
student interest. A link to the current session calendar is found below. Come join Mr. Todd and see what is happening during Tenth Period.

Cora B. Darling Elementary/Middle School

The Cora B. Darling Elementary/Middle School program is for students K-8 in the Postville Community School District. It is held after school between 3:30 and 6:30 PM on regular school days. The program is divided up into small groups working on homework and study skills. There are also Academic Enrichment Clubs available created based on student interests and needs. A link to the current session calendar is included below. Jennifer Hemesath is the site coordinator.

East Elementary After School Program

The East Elementary After School program is for students in grades 3-6. Students receive help with homework and study skills. Students also participate in clubs based on their interests and needs. The program runs from 3:15 to 6:15 PM after the regular school day. A link to the session calendar is found below. Deb Kubitz is the site coordinator.

Waterville Kid's Club

The Waterville Kid’s Club is for students in grades K-6. Students receive help with homework and study skills. They also participate in club activities based on their interests and needs. The program runs from 3:15 to 6:15 PM on regular school days. The current sessions calendar is linked below. Jane Rausch is the site coordinator.
**Waukon Senior High**

The Waukon Senior High program is held before and after school for students to use the Internet to get homework done, get caught up on homework if they missed lessons, to work together on projects, to form study tables, to study for tests, or to participate in Academic Enrichment Clubs. The morning program runs from 7:10 am to 8:10 am and the after school program runs from 3:30 to 6:30 on regular school days. Students involved in extra curricular activities can also participate before or after their activity. Clubs are created based on student interest and need. Mr. Todd is the site coordinator for this program.

**West Elementary Kid's Club**

West Elementary Kid's Club is for students in grades K-2. Students receive help with homework and study skills and participate in clubs based on their interests and needs. The program runs after the regular school day between the hours of 3:15 and 6:15 pm. A link to the session calendar is found below. Virginia Kurth is the site coordinator.

**Summer program**

Community Connections Summer Kids Club Program embarked to many historic sites in Allamakee County. The youth are learning the history of the Winnebago/Ho-chunk Indians who lived here. Our kids became “tribes” of their own to live a full immersion experience. The kids practiced their customs and ways of life, planted a raised-bed garden, made wiki-ups, fished with nets, and designed their own Indian outfits and pottery. They lived as Native Americans in Allamakee County History.

**The Keys to the Community Connections programs is the volunteers**

These are the people who give time, money and resources to support our youth. Volunteers can work with students in special clubs after school from crocheting to taxidermy, from technology to writing, and
more. They serve on advisory boards, attend meetings, and even share information about the program in their community groups. They purchase supplies for special and general activities. For more information on how you can help contact Barb Winters, Project Director/Student Learning Liaison for Inquiry-Based/STEM Projects at bwinters@allamakee.k12.ia.us or 563 568-4013. e in italics) were taken from either the Community Connection 21st Century Learning Center Grant application or the Welcome to Allamakee Community Connections https://sites.google.com/a/allamakee.k12.ia.us/communityconnections/. Specific comments and observations about the specifics of these programs will be examined in the section Connecting research finding with specific program reports and observation.
Key Finding:

A Short Review of the Literature

How People Learn: Brain, Mind, Experience, and School (The Committee on Developments in the Science of Learning, 2000) provides a framework for this report. The reason to articulate the Key Findings at the beginning of this report is that these findings are the consensus of many important scholars regarding what educators, teachers, and administrators should to some degree be familiar with. These Key Finding provide examples of both what is intentionally and thoughtfully taught as well as ideas and applications that are intuitively understood and practiced. As we will see later in this report, the Key Findings will also provide for a bridge between current knowledge and practice to new learning particularly for staff and administrators in the Community Connect Learning Centers (CCLC) program. A presentation on potential new learning will be presented later in this report. By stating the Key Finding clearly and succinctly, it is hope that this report will be both a statement of what is already in practice and a bridge to improve existing practices.

The First Key finding is

Students come to the classroom with preconceptions about how the world works. If their initial understanding is not engaged, they may fail to grasp the new concepts and information that are taught or they may learn them for purposes of a test but revert to their preconceptions outside the classroom (The Committee on Developments in the Science of Learning, 2000, pp. 14-15).

To state an expression often heard in schools of education, any lesson “need to start where the student is.” Teachers in training have no doubt heard this
statement repeated by many instructors almost as a mantra. However many times it is repeated, it often remains little more than a saying. Sometimes it almost appears to be a Zen Koan, that is, a saying that seems to make sense but the phrases meaning is beyond the hearer’s ability to comprehend. Sometimes this phrase is heard as a tautology; that is, a statement that merely repeats itself and therefore true but meaningless. However, Key Finding 1 is an important idea that demands a close examination.

To elaborate on this key finding a bit, an example is in order. Many students think that a heavy object drops faster than a light object. This is their preconceived idea. While we know at least since Galileo’s experiments that object regardless of weight fall at the same speed. It is important to begin by asking students which object will fall faster such as a baseball or a basketball. Giving students an opportunity to state their belief and give support for their position provides a chance to conduct a simple in-class experiment. This approach has at least two advantages. First, it is an opportunity to introduce the scientific method to the class. Second, it allow the students to see the rate of falling objects for themselves, thus making that knowledge more concrete and more memorable than it they were merely told that all objects fall at the same speed. It provides a corrective to the preconceived idea of the student or provides support for their thinking with an example. It also is a chance to entertain students potential counter examples such as “OK, but what about a feather?” This may lead to a discussion of friction, and why the ideal experiment should be conducted in a vacuum. The point is “starting where the student is” is not an endpoint, it is rather a beginning for clear and deeper understanding.
The second Key Finding is:

*In developing competence in an area of inquiry, students must (a) have a foundation of factual knowledge, (b) understand facts and ideas in the context of a conceptual framework, and (c) organize knowledge in ways that facilitate retrieval and application (p. 16).*

The second Key Feature may seem to go against the first Key Finding. The idea that we must both begin with what we already think we know and that we develop competence based on factual knowledge, conceptual frameworks and organized ways of retrieving what we know is counter-intuitive. The key words “develop competence” resolve this concern. We begin where the student is, but we develop the knowledge and competence as thinkers and doers. Let’s look at each of the points in this key finding individually. A student must have a deep foundation of factual knowledge *if they are going to truly understand something.* The point here is that to understand something is more than to memorize facts. This does not mean that there is not a place for memorization. We often begin our understanding of addition, for example, by memorizing our addition tables. But that does not mean that we understand addition. We know we understand some important things about addition when we can add two column of numbers using a variety of approaches and techniques such as grouping numbers in multiples of 10, or mentally rounding up and then subtracting as when in adding 25 and 27 we first go to 50 and then add the left over 2 to to make 52.

The second Key Finding states that there are three parts to what is to be understood. The first of these three understanding is a foundation in factual knowledge.
Another way to say this is we need to learn the facts. This fact learning is often reading what is in the textbook, or on the Web or what the teacher tells the students. The second part of that Key Finding is “understanding fact and ideas in the context of a conceptual framework.” To use the math example discussed earlier, one of the basic conceptual frameworks in Math is that it is a base 10 number system divided into the categories of units, tens, hundreds, etc. With this conceptual understanding, it becomes easier to learn, not only how to “carry” in addition problems but also why we do this activity which may not be intuitively obvious to some students.

The second Key Feature goes on to state that knowledge should be organized to “facilitate retrieval and application.” How does understanding a 10-based number system help with retrieval and application? One way that a conceptual framework helps in revival and application is that knowing the basics of a 10-based number system allows the learner to make fairly accurate estimates and therefore better equipped to retrieved the learned or memorized answer in their addition tables.

To use another example, we know that a person understands a topic if they can explain it to themselves and to other people. To explain something to another person requires that one know the content, a conceptual and a theoretical framework within which the issue or process is explainable, and that there is also a retrieval strategy that allow access to important concepts and fact. The skills presented above in the first example lead to the metacognitive approach discussed in Key Finding Three.

The Third Key Findings regarding the nature of learning in some ways provides a connection between finding 1 and finding 2. The authors of How People Learn: Brain, Mind,
Experience, and School (2011) state their finding as “a ‘metacognitive’ approach to instruction can help students learn to take control of their learning by defining learning goals and monitoring their progress in achieving them” (The Committee on Developments in the Science of Learning, 2000, p. 18). The word “metacognitive” while often used by educational researchers and university professors sometimes seems jargon-like and is many times misunderstood. The idea can be simplified as “thinking about thinking” but to use this idea effectively as an educational tool a little further explanation is helpful. The quotation above leads us in the right direction. A first step in learning to learn is the learner responsibility. To take that responsibility, the student has to know how to take charge of her or his education. This means at a minimum two things: (1) helping the student as she defines her learning goals, that is, what does the student wish to learn? and (2) aiding the student keep track of the progress made toward mastering those learning goals. While these may seem simple tasks, and to some degree they are, the point is that these are skills that are not intuitive for many students much of the time and getting students to use them and to stick to them can be a daunting task. This task becomes more challenging as the tasks become more difficult and complex.

Helping students define their learning goals also means helping them think about what they would like to learn within the parameters of the curriculum. Given that the student is required by the district curriculum to learn “X,” what within that requirement would the student find most relevant to their larger school and job/career goals? Some times the choices we need to give them may be quite narrow choices – would you like to focus on this or that? Rather that what would you like to choose?
This report will go into more details as we look at the implementation of the programs, but for now the above explanations will be used to look at the three implications for teaching presented next. Each of the implication for teaching matches closely and builds on the key finding regarding learning and learners.

**Key Applications for Teaching**

While each of the applications for teaching may be seem as a restatement of the Key Finding, each application puts the finding is a new light and allows an opportunity for teachers to test their understanding of the key finding in practice. Application of these principles to teaching is intended to provide some new insight in to the principles of learning. Teaching and learning are not merely the opposite ends of a process; they are rather an integrated process.

The first teaching application is “*Teachers must draw out and work with the preexisting understanding that their students bring with them*” (The Committee on Developments in the Science of Learning, 2000, p. 19). This finding is based on extensive research that supports the idea that children are not a blank slate but in fact come to school with a well established understanding of how the world works. This understanding is based on their experiences; however, it is not necessarily an accurate or scientific understanding of how the world works. Importantly, teachers need to help students express what they know (which may be correct or incorrect) so that the teacher can build on, correct information, or modify that knowledge.
With the need for helping students say what they know comes the need for assessment – not to evaluate students, but rather to understand what they know in order to move them forward. Another way to state the assessment demands of this application is to say the teachers need to do “formative” assessment rather than cumulative/evaluative assessment. Formative evaluation is an essential part of instruction as it provides a “snapshot” of what the students knows experientially, that is, what they know before they receive formal instruction in the classroom. Even though this experiential knowledge might be layered with “book” knowledge, an evaluation before instruction begins coupled with a discussion of the students reasons for what they know and understand is one way to get below the surface and begin genuine learning. The evaluative or cumulative assessment is most often done at the end of a chapter, or a semester, or the academic year. This also means that teachers need to learn and often re-learn how to recognize predictable preconceptions of students at various ages and stages of development\(^1\).

However, not all students preconceptions are predictable – many are unique to a given student, therefore teachers need to practice the skill of pulling these preconception out of their students in ways that validate and enrich the students experiences while not embarrassing the student’s misunderstanding of the phenomena being examined. On the other hand, a formative assessment might find that the student already knows the topic at some level. The next step is to find out how deep and wide that knowledge is. This is yet another application of starting “where the student is.”

\(^1\) Some readers might benefit from a look are appendix B & C in this document. These apprentices provide a look at developmental stages in creativity, problem solving, and critical thinking.
How do we address the second key finding as it relates to teaching? To restate the problem. How do we provide “a deep foundation of factual knowledge, understand facts and ideas in the context of a conceptual framework, and organize knowledge in ways that facilitate retrieval and application” (Committee on Development in the Science of Learning, 2000, p. 16). The answer is to “teach some subject matter in depth, providing many examples in which the same concept is at work and provide a firm foundation of factual knowledge” (p. 20). Implicit in this statement is that we cannot teach all subject matter in depth. It is, therefore, important to teach some subject matter in depth. The selection of what to teach is important, even, perhaps especially, when state guidelines or mandates require something that should be taught and will likely be evaluated on district or state required evaluation/tests. A thoughtful selection of which subject matter to be taught in depth and in what order one chooses to teach the material is important. Is some material more foundational and therefore should be taught first and in more detail? While some answers to this question may be included in the school curriculum, not all answers are found there. The teacher has some responsibility to think parts of the curriculum through for her or himself.

While a partial answer to “what to teach in-depth” is the utilization of before and after school programs and clubs, this is only a partial solution, though a valuable one. The selection of the content and/or the skills taught in the before and after school programs is still important. These programs need to be built on answers to the following questions. What skills and knowledge still need to be extended? Which skills on content need to be developed? How can we aid a novice as she moves toward mastery of a subject matter or a skill? A version of those questions also applies to content selection and the extension of a concept or the contextualizing of a topic. Howard Gardner provides some insight into
what it means to “start where the student is at” and how to move beyond that beginning point. He elaborates on his answer to these questions in The unschooled mind: how children think and how students should teach (1991). Additional insight into these questions can also be gleaned from The disciplined mind: what all students should understand (Gardner, 1999).

The third and final teaching finding is: “The teaching of metacognitive skills should be integrated into the curriculum in a variety of subject areas” (Committee on developments in the science of learning, 2000, p.21). In our daily lives as learners and as teacher, most of us, most of the time, conduct our metacognitive work in silent dialogue. Many students do not ask themselves these questions but can be taught to do so with minimal but persistent encouragement. Three of the major metacognitive skills are planning, monitoring, and evaluating. Planning is step one. What do we know already? Are these ideas connected to what I already know? What would we like to know? What resources will help us learn? These are all planning questions.

We also talk to ourselves: asking monitoring questions such as (1) Is this point stated clearly, and (2) did I follow-up on this idea? Likewise we evaluate our own thoughts and ideas by asking (1) is this a clear picture of what I wish to learn in this activity? (2) will this plan really work? and (3) is it better than my earlier idea or the idea if a friend or colleague? Students may not know that this is something we learn, either intentionally or accidentally or that it may be improved by making it self-conscious or that by making this process public we can get better at it. Once metacognitive skills are thought of as a teachable and learnable skill, much can be do to make learning easier and more effective. By connecting personal metacognition to academic situations and applying the
skill to various disciplines students become more self-reliant. A student may use a set of metacognitive skills in Social Studies but not in Math. Many time students use their metacognitive skills with things that they do well or in their own, but do not think to apply the skill in new learning or in unfamiliar disciplines and settings. When teachers make metacognition public, new options open to students by making these skills both learnable and transferable across disciplines and even into “real world” experiences.

Howard Gardner in *The disciplined mind: what all students should understand* (1999) presents one approach to selecting, extending, and contextualizing content and skills. He provides three statements of understanding based goals, one in biology, one in music and one in modern history. His example of a learning goal in biology is: A student will understand the way the evolutionary forces affect the individual, groups, and entire species. For a course in music, he suggests: Students will understand how Mozart and his librettist Da Ponte worked together to create a powerful and lovely score that captured the social conflicts of the era. In modern history he suggests the following learning goal: Students will understand the ways in which the Holocaust resembled and differed from other tempted genocides of the past century. (p.130). Even without further explanation, one can understand how these goals go beyond surface goals. For those who wish to examine Gardner’s take on one of more of these goals he provides a section of a chapter for each goal: for evolution, pp. 159 – 167, for music pp. 167 – 176, for modern history, pp. 176-184)
This concludes the presentation of the key ideas as distilled from *How People Learn* (2000). The next section of this report will highlight some of the interesting elements of the CCLC programs.

**Highlights**

Programs selected here are intended to feature those characteristics of the CCLC Clubs and the before/after school activities that best exemplify solid educational practices and also allow for an opportunity to enhance the generalizability of these practices as well as improve on the general quality of instruction as now practiced. While the selection of these programs and activities has not been systematic, the selection process was not random. These programs represent the ideals of the CCLC as outlined in the grant application and are referenced in general terms in Evaluation Reports of James Veale, PhD and Jan Mitchell, PhD. as well as lesson plans from instructors and some classroom observations.

Jerome Bruner in *The culture of education* (1996) argues that improvement in instruction comes in part from understanding the minds of students. In arguing that educators and staff need to work to understand the “minds of children,” Bruner develops the importance of the relationship between culture and education, i.e., the mind of the other can only be understood within the larger culture. This point is similar to some of the ideas presented in the Key Findings section (Committee on Developments in the Science of Learning, 2000) as represented in the phrase: Begin where the students are.
Knowing, as well as we can, the mind of the students leads to different approaches to education. Different approaches to learning, to discovery and different forms of instruction – from imitation, to instruction, to discovery, to collaboration – reflect different beliefs and assumptions about the learner – from actor, to knower, to private experiencer, to collaborative thinker (Bruner, 1996, p 50).

Two programs start this review as they stand out for their focus on the use of recent technology (Robots and 3D printers) and are following the current emphasis of many programs that accentuate the STEM curriculum. These technologies are at risk of being all about the technology and little about the science education that is essential to the program. However, this is not the case with the programs under review. These programs begin with intrinsic interest, that is, the “buzz” of new technology and go on to build skills and knowledge in the sciences.

Robots

This report begins with the robot program as it has been implemented for several years and has a good track record as measured by student interest and evaluation results. The mere mention of the word “robot” instantly conjures up an image of an almost human figure capable of completing assigned task with a simple word command. It is this image of robots that first attracts students to the Robotics Clubs. Some engagement with these clubs brings new understanding and continued interest.

A dictionary definition of robot is a machine capable of carrying out a complex series of actions automatically. A small foray into the etymology of robot provides its
Latin origins: “forced labor.” Robot was popularized by a Czech playwright, K. Čapek' wherein he coined the term in his play *R.U.R. Rossum's Universal Robots* (1920).

While the robots that students are likely to use will not look like the picture on the right, it is a common representation of a robot in the minds of many. The robots that students build, and program are more likely to be some versions of a vehicle. These vehicles are often used as a part of a competition to see wish robot has the best staying power or can outlast the other vehicles in some version of a demolition derby.

Educational robots are most often purchased as kits such as the one pictured here. These kits provide an array of options. Some kits may allow for the combining of elements of one kit with another kit, thus allowing more than following instructions (although building anything from a kit requires the development of several skills; it does not expand students creativity.

The educational value of involving students in Robot Clubs is that the students become fully engaged in the creation of something that can be shown to others as an individual and group accomplishment. Students, working with these kits, engage in planning, monitoring, and evaluating their work in a non-school-like activity. What makes
the creation of robotic devises not like school is that the goal is a public one – to be shared at minimum with classmates beyond the club members, other teachers and staff and parents. Additionally, the activity has an element of fun, just because they are building robots (it seems).

Watching students from these clubs present their robots to a group of community leaders indicated to this reviewer that the students not only learned how to construct these robots but also understood much of the planning, monitoring, and correction that went into the construction process. Their presentations also illustrated their ability to utilize conceptual strategies for retrieval.

**3-D Printing**

Using a 3-D printer at first blush might appear to be merely a showy bit of technology. However, this technology in the hands of thoughtful and capable instructors is a dynamic learning approach. Much like the use of robots in the CCLC program, 3-D printers are a way of hooking students on planning, problem finding, problem solving, monitoring of progress, and error correction. 3-D printer engagement also teaches and applies knowledge and skills in geometry and algebra, physics, and design.

To make a 3-D copy is not simply a matter of putting something on the top of a machine and pushing a button as one might do with an ordinary copy machine. A project of making a 3D print of something requires conceptualizing, measurement, mechanical drawing, and calculating. Not only do the students need to know and apply the
metacognitive skills and the curriculum requirements in physics and math, but students also engage sometimes directly, some times indirectly with history and social sciences.

The creation of a 3-D copy results not only in an “aha” sense of excitement, but also an opportunity to explore ways to make corrections and improvements. Many times the learning of new material in a class signals the completion of that learning. On the other hand, Robots and 3D printers may be the beginning rather than the end of the learning. While the experiential circle of knowledge and skills which moves from little or no knowledge (new concrete experience or skill) to an apprentice level (reflective observation) to a competence level to an application/rethinking level (active experimentation), ending with a new project (new concrete experience) is not unique to 3D printing, the approach used here may provide a model for other programs.

The role of technology in CCLC programs

As a way of connecting the robotic and 3D printing clubs undertakings with the other club activities, a short discussion of technology is in order. The authors of *How people learn: brain, mind, experience, and school* (2000) provide a broad view of the nature and role of technology in education. Many people both inside of and outside of educational

\[^2\] See Appendix A for applications of robots to the study of the social sciences
circles often narrowly think of technology as “fancy” and “flashy” gimmicks. Robots and 3-D printers as detailed above provide a different perspective. Additionally, technology also includes computers, smart phones with educational apps, and the internet as well as older technology such as “old fashion” calculators, and non-computer whiteboards and even ancient Chinese technologies such as the abacus.

The Committee on Developments in the Science of Learning (2000) argue that technologies may (1) bring real-world problems into classroom, (2) provide “scaffolding” support to augment the content and skill acquisition of learners, (3) increase opportunities for students to get feedback from software, tutors, teachers, and peers, (4) to engage in reflection on their own learning processes, (5) to receive guidance toward progressive revisions that improve their learning, (6) building local and global communities of instructors, staff, administrators, students, and parents, and (7) expanding opportunities for teacher learning (p. 243). One word, on the second point above, needs explanation and elaboration – scaffolding. An understanding of scaffolding as an educational concept comes from its use in the building trades, that is, a scaffold is a temporary structure on the outside of a building, made usually of wooden planks and metal poles, used by workers while building, repairing, or cleaning the building. As an educational practice, the goal is to provide a scaffold for a student that gives support as the student is figuring things out. The teacher provides clues and hints, models behavior, or gives examples, and over the course of time, removes those prompts and supports to allow the student to “stand on her own.”
Closely related to scaffolding is the zone of proximal development or ZDP. The ZDP “is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (Vygotsky, 1978, p. 85-86). Using the principle of scaffolding, teachers and more able peers aid students in bridge the gap between what can be done with assistance and what will later be accomplished independently. The ZDP is the space created in many of the Clubs activities as shown above in both the 3D section and the Robotic section of this report.

The relationship between children and adults is determined by the child’s social space (Cole a cited in Wertsch, 1985, p. 153). A mentor is the personification of the ZDP as she models skills, shows the small steps the student needs to move toward a larger goal, and then pulls away as the student makes progress. The two Clubs using technology began the review of the program highlights not because they are unique examples. All or most of the programs sported by CCLC are in fact consistent with the general timber of the before and after school Clubs and activities as a whole because these programs provide a glimpse into how teachers/instructors intuitively or intentionally use these principles in their implementation of these programs modeling scaffolding and optimizing the learning opportunities embedded in the idea of the ZDP.

The zone of proximal development or ZDP “is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (Vygotsky, 1978, p. 85-86). This ZDP is the space created in many of the Club activities as show above in both the 3D section and the
Robotic section of this report. The relationship between children and adults is determined by the child’s social space (Cole a cited in Wertsch, 1985, p. 153). A mentor is the personification of the ZDP as she by modeling skills, show the small step to the students as they move toward a larger goal, and then pulling away as the student makes progress. The two Clubs using technology begin the program example not because they are unique example for the Key Findings (Committee on Developments in the Science of Learning, 2000) [they are in act consistent with the general timber of the before and after school Clubs and activities] but because these programs provide a glimpse into how teachers/instructors intuitively or intentionally use these principles in their implementation of these programs.

**Reading groups and Reading Clubs**

The activities for the enhancement of reading skills were designated as Reading Groups for the students in grades K-2, and called Reading Club in grades 3- Activities included free reading, comprehension trivia game, sight word BINGO game, reading with a partner, and a board game. (The structure of a sentence - how to write a proper sentence) Some of the program instructors also used drawing pictures as a way to aid students with the writing of stories especially in the Reading Clubs. Underlying much of the reading activities as indicated by the selection of materials and the playful approach is the structure of storytelling (whether intentionally or accidentally) as presented by Jerome Bruner in *Acts of Meaning*. Bruner (1990) argues that to tell and understand a story four elements are needed: (1) a means of emphasizing human action, (2) that a sequential
ordering is established and maintained, (3) a sensitivity to what is canonical and what is not canonical, and (4) a voice or a writer’s perspective.

A group of kindergarten students are given an object to draw in then to tell a story about what they drew, a good example of Bruner’s reading and writing principles. Board Game Madness provides a good example of how the development of reading skills is heightened. In this activity, conducted at the library, students get involved in the design and creation of board games that are then laminated and played with by the student creators and others. The creation of board games is depended on the four elements of reading and writing as outlined above. The Writer’s Workshop includes the uses of picture storyboards construction provide an example of using the scaffolding principles to the learning and improvement of writing, planning, and creativity.

The Sign Language Club allows for easy integration of social awareness, first language enhancement, and second language learning. This club also brings within some of the same enticement as the robotic and 3D printing clubs as sign language is not only seen by many as a socially valued skill but also somewhat exotic. It also has a built-in scaffolding mechanism as some of the first sign that students learn are almost intuitively understood (much like cognate words in other second languages) but the mastery of sign language become more complex while building on previous intuitive understanding. Learning sign also provides a model for self-correction as well as instructor connection. The potential for better understanding of one’s first language its syntax, semantics, and pragmatic structure is almost built into learning to sign.
Reading and writing, a 1st grade Cooking Activity, provides another example of reading and writing as a declarative activity. There are many clubs that continue and build on cooking activities and connect them to reading (following directions) and math (measuring, fractions). Reading and math are easily integrated in the process of learning how to cook.

There is also a program at the Good Samaritan Home involving senior citizens reading to students. This exposure to people outside of the classroom reading can become a first step toward a lifetime of reading as life enrichment.

**Math groups and math clubs**

UNO math games are among the non-traditional/non-classroom approaches to teaching and reinforcing skills is addition and subtractions. Keeping score, addition, and subtraction are all taught/reinforced using UNO math games. The Money Club for 2nd and 3rd graders worked on the purchasing power of money through games reading. The Little Bites Cooking Club and Kooky Cooking Club works on calculating measurements as well as an opportunity to be creative. The task of increasing/decreasing or creatively modifying recipes and serving sizes of recipes is no easy task but one that is implicit within the stream of clubs enrichment activities.

Math board games are used to reinforce and teach addition, subtraction and multiplication in a 3rd grade math club. The Math flower game was also an activity used in several clubs.

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3 See discussion of the three key learning and teaching findings for an explanation of the “how” and “why” of these strategies (pp. 8 — 17 in this report).
The Science Club for 2nd through 5th grade is a good example of the integration of science, math, and reading. In the Club students use the Foss Kits to conduct science experiments learning about the scientific method implicitly as they work there way through the experiments. Predicting, planning, and evaluating are built into the work of any science experiment. Weird: Believe it or not, fact or fiction (4th through 7th grade), Rocks Rock Club (2nd to 5th grades), and Iowa Food Club (Kindergarten through 8th grade) all combine math, science and cultural understanding as a part of there goals. Believe it or nor uses critical thinking, reading and math skills to address the binary implication of the implied question in the club name.

The use of ideas, from the Guinness Book of Record and Ripley’s Believe It or Not, have educational value. Egan (1990) argues “reality and its limits seem to gain a new kind of intellectual importance about age eight” (p. 87). Kieran Egan, in several books on the ways children learn, suggests that the exploration of extremes may play an important role in the way young people learn. Exploring these “real” extremes is a part of the development of rationality and imagination during the ages of 8 to 15.

The two other examples more closely follow the lead of John Dewey and his “from the

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4 See Designing Educational Curriculum Materials: a theoretical and empirically driven process (Harvard Educational Review, 84, 1) for detailed description.

5 Romantic understanding: the development of rationality and imagination, ages 8 -15 (1990) and Imagination in teaching and learning: the middle school years (1992) are good sources for gaining a better understanding of the theory and practice of this approach to education.
local community to the larger world” perspective. Within these local communities students begin to find problems by observing the world close to their own experiences. Dewey argues that curiosity becomes intellectual by transferring observations of things and accumulated material into problems (Dewey, 1910; 1999, p. 33). There are other examples of science activities, but these three Clubs provide a sample of the type of work the students are involved in.

**The Arts**

The Drama Club (5th through 8th grades) and Arts in Shapes Club (K to 2nd Grades) are but two examples of available opportunities for elementary and middle school children. Beginning with learning shapes and figuring out how these shapes are the building blocks for the making of a picture. To accomplish this goal, students learn to categorize via observations, listening and reading. The geometric shapes are basic to math and to art.

The Drama Club worked on a play to be presented to Mayo Hart. The primary audience for the play was immigrant families. The skills involved included memorizing the script, understanding the underlying message, and dramatizing emotional and content message of the play.

**Emotional Education**

Three Club events are selected for discussion here: (1) Bullying-Being Responsible Club (Elementary and Middle School), (2) Huggable Animal Club (Elementary School), and (3) Feelings Club. These clubs are based on reading and discussion with some video recording also used. Small group sharing and writing activities are used to aid in the identifying and expression of feelings. While the Drama Club is mentioned above it might
also be included here. All of the activities in the Arts and Emotional Education Sections are also a part of the goal for improving and applying skills in reading.

**Closing Comment on Case Examples**

The program activities presented in this section are only a small sample of the actual activities implemented during the projects. I focused on these programs as I think they represent the spirit of the CCLC Programs both in their content and their approach to learning. These clubs and before/after school events are taught/facilitated by a wide variety of staff, including school administrators, classroom teachers, project staff, and many volunteers including, but, not limited to, university students, community leaders, and local and regional experts.

The staff almost to a person knows the students, their strengths and weaknesses, as well as their academic history. This knowledge is used not to pigeonhole and limit student abilities but rather to find ways to connect with them as individuals. The observed interaction with staff and students shows a lively and caring connection that is respectful and supportive. Staff appears to have both high standards in behavior and willingness to work on projects. The atmosphere of the observed programs and clubs was lively with a serious undertone. It is enjoyable to observe learning and teaching in action.
Recommendations

Everyone has understanding, resources, and interest on which to build. Learning a topic does not begin from knowing nothing to learning that is based entirely on information. Many kinds of learning required transforming existing understanding, especially when one’s understanding needs to be applied in new situations. Teachers have a critical role in assisting learners to engage their understanding, build on learners understanding, correcting misconceptions, and observing and engaging with learners during the process of learning (Committee on Developments in the Science of Learning, 2000, p. 138).

Building on this statement from How People Learn: Brain, Mind, Experience, and School (2000) the suggestions that follow include ideas from the work of Carol Dweck on self-theories of intelligence and rewarding effort over accomplishment, Howard Gardner’s work on educational goals and curriculum ideas, and Jerome Bruner’s work on culture and education (1996). Most importantly, recommendations have as their base three essential characteristics about learners: they all strive for a sense of competence, their own identity, and relationships with others, including teachers, mentors, parents, and peers (Selman, 2003; Ryan & Deci, 2000; Bandura, 2000). These authors along with Erik Erikson, Erich Fromm, and Abraham Maslow argue for these characteristics as being central to human well-being, as well as important qualities within the learner.

Richard Ryan and Edward Deci in “Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being” (2000) make a case that competence, autonomy, and relatedness “when satisfied yield enhanced self-
motivation and mental health and when thwarted lead to diminished motivation and well-being” (68). As much has been written here already on the development on competence, I will now present some recommendations on the understanding of the role of relationships in and around school as well as some practical suggestions that connect back to and extend existing practices before going back to competence.

Promotion of Social Awareness: Powerful Lessons from the Partnership of Developmental Theory and Classroom Practice

Robert Selman in this long career as a developmental psychologist and a therapist within schools and clinics has developed an appreciation of how we understand our experiences with other people and the world moving as we move from a very personal individualistic perspective to an expansive view that includes the larger society with ourselves as a part of the whole. His work has come together in a series of books culminating in The Promotion of Social Awareness: Powerful Lessons from the Partnership of Developmental Theory and Classroom Practice (2003) as this book provides a detailed overview of how schools can contribute to both the interpersonal growth of students while also working toward the enhancement of the communities the students live in.

Central to Selman’s approach is his theory of interpersonal development builds on the basic psychological needs of autonomy, relatedness and competence presented above. Selman calls this dimension the “interpersonal orientation.” By interpersonal orientation he means a person’s tendency to accommodate to another’s wishes or to assert his or her own will (p. 37). The goal is to balance one’s need for autonomy with one’s need for relatedness. When these two needs are balanced, one can be said to have reached a sense of social competence
The interpersonal stages move from level 0 to level 4. Here are the 5 stages: Level 0: Egocentric Role Taking (ages 3–6, roughly), Level 1: Subjective Role Taking (ages 6–8, roughly), Level 2: Self-reflective Role Taking (ages 8–10, roughly), Level 3: Mutual Role Taking (ages 10–12, roughly), Level 4: Societal Role Taking (ages 12–15+, roughly). Two points need to be presented here, (1) the students can learn to act age-appropriately with each stage, and (2) working with kids a opposite ends of the autonomy and relatedness spectrum is a helpful way to work with difficult students.

Selman’s work with schools utilizes class readings and discussion by selecting books that address some of these issues, such as *A Day’s Work* by Eve Bunting. While this is a picture book illustrated by Ronald Himmler, it is intended as a grade three to five class reading assignment. This story and others are a part of the *Voices of love and freedom* curriculum developed for the Boston school system and has a focus on minorities within the school and community. While the curriculum as a whole may not be appropriate for general use, Selman’s Book *The promotion of social awareness* (2003) is a good source for ideas regarding educational attainment as well as improvement of the school’s culture.

**Motivation, Social Development, and Well-Being**

Richard Ryan and Edward Deci of the University of Rochester have examined motivation as it relates to learning and teaching. These authors are concern with “how individuals acquire the motivation to carry their goals and how motivation affects persistence, behavioral quality and well-being (2000, p. 71). They argue that it is the intrinsic appeal of the project or a supportive relationship with the instructor that lead to a motivated learning situation. Based on this point, if a before or after school program or club is to succeed, one of two things is essential. Either the activity needs to be
intrinsically interesting to the learner or the learner needs to feel attached to the instructor if the activities are not intrinsically motivating. In an ideal situation the project would be intrinsically interesting and the instructors would establish a supportive and nurturing relationship with the learner.

Because extrinsic motivated behaviors are not typically interesting, the primary reason people initiate such forms of action is because the behaviors are prompted, modeled, or valued by significant others to whom they feel (or want to feel) attached or related. This suggests that relatedness, the need to feel belongingness and connectedness with others, is centrally important for internalization [of new learning] (p. 73).

The ideas of Ryan and Deci are at the basis of much that is done in the CCLC programs. This research merely supports what is already being done, but also a more detailed examination of the work of these authors will provide both support, and perhaps some new ideals as to way to make those connections and enhance nurturing relationships. At their best before and after school activities and clubs provide both intrinsic motivating activities and instructors to whom the students connect. It likely has occurred to many readers that Ryan and Deci’s pout about the importance of making connections with students through prompts, modeling, and valuing by significant others is closely connected to Vygotsky’s suggestions regarding scaffolding and the ZPD.

**Carol Dweck and self-theories of intelligence**

Carol Dweck (Stanford University) has researched how people think about their intelligence; how they understand what it means for them to be smart. Her research indicates that students generally fall into two categories. One group tends to think that
one is either smart or not so smart and that there is little they or anyone else can do to change that. She calls this group, entity theorist, or says that they have a fixed mindset. The other group looks at intelligence as something that can be improved by hard work. She characterizes this group as incrementalist or as having a growth mindset. Dweck goes on to argue that a person with a growth mindset is more likely to work on challenging problems and to keep at them, while people with a fixed mindset are more likely to seek out easier tasks so they can show how smart they are. The folks with the fixed mindsets are also likely to give up if they do not get the results quickly.

Importantly, Dweck’s research also says hows that a part of the way that students establish their mindset is through the types of encouragement they receive. If the student is praised for effort “I like how hard you worked of this project” as apposed to praise for ability “You are brilliant” or even “that was a great project” are more likely to develop a fixed mindset. This is not to say that students should never be praised for accomplishment or that they should only be praised for effort, any encouragement is generally a good thing. Dweck’s research does suggest that it is valuable to praise effort as often as possible (Dweck 2000; 2006).
The School-wide Enrichment Model

Joseph Renzulli (University of Connecticut) is famous for his work in TAG (Talented and Gifted) programs though recently he has proposed a model for school-wide enrichment that grew out of his work in TAG education. The model presents three types of activities. Each type of activity informs they other two types of activities and flows into the other activities. Type 1 activities Renzulli calls: general exploratory activities. These activities are designed to give a taste of something new that the student might not have been inspired to pursue previously or in any depth.

Type 2 activities, Renzulli calls training activities. These might also be called skill building activities as their purpose is to enhance the students’ abilities in a specific area: problem solving, calculating, recall rehearsal, or any of the metacognitive skills.

The third type of activities are individual and small group investigation of real problems. Most of the before and after school programs and clubs use type 1 and type 2 activities on a regular basis. Type 3 activities are used less often and with good reason. All learning opportunities do not fit into solving “real world” problems, but to open the possibility of moving type 1 or type 2 activities into a type 3 activities offers some exciting possibilities.

One of the basic needs implicit in the work of Selman and Renzulli is autonomy. Autonomy may be defined as the capacity of an agent to act on his or her own understanding and values rather than under the overly persuasive demand of others.
Selman looks to independence and self-assuredness as signs of autonomy. The autonomous learner is a self-activated maker of meaning, an active agent in his own learning process. He is not one to whom things merely happen; he is the one who, by his own volition, causes things to happen. Learning is seen as the result of his own self-initiated interaction with the world, such as a type 3 “real world” project.

The above discussion focused primarily on relatedness and to a lesser degree on autonomy. Autonomy is similar to independence but they are not the same. Autonomous learners think for themselves but often think in the presence of others whose ideas they value. They often have insights into their learning styles and strategies. These learners tend to take an active approach to the learning task at hand. They show a willingness to take the educational risk of being wrong and are willing to revise and reject hypotheses and rules that do not apply. According to Dweck, autonomous learners are likely to have a growth mindset (2000) Both Selman (2003) and Ryan and Deci (2000) use autonomy in this sense.

**Pulling together the recommendation**

Addressing the basic needs of students, whether they are struggling, very successful, or somewhere in-between is the overall goal of education. While the 21st Century program focuses mostly on the students who a struggling for whatever reason, all solid educational strategies are in some manner based on the reasons compiled in *How people Learn: Brain, Mind, Experience, and School* (Committee on Developments in the Science of learning, 2000). To repeat: Autonomy, competences, and relatedness are key to all learning and intellectual growth.
Lev Vygotsky’s work brings the instructor (teacher, mentor, parent, more competent peer) into a fuller picture of the nature of learning and teaching. A short discussion of scaffolding and the Zone of Proximal Development (ZDP) was presented earlier. Here I wish to connect these Vygotskian ideas with the work of Carol Dweck and Howard Gardner as a way of pulling things together. If one can change one’s understanding of what it means to be intelligent, that is, it one can learn to be either a fixed/entity theorist or growth/incremental theorist of intelligence, then Vygotsky’s theory show us how that may be done. Instructors and mentors provide small steps and models for learning that allows a learner to rise to the next level of mastery. Each small step coupled with prompts and encouragement encourages the student to the next small step. As each step along the way is completed, the students feels a sense of accomplishment and the possibility of seeing that they might develop new knowledge and skills.

Gardner (1999) suggests that we look closely at (1) new and old forms of apprenticeships, (2) direct confrontation with erroneous conceptions, (3) frameworks for learning that facilitate understanding over memorization, and (4) multiple points of introduction for learning (p. 1999). Apprenticeship, understood broadly, fits neatly into Vygotsky’s scaffolding principles as well as the idea of beginning where the student is. Directly addressing errors has to begin with knowledge of what the student knows or thinks he knows [Key Finding 1 (Committee on the Developments in the Science of Learning, 2000, p 1)]. The frameworks to facilitate learnings begin by re-thinking the learning goals by making them more complex and connected to the local community and the larger world. Individual objectives, however, may remain more narrowly focused. Creating multiple points for learning is at the core of the CCLC programs and clubs.
The recommendations in this report create a narrative for enhancement of work already in progress in the CCLC programs by showing connections between what is, and what might be. These theories, taken together, provide an additional lens that will help of foes on and develop better educational practices.

Summary

The CCLC programs are on a solid foundation. These comments are intended to provide some integration of the supportive theories and research upon which these programs are based. The small suggestions in this report are given in hope that they will contribute to the improvement of a well conceived and executed program that has already provided great benefit to the students, the staff, the school and the community.
References


Appendix A\textsuperscript{6}

Re-thinking the role of non-humans in Human Development\textsuperscript{7}

With this background in the nature of interpretative inquiry and a brief look at the status of cognitive developmental theory, I embark on a journey into uncharted waters, i.e., a beginning exploration of a re-thinking Human Development. This is a part of a larger project entailing about ten or so topics in need of re-thinking. The following is

\textsuperscript{6} All the appendixes are intended to provide an additional dimension to the report. Each appendix provides another look at questions and concerns that have not been address within the body of the report.

\textsuperscript{7} This appendix is a personal response to some of my work on interpretative research that was a part of a series of seminars I presented at GlyndŵrUniversity Wrexham.
a tentative list of the topics under consideration: (1) Attachment as key to understanding the organization of behavior by the child, (2) motivation and self-regulation as elements of social awareness, (3) personal epistemology as a factor in understanding and living in the world, (4) personal narrative as shaper of life trajectory, and (5) technology (specifically robots) as shaper of the self or of personality. My understanding of interpretative inquiry will shape the examination of these topics with special emphasis on persons within context.

The specific example: Robots as an additional part of a new look at human development

Sherry Turkle is an anthropologist and a psychologist who has worked at MIT for over 30 years. She is Professor of Social Studies of Science and Technology. Her book, Alone together: why we expect more of technology and less from each other (2011) is a part of a three book series on human/technology connections. These books provide an almost endless opportunity for reflecting on how technology is changing the development of we humans. Alone together, most recent book in this series provides a specific vehicle to address the issue stated above, while the other two works situate computers in the context of contemporary life and educational practices. The issue raised by Alone together is characterized by the following question: How does the study of children and adults interacting with roots change the well-worn explanations of how humans develop? While the research presented in Turkle’s book focuses on both robots and “being networked,” I would like to focus my attention on three different robots (Furby, AIBO, and Kismet) that have been used as a part of various efforts to connect
with and comfort children and older adults. To aid in our exploration of these robots and their potential influence on human development, I will discuss some of the key features of each of these robots.

A picture of each of the robots is inserted in the text alone with a short description of what they are capable of doing, typical behavior/interaction with children or older adults. This essay also includes some selected comments from both the scientists who invented and developed them as well as comments by children and older adults about their experiences and feeling when engage with these robots. My purpose is not to draw definitive conclusions about the meaning of these interactions but rather to begin a conversation that might lead to a better understanding of our relationship with various inanimate objects and their possible influence on development and therefore contribute to how Human Development textbook consider new research.

The FURBY is the first of the robots to be examined here. I begin with the Furby, as it is the most widely used in pre-school, at home, and in care facilities for the elderly. The Furby, unlike computers, did not play tic-tac-toe but would tell you if it was hungry or unhappy (Turkle, 2011, p 30). Children who played with the Furbies did not necessarily want to understand the creatures; they wanted to care for them. The Furbies ask children to take care of them and to teach them English. Each Furby arrive speaking Furbish. Furbish is a pidgin language that can nonetheless be understood by children and adults.
Furbies are programmed. Furby make demands but also say “I love you.” “They present themselves as already animated and ready for relationship” (Turkle, 2011, p 39).

The instruction manual that comes with each Furby states that the child is to take care of the Furby and to teach it English as the Furby begins, as stated earlier, by speaking Furbish. However, the children cannot actually teach their Furby English or anything else, as the Furby is programmed to increase its vocabulary over time. Most children take these instructions seriously. To take care of a Furby one works to put the Furby to sleep by nestling it under a blanket and talking to it softly. When something goes wrong with a Furby, it is more likely that the child (and often the parents) see the Furby as sick rather than broken. For example, the instruction manual states that a way to fix the Furby might be to remove and replace the battery, but to do so means that the Furby loses its memory. This is like starting over with a new Furby, and many children have invested time and energy into their Furby and do not want to start over with a new Furby.
Turkle explores one aspect of quality of the involvement of children with the robot with which they have developed some sort of relationship.

Taking care of a robot is a high-stakes game. Things can—and do go wrong. In one kindergarten, when a Furby breaks down, the children decide they want to operate to heal it. Ten children volunteer, seeing themselves as doctors in an emergency room. They decide they’ll begin by taking it apart (Turkle, 2001, p. 45).

The discussion among the children during the operation turns to what happens when the Furby “dies?” Their questions are an illustration of how these kindergarteners were trying to figure out the essence of life. “When does a Furby die?” “What is the relationship between the health of its part and its whole, its life?” “Is the Furby alive enough so that if it dies, it will become a ghost?” (43).

What the children’s discussion about the life and death of a Furby raises for me are questions of ontology: what does being alive mean? Are plants alive? Are computers alive? Are robots alive and what would it mean when a plant, a computer, or a robot or a person dies?

Kismet is the second of the robots to be discussed. Kismet is a more complex entity. Kismet is a robot conceived and constructed in the late 1990s at Massachusetts Institute of Technology by Dr. Cynthia Breazeal
The robot designed to participate in human social interaction. Its auditory, visual, and expressive systems were intended to allow it to participate with humans and to simulate human emotions and appearance. The name Kismet related to word in Arabic, Turkish, Urdu, Hindi, and Punjabi. Kismet may mean "fate" or sometimes "luck."

Children’s responses to engagement with Kismet are fascinating. Some children explicitly put themselves in the role of sibling or parent when engaging with Kismet. Turkle writes about Kismet (a robot) and Madison (a child) talking about ice cream flavors, mean girls, and baby sitters. Turkle observes that Madison, when playing the part of sibling or parent, enacts family conflicts and tensions (94).

After more descriptions of the interaction between Madison and Kismet, Sherry Turkle writes:

In the hour she plays with Kismet, Madison becomes increasingly happy and relaxed. Watching girl and robot together, it is easy to see Kismet as increasingly happy and relaxed as well. Child and robot are a happy couple. It is almost impossible not to see
Madison as a gratified mother and Kismet as a content child. Certainly, Kismet seems to prefer Madison to the children who have visited with it earlier that day. For me, their conversation is one of the most uncanny moments in the first-encounter study, stunning in its credibility because Kismet does not know about ice cream flavors, baby sitters, or mean girls. Kismet does not like Madison; it is not capable of liking anything or anybody (Turkle, 2011, p. 95).

Kismet though a robot appears to have a rich emotional life as the passage from Turkle above indicates. Many children not only engage in conversations with them but share secrets and intimate details regarding their lives and their relationships with others: peers and parents alike. These encounters bring forth questions for the children and for the adults around them: What does it mean to have a relationship with a robot? Is the interaction truly two-way or merely an imaginative one-way relationship? Is emotional learning enhanced or diminished but human/robot interaction? Do children outgrow robot relationships as outgrow imaginary friends?

These questions continue for the children and for us as we look at a robot dog, AIBO. The children’s interaction with AIBO raises new questions. This is a robot designed to look and act like a dog. The owners of these robots named their pet robots as they would name a pet dog. They also treated the pet robot as a dog: caring for it, taking it on walks, and teaching it to do tricks.
AIBOs begin as puppies: barely to walk. They can be trained to do ticks, such as kick a ball, to fetch a ball, and beg for a treat. They express feelings by flashing their eyes in either red and green accompanies each of its moods with a sound track. The AIBO can recognize its caregiver and can return to its charging station, smart enough to know when it needs a break (Turkle, 2011, 53). Owners become attached to the AIBO, particularly if they do not turn the AIBO off and it continues to learn.

When I presented the image of AIBO at a faculty seminar at Glyndwr University Wrexham, a flurry of questions followed. The questions raised about AIBO were not about its abilities, but rather about the merit of developing a relationship with a robot dog. This robot seems to have violated a boundary between human and robots; a boundary that pet-owners had with their pets. Many of the participants at the seminar found this robot an affront to their own pets and well as to themselves as pet owners. A robot dog appeared to be offensive to their understanding of the nature of human/pet interaction. These feeling were not as overtly expressed regarding the other two robots.
Among the questions raised by AIBO are: How are the interactions between a robot dog different from human-like robots? Why are we put off more by a dog-like robot than a human-like robot? Why would someone make a dog-like robot much less buy one?

Some of the things learned from a brief look at three robots

Robots are more than toy in the eyes of children, parents, their inventors, and the people using them in research project. While one might expect that children would begin to give human-like qualities to these engaging entities, it is somewhat surprising to find that teachers, inventors, and researchers talk in the same language regarding the quality of the interaction between persons and robots. The language Turkle uses earlier in this paper in talking about Kismet and Madison is telling. It indicates a level of engagement with robots as more than things.

Sherry Turkle’s sensibilities regarding humans and robots are contextualized within a larger social/cultural/scientific world when she writes that a new sensibility is emerging regarding how we understand robots.

With psychopharmacology, we approach the mind as bioengineerable machines. Brain images train us to belief that things - even things like feelings – are reducible to what they look like. Our current therapeutic culture turns from the inner life to focus on the mechanisms of behavior, something people and robots might share (Turkle, 2011, p. 30).

This is a major shift in understanding human/robot relations, as well as the nature of human development. I am agnostic about the rightness or wrongness of this shift; it is,
however, something that we need to pay close attention to us as rightly or wrongly, this shifting understanding is at the center of how we live in the world today.

A position close to the one presented above is discussed in a special two-issue edition of New Ideas in Psychology (2012). One section is entitled “Special issue title: Human agency and development” (Sugerman 2012) and second section called “Special issue title: The new psychology of personhood” (Martin 2012) Taken together these special editions validate and extend the gist of my argument. Daniel N. Robinson argues that robots may be understood as agents. He reports that in South Korea, the legislature has enacted a law against cruelty to robots (2012, 90).

Human evolution is an on-going process, and a child’s development of language, emotions, and cognition are a function of their experiences according to Greenspan and Shanker (2004). These experiences include I argue, the experiences of the “as if” and fictionalism. Hans Vaihinger (1852-1933), a German philosopher, argues for something call the “as if,” or fictionalism. Fictionalism is an idea whose theoretical untruth or incorrectness, and therewith its falsity is accepted. However, even when this fictionalism is admitted, it “is not for that reason practically valueless and useless; for such an idea, in spite of its theoretical nullity may have great practical importance" (p. viii). That is, a fiction may have a clear function (Hermans, Kempen, & van Loon, 1992, p. 24). A thinking robot may be fictionalism. This seems to be the approach implied in Turkle’s discussion of “as if” below.

It will begin with our seeing the new life as “as if” life and then deciding that “as if” may be life enough. Even now, as we contemplate “creatures” with artificial feelings and
intelligence, we come to reflect differently on our own. The question is not whether machines can be made to think like people but whether people have always thought like machines (Turkle, 2011, p. 54).

Douglas Hofstadter looks at Turkle’s point about “people have always thought like machines” very differently. He sees an understanding of intelligence as built on understanding the fluid nature of mental categories (Hofstadter, 1980). Paradoxically, Hofstadter uses a comprehension of the complexity of thinking and human grappling with understanding, and misunderstanding of mental categories to teach computers to think using computer programming errors to better understand human thinking (Somers, 2013) Using an “as if” thinking to better understand humans and machines. It is these “as if” similarities and differences that I think are at the heart of how we need to think about how children grow and develop. Robots may well change what it means to be human. The power of the “fictional” thinking may be crucial to the answer.

“Fictionalism” and the “as if” may be seen as a part of a claim made by Jerome Bruner. He makes two claims about humans and their culture in Acts of Meaning. He argues that we have a capacity for reflexivity and a capacity for envisioning alternatives. Reflexivity allows us to “turn around on the past and alter the presents in it’s light, or to alter the past in the light of the present. Neither the past nor the present stays fixed in the face of this reflexivity” (Bruner, 1990, p. 109). Bruner’s second claim is that we have an enormous capacity for envisioning alternative “to conceive of other ways of being of acting, of striving” (p. 110).
If it is true as Bruner claims that we must treat the self as a construct that “proceeds from the outside in as well as from the inside out, from culture to mind as well as from mind to culture,” (p. 108) then Turkle’s discussion of robots is and will have a profound influences on self and culture (Somes, 2013; Hofstadter 1980).

Bibliography


A Developmental Perspective of Creativity, Critical thinking, and Problem Solving: Toward a Framework for Educators, Part One

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Educators have long been interested in teaching critical thinking, problem-solving and creativity. However, the question rises as to when pupils are ready to engage in these activities. An additional question is whether these abilities develop uniformly across disciplines, that is, in language, music, and art at the same rate. This paper provides a beginning outline of the developmental trajectory of these abilities and presents some suggestions for teachers as they engage pupils in music, language, and art activities that involve problem-solving, creativity and critical thinking.

There is much conversation among teachers, administrators, and parents concerning creativity, and two related abilities: problem-solving and critical thinking (Welsh Assembly Government, 2009; Gardner, 2009; BMG Research, 2008; Kuhn, 2005; Kuhn & Dean, 2005; Buehl & Alexander, 2001; Means & Voss, 1996). As I will argue these three abilities are closely related conceptually as well as how they relate to child development. I begin with definitions of these three abilities.

Creativity, according to Torrance (1988) is the ability to produce new ideas and to find new problems as well as redefine old problems, and the ability to interpret the external world and transformation of the external world and internal representations by forming analogies and bridging concepts. He lists four qualities as predictors for creativity: flexibility, fluency, originality, and elaboration. He also includes these qualities as creativity skills. Howard Gardner’s defines creativity as “the ability to solve problems or create products that are valued within one or more cultural settings” (1999:33). Robert Sternberg (1988), in his anthology on creativity, cites other authorities on creativity such as Frank Barron, Mihaly Csikszentmihalyi and Teresa Amabile. These leaders in the field of creativity do not disagree with Torrance in any major way, however, they do disagree on who is creative with Howard Gardner deviating the most, especially in Extraordinary minds (1997) where he identifies truly creativity with people who change the course of history.

Following Barron (1988), Kuhn (1991), Perkins (1985) Voss et al. (1986), critical thinking may be understood as a “goal-dependent process that involve generating or evaluating (or both) evidence pertaining to claims and conclusions” (Means & Voss, 1996). Means and Voss propose a two-component model for critical thinking: informal logic skills (ability to generate and evaluate arguments, to use counter arguments, and to use qualifiers) and subject matter knowledge and personal experience. Their two-component model of critical thinking has the following elements:

8 Appendix B and C are articles on how creativity, critical thinking and problem solving fit into a modified Piagetian developmental model.
1. a knowledge of the field in which the thinking is being done as a prerequisite (subject matter knowledge);
2. an acceptance that method is essential to understanding and an attitude of suspended judgment; a habit of examination before accepting (informal logic skills and subject matter knowledge);
3. some application of method of logical analysis and/or scientific inquiry (informal logic skills); and
4. taking action in light of analysis or reasoning (personal experience) (168). The last of these related abilities is problem-solving.

John Dewey in ‘How we think’ (1933) defines problem-solving, which he sees as roughly equivalent to thinking, as the process by which a person goes from the task as he/she sees it to the solution which is demanded of the task. Dewey outlines five steps in the process:

1. feeling a need or difficulty;
2. locating or defining a need or difficulty;
3. suggesting possible solutions;
4. developing reasons which bear on the suggested solutions; and
5. further observing and experimenting which leads to acceptance or rejection of the suggested solution.

The model presented below illustrates one way in which these three abilities may be related to one another. This model is not empirically derived, but is rather a conceptual model drawn from a wide reading in creativity, critical thinking, and problem-solving and my experience as a teacher and teacher educator. Creativity as defined by both Torrance (1988) and Gardner (1999) (see above) provides a bridge between problem-solving, critical thinking and creativity.
My argument is that if we see these three abilities as related, we can gain a more helpful picture of pupils and ways to plan lessons, judge their appropriateness, and access their success. What is presented below uses Jean Piaget’s (1950) developmental stages and Howard Gardner’s Frames of mind (1983) as a framework to examine creativity, critical thinking, and problem-solving. While Piaget’s work has been considerably modified and expanded by neo-Piagetian (Fischer, 1998; Case, 1991) and other developmental psychologists (Bruner, 1960; 1966; Damon & Hart, 1988; Kuhn, 2005), his work provides an assessable benchmark for the purposes of elaborating this application.

This paper is organised by using Piaget’s stages, however, a caveat should be noted. These stages of organisation are not always as stable as Piaget had originally thought. “The types and complexities of organisation found in dynamic skills are always changing … (Fischer & Bidell, 1998:483), however, for our purposes Piaget’s more static stages shall provide a framework for examining creativity, critical thinking and problem-solving in each of their of their intelligences: art, music and language. Each section begins with a short description of the stage of cognitive development. The basic level of activity and/or skill that the child possesses is presented next. An overview of what the child is capable of doing in each of the ability areas, that is, creativity, critical thinking and problem-solving concludes each section.

Sensorimotor period
Birth to 2 years
The infant understands the world in terms of her overt physical action on the world. During this stage the child gains practical knowledge of the world around her. She moves from simple reflex through several steps to organised sets of schemes. While Piaget focuses mostly on cognitive development as I shall in this article, it is important to note that other developmentalists, such as Greenspan and Shanker (2004) and Sroufe, Egeland, Carlson, and Collins (2005), stress the key role of emotional development and attachment to the growth of cognitive processes. For example, Greenspan and Shanker (2004) argue that between 9 and 18 months children engage in a long chain of co-regulated emotional signaling and social problem-solving that leads to the creation of representations, symbols and ideas that allow for the development of language (pp. 88-89). In other words, the social-emotional signaling precedes and leads to language as the further development of skills.

Children even during the sensorimotor period have a sense of causal relationships. While there are mini-theories of cognitive development that challenge the age specific response of children in this age, Piaget’s theory of cognitive development still provides a workable framework for thinking about, researching, and applying these findings to teaching and learning (Haith & Benson, 1998).

Basic level of activities and skills in art, music and language
In art, the child does not have sufficient motor skills to hold and use drawing objects until late in this stage. In music, the child as young as 2 months can imitate pitch, loudness, and melodic contours of the mother’s song (Winner, 2008). In language, the child’s coos and babble soon lead to first words and sentences.

The child is limited in creativity and critical thinking, but has more abilities in problem-solving. Piaget’s observation of his own children documents an increasing ability of solve problems – both problems posed by others and problems they detect in the environment. For example, Piaget presents his observations of his daughter Jacqueline learning to solve a problem he posed. The problem is how to insert a pencil in a small hole when she is given the pencil with wide end of the pencil (the end that is too large to fit into the hole) facing the small hole. At about age 1, Jacqueline can turn the pencil around and insert the smaller end into the hole, whereas she could not do that a month or so earlier. (Piaget in Gruber & Voneche, 1995). The child solves an externally presented problem non-verbally.

Creativity

Art: Sometime around 18 months many children begin to use markers and pencils to make scribbles. While it is not art, it is a step in the development of the child and her understanding of the world. Howard Gardner makes the following observations about his son Jerry at about a year and a half.

Jerry’s pleasures in using the marker are still primitive. One could hardly say he has any grand representational schemas up his sleeve. But the delights are far from nil. Earlier he gained satisfaction merely from the cool feel of the marker in his hand and the rough muscular movements of his forearm. Now he wants to behold the impression made by the marker, he is frustrated when no mark is made, and he gains satisfaction from beholding the paper filled with his labours (1980, p. 23).

Understanding the representational nature of art is a prerequisite for creativity, problem-solving and critical thinking. Ellen Winner writes the ability to represent an object and to talk about representation is key to creativity in art (2008). Hardly any child at this age cannot draw a representational picture.

Music: While children are not musically creative at this age, some exceptional children are able to imitate singing around age one and by two years old can imitate melodies (PITT, 1933; Révész, 1954). Infants possess the rudimentary ability needed to remember auditory patterns (Fagen, Prigot, Carroll, Pioli, Stein, & Franco, 1997) and to make music. They vocalise and vary and imitate pitch and they can remember tempo and timbre (Trainor, Wu & Tsang, 2004). While this does not meet the criteria for creativity presented in this paper, it is an indication of potential creativity in music.

Language: Children as they begin to use one- and two-word sentence can be said to express creativity. While most of the child’s early two-word sentences are very impressive to parents (Mommy-up), they are not unique and therefore do not meet the definition of creativity. However, most children might be considered creative in their use of language at sometimes
during this early language period. One indication of that creativity is the child making a joke and knows that they are making a joke as indicated by laughter or that silly grin.

Critical thinking

Thinking done by children during this period does not rise to the standard of critical thinking presented here, that is, the child is not “generating and evaluating evidence that pertain to claims.” While we all know that a child somewhere around two years of age can say “no,” there is almost never a reason given for that response until at least the beginning of the next stage.

Problem-solving

Problem-solving at this age is non-verbal. Piaget documents many examples from his observation of own three children of solving problem that he posed as well as problem that the children encountered in their daily life experiences. The example presented above is typical of Piaget’s many examples.

Language: The child solves simple problems with the use of one or two-word sentences. “Up” becomes a one-word request. “Mama” is a request for many different things, often understood because of the close relationship between caregiver and child. The development of language on some levels begins with a shared gaze. The shared gaze is instrumental in language development and much more (Greenspan & Shanker, 2004). Building on the shared gaze, a mother and a child begin a simple conversation. This give-and-take leads to mothers asking more and more sophisticated questions (from “Do you want the ball?” to “What would you like?”). Toward the end of the first year, the mother’s questions refer to more distant objects, and the child begins taking the lead in the give-and-take language game (Bruner, 1987). Mother-dominated problem-solving moves to joint problem-solving and during the next stage the child solves her own problems.

Pre-operational (Intuitive or Symbolic Thought) Period
2 to 7 Years

No longer does the child simply make perceptual and motor adjustments to objects and events. He can now use symbols (mental images, words, and gestures) to represent objects and events. He uses these symbols in an increasingly organised and logical fashion. Language is the major symbol system used by children of this age although they have some use of symbols in art and music during the later years of this stage. The task during the preschool years (2 to 6) “is to establish proficiency in the use of those symbol systems that are highlighted in one’s culture” (Gardner, 1998: 428).

Play is one of the key activities in which we see the development of children’s use and understanding of symbols. Children between the ages of 2 and 3 develop four symbolic milestone abilities. They can substitute one object for another in play. They can decontextualise by imitating an event in a situation in which it does not normally appear. They can engage in self-other transformations (as seen when playing with dolls). And they can use collective symbolisation where one object can symbolise many different objects (Gardner, 1982: 170-171).
These growing abilities to use symbols affect the child’s abilities in problem-solving, critical thinking, and creativity in all three disciplines: art, music, and language. The reader shall see examples of children’s engagement with these disciplines as they play with a variety of objects, and with each other as well as with adults.

Basic level of activities and skills in art, music and language
Art: Children begin to make marks during the second year of life, at first enjoying the motor sensation of banging a marker on paper but soon coming to prize instead the contrast between dark scribble lines and light surfaces. Before 2.5 years of age children do not understand that a picture stands for its referent (Diesendruck, Markson, & Bloom, 2003; Winner, 2008). As a child begins to draw and to have others say what they see in the picture, the child slowly begins to understand a drawing is an intentional creation that can be interpreted and misinterpreted.

Understanding representation has four parts according to Winner. First, the child must recognise the similarity between the picture and what is being represented. Second, the child has to be able to understand the difference between a picture and what it represents. Third, the dual nature of the flat object and the three-dimensional world must be recognised. Finally, the child needs to understand that pictures are intentional and may be interpreted. “Infants are excellent at the first two understandings while the third and fourth kinds develop later” (Winner, 2008: 326).

As to the actual drawing of some object, the construction of certain geometric figures - circles, rectangles, and triangles - coupled with an increase proclivity to combine these figures is part of the basic development of years three and four. During this period the child produces recognisable depictions of some things in the world. Among the most often produces bit of art is the ubiquitous “tadpole person.” This tadpole person stands for everyone (Gardner, 1980: pp. 54-74).

Pre-schoolers are also sensitive to the expressive properties of representational stimuli, such as angular lines versus softly curving lines and bright colours versus dark colours (Winner, 2008),
even if they cannot always create these expressions themselves. Perhaps surprisingly, five-years-old labels the mood of a picture much the same as an adult does.

Music: In the middle of the second year, children experience an important transition in their musical lives. For at that time, they begin on their own to emit series of punctuated tones that explore various small intervals, that is, seconds, major third, and fourths. They invent spontaneous songs, and, before long, they begin to produce small sections of familiar songs (EI-EI-O) that are heard around them. By age three or four, the spontaneous gives way to the melodies of the dominant culture (Gardner, 1982). Swanwick and Tillman (cited in Koopman, 1995) report that children around that time begin to pay attention to sound, especially timbre, that is, the quality of a musical sound as distinct from pitch or intensity. However, the sound sequences produced by the child lack structural organisation. Compositions tend to be long and rambling, but the child now organises a steady pulse.

Language: By two years, children combine words into two-word statements. These two-word statements soon expand to grammatically correct sentences. By school age, most children have more or less mastered their mother tongue (speaking). An English-speaking child will have a vocabulary of about 2,500 to 5,000 words.

Problem-solving

Art: The child is able to “solve” simple problems of design and representation, that is, given a suggestion to draw a particular shape or object, the child can reproduce a basic object and simple drawing by combining shapes into an object such as a house or a boat.

Music: The child is able to repeat melodies and rhythm patterns. Asked to sing a familiar song that would make a listener happy or sad, they sing faster, more loudly and at a higher pitch for a happy (song) and more slowly, softly and at a lower pitch for a sad (song) (Baruch & Drake, 1997). I see this more as problem-solving than creativity as it addresses a question posed by someone else.

Language: The child uses language as part of problem-solving. Vygotsky documents the manner in which most children solve problems by talking aloud to themselves. A child at this age thinks, talks and acts simultaneously. “Children not only speak about what they are doing; their speech and actions are part of one and the same complex psychological function, directed toward the solution of the problem at hand” (Vygotsky, 1978: 95). Children solve practical problems with speech as well as with their hands and eyes (p.96). This speaking aloud begins to be internalising up to around 5 years old or toward the end of the preoperational stage.

Creative thinking

Earlier I presented Means and Voss’s two-component model of problem-solving. Gardner (1980) used a similar model with regard to creativity in the arts. The two components are ‘know how’ and ‘know that’.
Know how: The person needs to be able to use the “medium productively, that is, to vary its basic elements, to combine them in diverse ways in order to achieve certain effects” (pp. 15 -16).

Know that: The child needs to know that options are available to her, and that each option entails various costs and benefits, and that the ultimate product will have effects on both and audience and herself (pp. 15 -16).

Art: Work in art is judged by looking closely at expression, style, and composition. As stated above preschool children are quite good at understanding these elements of art, but do not do well at expressing them. Within limits, students express such things as happiness and sadness by using colour and line density and angularity (Winner, 2008), even though they may not be able to articulate how they are using colour or line density. Pre-school children generally lack the ability to recognise the representational nature of picture, that is, that the picture stands for something else. They are also not skilled at understanding intentionality, that is, the creature chose to present something in a particular manner. This skill, for some, will come in the next stage, thus allowing for true creativity.

Music: In the case of music, rhythm and melody, diatonic structure and key changes are the ‘know that’ of music (Winner, 2008). Children have ‘know how’ (also called understanding at the figural level) with regard to rhythm and melody, but generally do not have ‘know that’ (also called the structural level).

Only a few children create music in the formal sense before adolescence, those that do create music at this age are often prodigies. Many times these prodigies master the formal understanding of music intuitively.

Language: Children are quite capable of metaphor and story-telling, two important parts of creativity in language (Winner, 1984). Toward the end of this stage, they can tell stories about themselves and ‘make up’ stories. Many children, in making up metaphors, fulfil the two criteria of ‘know how’ and ‘know that’. Consider a four year old who says of the traces left by a skywriting plane, “Look at the scar in the sky.” Kieran Egan (1988) is not alone in arguing that children of this age understand the world primarily in terms of stories and metaphors (cf., Pramling & Samuelson, 2007).

Critical Thinking

Art: With regard to their own work, the child is too focused on what they reproduced (“I made a house!”) to respond critically to it. In other words, the child sees the work of art largely as an extension of the self and therefore is not likely to be critical. Without the ability to recognise the intentions of the artist or the ability to understand that the drawing is to be interpreted by the artist and the beholder, the child cannot be seen as being a critical thinker about the visual arts. Likewise, she fails to recognise the intentions of another artist and therefore cannot make critical judgments beyond like or dislike.

Music: The child at this age clearly knows what he or she likes, but generally does not have either the language or the understanding to articulate their views critically. Their spontaneous songs are
playful and enjoyable but children at this age cannot think critically about music, with the possible exception of some prodigies.

Language: Children are beginning to have some sense of criteria for critical thinking but it is quite rudimentary. However, by engaging children in thinking aloud, children learn to self-correct their thinking and critically examine the thoughts of others. Matthew Lipman (cf., Lipman & Sharp, 1986) provided an elaborate approach to critical thinking in the classroom. Patrick Costello (2000) also provide example of children using critical thinking toward the end of this period.

Conclusion
Children have more abilities than we sometimes think. I hope I have provided a conceptual framework of understanding some of these abilities as well as some criteria for understanding the limits of their skills so that better serve them. As teachers, teacher-educators and parents we need to continue close observation of children so as to both encourage them and understand their limits.

I end with a note of caution and a plan for a second phase of this paper. The cautionary note is this: the reader should not use the ideas presented here as a way to pigeonhole or label children. It is only to provide a general understanding of when capacities emerge. Some children will not develop as quickly, and of course there are prodigies. Our understanding of the development of problem-solving, critical thinking and creativity in art and music is still evolving. It is much clearer in the realm of language, although even in language our understanding is clearer as it relates to expository writing as opposed to creative writing.

This paper covers only the first two of Piaget’s stages of development. The next instalment will begin with the concrete operation stage and end with the formal operation stage. It will be more detailed as we both know more about these stages of development and the child’s capacities and potential accomplishment are much greater and therefore more visible.

References


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Appendix C

A Developmental Perspective of Creativity, Critical thinking, and Problem Solving: Toward a Framework for Educators, Part One

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A Developmental Perspective of Creativity, Critical Thinking, and Problem Solving:
Toward a Framework for Educators, Part two

Abstract
This installation of a framework for teachers on creativity, critical thinking, and problem solving in the areas of music, art, and language looks at the some of the important characteristics of school-aged children (ages 7 -12). The thinking of older children gets more complex. Therefore, the presentation of a developmental framework is more
multifaceted and detailed. Every effort is made to make the presentation as clear as possible without over simplifying the nature of the children's thinking. Readers are encouraged to go back to the first article as this article uses the same framework as the earlier one.

As in the earlier paper, I take a Piagetian perspective on development. While that perspective is helpful for sorting out many of the issues discussed here, I also think that some of the best thinking in developmental psychology has gone beyond Piaget to include the work of Lev Vygotsky (1986; van der Veer & Valsiner 1994) and others (Bruner, 1966; 1990; Rogoff, 2003) in a more comprehensive and dynamic picture of human development. The works of Kurt Fischer (Fischer & Bidell, 1998), Robbie Case (1991) and others (Siegler, 1996; Valsiner, 1998) are used to expand the understanding of development and the implications for creativity, problem solving and critical thinking. However, in order to keep the article manageable and accessible to a wide readership, I have sometimes reverted to a more static Piagetian outlook in both the explanation and the examples in art, music and language.

As I expand the age range of my framework for understanding creativity, critical thinking and problem solving, it is valuable to think about music, art, and language as anchors for these skills. “Skills,” as Fischer and Bidwell argue, “are context-specific and culturally defined” (1998, p. 479). Thinking does not occur in the abstract, it is always thinking about something, that is, it is context specific. Thinking, also, occurs only within a cultural context.

A primary culture that helps define these skills is the culture of the school. As children enter school their social and intellectual worlds expand (Bronfenbrenner & Morris, 1998). One of the things that this means is that the new context that children find themselves in is most often richer and more diverse than the world of family and neighborhood. The changes in the cognitive development of the child take place in this larger context. These changes in the cognitive and social development of the child affect creativity, problem solving and critical thinking in music, art, and language,

Erik Erikson’s classic work (Childhood and Society, 1950) on the physical, psychological and social changes in childhood has help to frame my thinking on human development in general and on creativity, problem solving and critical thinking in particular. The child during school-age (6 to about 12 years of age) is gaining better control over the motor skills essential for drawing, playing musical instruments, and writing. As the child’s social world is also expanding, moving from home to
neighborhood to school, cognitive abilities are also changing (Erikson, 1950). He suggests that these physical, social, and cognitive changes precipitate a need within the child to develop a sense of competence (see also Ryan & Deci, 2000; Selman, 2003). Specifically, Erikson (1950) sees the need for competency as growing out of the confluence of cognitive, physical, and social changes that occur about the time the child enters school and engage in school activities.

**Concrete Operations Period**

*7-11 years*

Returning to the specifics of cognitive abilities, the child now acquires certain logical structures that allow her to perform various mental operations (Piaget, 1967). Piaget defines an operation as an internalized action that can be reversed. The concept of operations is important to our understanding of creativity, critical thinking and problem solving because to understand how each of these abilities works, one needs to understand them as a process of putting things together and taking them apart. Piaget’s discussion of the psychology of operations, and its connection to earlier stages, helps us to see that point.

Psychologically, an operation is, above all, some kind of action (the act of combining individuals or numeric units, displacing them, etc), whose origins is always perceptual, intuitive (representational), or motoric. The actions, which are the starting point for operations, are thus rooted in sensorimotor schemata, i.e., in actual or mental (intuitive) experiences. Before becoming operational, they constitute the substance of sensorimotor intelligence, then of intuition (p. 48).

A bit later in “The mental development of the child, Piaget (1967) states the intuitions become operations, that is, groupings that are both composable and reversible.

It is remarkable to see the formation of a whole series of these groupings by children at about age seven. They transform the intuitions into operations of all kinds … Above all, it is striking to see how these groupings are formed, often very rapidly, through a sort of total reorganization (p. 49)

From a social psychological perspective the child seeks to win recognition by producing things (Erikson, 1950), including pictures (art), songs (music) and stories (language). This includes doing things with and besides other children. As they engage with other children, they are gaining some criteria for what is acceptable and culturally valued in art, music and language. A sense of competence may grow as children begin to compare their abilities and skills with other children.
Basic Level of Activities And Skills in Art, Music and Language

A quick summary of the abilities of the child in art, music and language provides an overview for a more detailed discussion that follows. In art the child of 8 or 9 years of age begins to have a sense of precision, a concern for detail, and a command of geometric forms (Gardner, 1973; 1994). The child is making his first steps toward representational art. In music, most children are continuing to gain mastery over the basic of know-how to make music, including learning to play simple instruments. Development of spoken language is largely completed. The areas of syntax (the ability to put words together in meaningful ways and to understand, intuitively, the structure of a sentence) and phonology (the ability to connect sounds and letter and works) are largely complete. However, the semantic (the meaning of words) and pragmatic (the expressive elements of language) use of language continues to develop. The development of language in written form develops much more slowing.

Creativity

Art: A key to creativity begins with understanding that a drawing is something in someone’s mind (Winner, 2008, p. 327). Although not addressing this issue directly, Sonja Dennis’ (1991) studies of children’s spatial representation clearly shows that children can understand that art is the creation of another mind as they clearly folloed directions in order to draw a “picture that shows a girl (boy) your age, doing something that makes her (him) happy” (p. 232). Richert and Lillard (2002) also argue that children at school age become aware that a drawing is the vision of someone, not just a representation of the world. They demonstrate that children eight years of age “responded similarly for the subjective and objective questions in the pretend condition, indicating that the understanding of drawing and pretending is fairly sophisticated by 7 years of age” (p. 1008).

Although some children are capable of creative work, that is, work that is original, most efforts of 7 to 10-year-olds are directed toward mastery of realistic reproduction. Jolley and Thomas report that most eight year olds can read expressions of mood in line drawings (1994). At around age eight, some children consciously use color, line, shading, and expression to make a statement about some visual image (Carothers & Gardner, 1979; Porath, 1993). The beginning of realistic drawing is present in many 8-year-olds. Dennis (1991) reports that most 8 year-olds could draw a scene with front (near) and back (far) with both ground and sky represented, but only 33 per cent of
students could complete a drawing that showed a realist sense of depth. By age 10, the percentage of students illustrating real depth increased to 43 percent (1991).

This opens up the potential for children at this age to be creative, that is, as they understand line, color, shading, and expression, they are capable of using these understandings to make a creative drawing. However, they must able to understand the costs and benefits of their choices to be truly creative. Csikszentmihalyi and Getzels (1971), studying adult art students, found that problem finding was an essential part of creative expression in art. They found that students in a prestigious art school who made a collection of inanimate objects into a problem of composition were judged to be the most creative students. My sense is that school-aged children engage in problem finding. When we observe children slowing down and thinking before they begin to draw, we are seeing problem finding. This is an area for further research but also careful observation by teachers and parents who wish to encourage creativity in drawing.

**Music:** Many children, perhaps most children, have opportunities in schools to experiences music in classes – at the minimum singing, but many times band and even orchestra are available. Children generally know how to make music. As discussed in an earlier paper (Morehouse 2010), Howard Gardner argues that there are two sides to making art, know-how and know–that. Know-how is the ability to use the “medium productively, that is, to vary its basic elements, to combine them in diverse ways in order to achieve certain effects” (Gardner, 1980, pp. 15 -16). Know-that is knowledge the child needs to know regarding options that are available to her based on an understanding of the key elements of music and its structure. Each option entails various costs and benefits. The ultimate product will have effects on both the audience and the creator (Gardner, 1980). The basic elements required for musical production are the ability to regulate timbre, tempo, dynamic and simple melody, and rhythm (Richert, & Lillard, 2002). Often, children learn these elements by doing, that is, by singing or playing an instrument. They may not, however, learn how these elements fit into a larger picture of how music is composed and arranged.

While most children participate in music created by others, not nearly as many children are given the opportunity to create music. In order for a person to create music, they need some mastery of *know-that*. This know-that include an awareness that options are available and that each option entails costs and benefits. The creator of music also knows that the ultimate product will have effects on both audience and herself (Gardner, 1980, pp. 15 -16). In order to creative music, the child need to gain a level of proficiency in know how and know that. They need to be able to understand the
role played be such sophisticated elements as complex melody and rhythm, tonality, form, texture, and expression are used in composition (Deturk, 1989) and be able to use those element in singing or playing an instrument. An important part of musical know-how is mastery of the performance concepts of “tone quality, accuracy of pitch and rhythm, ensemble, and personal sensitivity” (p. 23). So the creator of music need to not only know about timbre, tempo, dynamic and simple melody, and rhythm, but also know, for example, the costs and benefits of the use of a complex melody over a simple melody in conveying a feeling or stimulating an experience. Consideration of costs and benefits of individual choices also applies in art and language.

In most school program children are either relatively passive participants in music production, that is, they are engaged in singing and playing instruments, but not involved in the creation of music. Knowledge of the structure of music, necessary for creative expression, is usually not taught to elementary students, that is, before around age 11 or 12.

**Language:** The written word becomes the medium for expression of language creativity and while most children master the spoken word, few are given much experience in creativity with the written word. Understanding and telling stories is an ability, Jerome Bruner (1986; 1990) argues, that comes before that ability to think logically. Children think first in narrative. They understand narrative, at least on an intuitive manner before school age. By school age, children begin to develop the four “critical grammatical constituents” (1990, p. 77) necessary to understand and tell (verbally or in writing) a story. These include (1) a means for emphasizing human agency, (2) the ability to sequence action toward a goal, (3) a sensitivity to the canonical, and (4) a narrator’s voice.

Berman and Katzenberger (2004) examined the narratives of children ages 9-10, 12-13, and 16-17 as well as adults. They found that children of between 9 and 13 wrote introductions to stories that could be divided into five different categories: (1) stative (expressing a state or condition rather than an activity or event), (2) event plus description (sets the story and provides some background), (3) generalized (describes such things as habitual activities, routines, and relationships), (4) text oriented expository-like comments (intended to explain and set up what will happen in the story), and (5) commentary on text production (a metatextual commentary on how the story was written). Most of the 9 to thirteen-year olds, wrote an introduction in the events plus description category. Only adults (college students) wrote more introductory statements for their stories in category 3 – the generalized category. The 9-thirteen-year
olds’ introductions to their stories were focused on isolated background events. These students wrote stories that were monolithic or linear in their temporal anchoring (Berman & Katzenberger, 2004, p 70). Most were written in past tense.

Children ages 7 - eleven have the “know that” to be creative with regard to figurative language. School-aged children have the potential for creativity but need more opportunities to express their creativity in writing if these abilities are to be more full developed. "In this, as in every intellectual realm, practice is a sine qua non of eventual success"(Gardner, 1984). If as a child you are not writing with some regularity, your chances of being a creative writer are diminished.

Problem Solving

Art: I have defined problem solving as the process by which a person goes from the task as he/she sees it to the solution that is demanded of the task. Sonja Dennis (1991) reports that students at age eight can draw people and objects in a scene that includes a front (near) and a back (far). All the eight year-olds children in her study were able to draw in that manner. She conducted an experiment that asks pupils to do each of the following activities. First, draw a picture of a man. Next they were asked to draw a picture of a girl standing in a park next to a tree. Then they were to draw a picture of two boys shaking hands in a park with a fence just behind them. The forth task was to draw a picture of a man and woman holding hands in a park with their baby in front of them. A tree is very far away behind them. And finally, they were asked to draw a picture of a mother looking out the window of her house to see where her son is playing in the park across from where they live. She only sees her son’s face, because he is peeking out from behind a tree. These are real and challenging problems for the young artists, even though the problems a posed from outside. All of the eight year olds could solve the first problem ninety-seven per cent of eight year olds could solve the second problem, Eighty-seven per cent could solve the third problem, while only thirty-three per cent and 7 per cent of 8-year olds could solve the fourth and fifth problems. All 10 year olds about solve problems one through three. Forty-three per cent of ten year olds could solve problem four and twenty per cent could solve problem five. While these findings are helpful in understanding the abilities of school-aged children, it is important to remember that left to their own devises, many children do not "see" the representation as a problem. Dennis (1991) found that children ability to solve problems of perspective correlated to the amount of short-term storage of the child.

Dennis's findings (1991) are consisted with Willats’ (1977) observation that some children will begin to solve problems of perspective (to show depth of field or distance),

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shading (to show mood or emotion or depth of field), and expression (to show action). He found that most 7 to 12 year olds draw a table with an orthographic projection. (A method of projection in which an object is depicted or a surface mapped using parallel lines to project its shape onto a plane but without a 3 dimensional representation).

Lee Emery (1989) in a case study of 10 year-olds in Melbourne, Australia found that belief was important to problem solving.

Belief in making and thinking involved a willingness to engage in the pretence or imaginings of the making process. It involves a preparedness to accept that artistic works are always a little removed from the mundane, the commonplace, and the conventional. (p. 242).

In order to make art the child must believe that there is an unresolved problem “or something that should be stated, shown, or made evident” (Emery, 1989, p. 241). Those children who could not recognize and value an unresolved problem, failed to understand that artistic products could be made within a formula or by using proven procedures (p. 242). Emery does not make the case that this is a cognitive deficiency, only that some of the student failed to see problems is some activities.

It seems that school-aged children are capable of solving both problems presented by others, and to find problems to be solved within a given art project. It is important to note that in Emery’s case study, the children were encouraged to see the task as problematic, and not merely as a mechanical execution. She followed these ten students using qualitative data collection methods over the course of an academic year provided an opportunity to see these children both working in artistic media and thinking about their work.

**Music:** What constitutes a problem in music? One problem might be how to express a feeling or a mood. To solve this problem the child does not need to be able to create a melody, or even play it on an instrument or sing it. All that is required is that the person is able to suggest how a sad melody, for example, might be presented. In order to solve problems such a problem in music one has to first be able to understand the basic structure of music. The student needs to know how a musician thinks as much as they need to know how a musician performs (Paulz, 1989, p. 66).

In most schools very little music theory is taught and musical composition is rarely seen as an option for the typical student. Paulz suggests that this is in part because of the time demand of music teachers, including the demands of the “principal and parents who expect holiday and seasonal programs as well as by faculty’s requests to have music correlated with everything form dental health to sex education” (p. 64).
However, as discussed in the earlier article, most children know that a happy song is likely to have a quick tempo and bright notes, while a sad song is likely to be in a lower register and be more slow paced. Not as many children will know that a scary melody is more likely to be in a minor key.

While solving problems presented by others, most children would not be able to address a more open-ended problem like “what would make melody more interesting, more appealing to a given audience?” In fact the awareness of audience is not likely to be in the mind-set of children of school age. Teachers are more likely to help students be aware of audience in writing projects than in music lessons.

Most children increase their repertoire of songs they can sing and melodies they can play on an instrument. They also learn to sight-read music but do not encounter musical problems. Capodilupo (1991) showed that children progress in their ability of sight-read music. Given instruction, students at age 10 were twice as good at sight-reading as children at age six. Sight-reading without more knowledge of music theory, however, does not lead to the child’s ability to solve musical problems.

**Language:** Problem solving using language takes many forms. Children use language as one of their primary methods of problem solving. As this article focuses mostly on artistic expression, the focus here ill is on narrative and poetry. One way that we engage in problem solving is with the use of analogies. Tunteler and Resing (2007a; 2007b) have shown that 5 and 7-year-olds are able to use analogies and that practice is a key to improvement with or without initial instruction. However, assistance in completing analogies increases the child’s ability to solve analogies one week after initial an practice session. The ability to solve problems by using analogy can be applied in different types of problems. “The finding of greatest interest in the study is that ability to use analogical transfer spontaneously improves with practice regardless of age” (Tunteler & Resing, 2007b). These improvements in the use of analogies were incremental, that is they moved back and forth but with an overall positive trajectory, rather than in a consistent step-like manner. Stenberg and Nigro (1980) also showed an improvement is the use of analogical reasoning between 6 year-olds and 8-year-olds with functional and antonymous relationships being solved both more accurately and faster than semantic relationships.

With our focus on narrative, the types of problems to be solved are problems of plot (the ability to sequence action toward a goal), setting (the where of the story), character development (human agency), and voice. The importance of understanding what is canonical is also important in story telling, as it is what allows for plot twists and
surprise ending. Children use these abilities intuitively but instruction and especially lots of reading and practice writing allows them to develop more fully.

A number of thinking aloud programs, including philosophy for children (Lipman, Oscanyan, & Sharp, 1980) have provided example of children using reasoning skills to relational solve problems. Language may be used as an internal problem solving devise and does not need to be vocalized to be effective for children at this age. The logical patterns of language are beginning to be used and understood. Philosophy for Children is one of the programs, which specifically builds on this growing competence with languages and aid student growth in the understanding, and use of the logic embedded in language.

Critical Thinking

Art: One way to look at critical thinking in art is to look at aesthetics. Emery provides a working definition of aesthetics: the construction of artistic values related to experiencing and making art (Wilks, 2000, p 100). David N. Perkins (1994) argues that looking at art requires thinking. To see art one needs a long and thoughtful look, not just the passing glance, if we are to understand art’s message and savor its elegance (p.5).

Wilks reports that children between 9-11 years olds can engage in discussion on aesthetic and think critically about art if teachers are given appropriate in-service training (Wilks, 2000). She provided extensive in-service for teachers both on method of instruction, which was based on community of inquiry as used in Philosophy for Children. This approach toward teaching critical thinking through discussion along with support for teachers enables a better understanding of aesthetic as a subdiscipline of philosophy.

Another indication of the evolving application of critical thinking has been the increased use of children’s program in conjunction with museums. The one’s that I am most familiar with involve using philosophy for children group discussions around museum visits (Slade & del Gigante, 1987; Bosch, 2005; 2008).

As children begin to be able to take the perspective of others, they have the potential for critical thinking. While Deanna Kuhn defines critical thinking in terms of the skills of inquiry and argument (2005), a more widely use definition is the ability to reflect on the work of others as well as one’s own work (Hudgins & Edelman, 1986; Ennis, 1962) Children before the age of about seven see their work largely as an extension of the self (Diesendruck, Markson, & Bloom, 2003). Some children can look at work of
other, as with their own work, with a critical perspective. The know-that understanding of art is present in some children.

The art of some children will begin to show: perspective (to show depth of field or distance), shading (to show mood or emotion or depth of field), and expression (to show action). Building on this ability, children at an operational level can find these elements in their own art as well as the art of other. Once they find these elements, they can learn to evaluate better from worse expressions of these elements.

Many children have the cognitive ability to fully understand the representational and intentional nature of a drawing, painting or sculpture. These children can learn more about representation and intentionality. Emery’s (1989) case study again provides examples of ten-year-old children conceptualizing problems and working to understand the intentionality of other artist. Interns of understanding their own intentionality, Emery argues that children creating and thinking about art, often need to be able to delay intentionality and to some degree let their intentions emerge as they create (1989,p. 243). Their ability to understand representation and intentionality allows them to look at their own work as well as the work of others with a critical perspective.

Music: While some schools do not provide opportunities for children to learn about the structure of music, students need to understand the lower level concepts of timbre, tempo, dynamics and simple melody children do learn melody, rhythm, expression, and tempo. They also need to understand middle and higher relational levels such as complex melodies and rhythms, harmony, tonality, texture, form, and expressiveness. These are the building blocks on which they already they can apply what they know about critical thinking (Deturk, 1989). “Only after music can be accurately described can it be evaluated” (p. 24). Popular music, which many children love to talk about, can provide the basis to build critical thinking skills in music as listening is the first step in thinking about as well as in creating music (Kennedy, 2002).

Language: Children are beginning to have some sense of criteria necessary for critical thinking but it is quite rudimentary. Language facilitates and guides our thought processes and gives students opportunities to think critically (Wilks1995). The built-in logic of language provides the beginning place for the development of critical thinking. Matthew Lipman, in Philosophy Goes To School (1988), uses an example of children giving criteria as a part of critical thinking. Lipman presents a scenario in which several children are discussing a teacher. One student says that the teacher is “good,” while the other student says the teacher is “bad.” In there conversation one student supports his claim that the teacher is good because the teacher give his attention for all the
students. The second student say the teacher is bad because the teacher does not know the material very well. Lipman argues that the exploration of multiple criteria can lead to critical thinking by these students (Lipman, 1988). This same philosophical approach may be used as children examine their own stories and the stories of their classmates. As students develop criteria by looking at the individual elements of plot, agency, and the twists of the story line through a discussion on what makes a good story, they develop the tools to be critical and self-critical.

Demorest (Demorest, Silberstein, Gardner & Winner, 1983) report that 29 per cent of 11-year olds could identify both the discrepancy and intention of a speaker using sarcasm, compared with 6 year-olds who could only indentify discrepancy in such statements but not the intention of the speaker. They also looked at children’s understanding to understatement, hyperbole, irony, and metaphor. The results showed a similar trend with increasing recognition of discrepancy and a move toward understanding, that is, knowing both the discrepancy in that statement and the speakers intended meaning (Demorest et al, 1983).

Deanna Kuhn (1999) supports this view of the development of critical thinking that grows out of thinking aloud. She argues that in order to think critically one needs to understand that knowledge is generated by human minds and is uncertain but that critical thinking can support sound assertions. Students have the ability to judge whether some solutions are better than other solution at this age. They need practice in order to get beyond “because I like it” answers to publically defendable criteria, but the potential is there beginning with the concrete operational stage at around age seven. Therefore, one can evaluate good ideas from bad ideas. Kuhn sees the ability to think critically, at least in science, as the ability to consciously coordinate theory and evidence (Kuhn & Pearsall, 2000). Lipman does not make a specific claims about the ages at which these abilities develop, though their educational programs begin working with children at around age 7. Kuhn (1991) shows that some school-age children do this regularly and only improve slowly into adulthood.

**Summary**

Our schools, communities and homes provide the dynamic elements that foster or inhibit the development of creativity, problem solving and critical thinking. Human development is dynamic and not static. Kurt Fischer and colleagues argue for this dynamic perspective of human development.
The alternative metaphor for development that includes variability as well as stability in development is the constructive web. The metaphor of a web is useful for dynamic models because it supports thinking about active skills construction in a variety of contexts as well as types of variability. … human webs are constructed jointly by multiple agents, not by an individual alone, although most psychological research examines individuals isolated from their social networks (Fischer & Bidell, 1998, p. 473).

While educators may disagree the extent that children should continuing to be active in making art, music, and narrative writing, if our goal is to produce of adults capable of appreciating and participating in these endeavor, we will need to work to understand as fully as possible the extent and limits of their potential and to engage them in thinking about the arts. it is critical during pre-adolescence for students to have some mastery realism in art, the ability to perform using at least one instrument (including the human voice) and the write complete stories . If preadolescents do not gain some mastery of the production within an art form, they are unlikely to continue to produce art (Gardner, 1982). For the young artist, this is more important than creativity.

References


