Digital Technology for Conviviality:
Making the Most of Students' Energy and Imagination in Learning Environments

by

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Submitted to the Program in Media Arts and Sciences,
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Abstract

This thesis contributes to the body of research on constructionist philosophy. It expands the conceptual framework to a broader scale by linking constructionism to Ivan Illich's notion of conviviality. An emphasis on developing convivial learning environments has been made. The learning activities were developed with a special highlight on the idea of emergent design. The emphasis on conviviality and emergent design allowed a systematic and theorized framework to identify and discuss the pattern in the developmental process of learning activities, which is an area in the constructionist framework that needs more study. I gave special emphasis on learning activities that involve tool construction. I show how the making of tools could strengthen conviviality. I present a concept of dynamic equilibrium that allows different methods of learning and teaching to intertwine. I present a case study based on a five-week fieldwork conducted at a rural school of northern Thailand.

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1.1 Overview

This research is about experimenting with ideas that could deeply change learning environments. This thesis presents a new learning framework and a case study based on a five-week fieldwork conducted with a group of eight-graders at a rural school in northern Thailand. This research develops new discussions both in the theoretical and empirical level.

1.1.1 Theoretical Contributions

The basis of this thesis joins many works\textsuperscript{1} in its constructionist philosophy [Papert, 1993]. However, the ideas presented are unique in the following ways:

- I put constructionism into the context of Ivan Illich’s notion of conviviality [Illich, 1973].

\textsuperscript{1} Examples of these works are [Papert, 1980], [Martin, 1994], [Resnick, 1994], [Cavallo, 2000], and [Bers, 1999].
Although a relationship between Papert’s work and Illich has been noted before (See [Falbel, 1990] and [Segall, 1990]), I believe that my development goes further and has a unique character.

- Constructionist writers generally give importance to projects. However, only few have paid attention to features in the development of a project conducted by school-aged students (See [Cavallo, 2000], [Harel, 1991], and [Kafai, 1995]). I specifically use and add to the idea of emergent design [Cavallo, 2000] in my framework. I make a more systematic and theorized approach that could identify patterns and strategies that would be useful to constructionist educators.

- I give special attention to the role of tool-making in project work and use the making of tools in a double role: as tools and as projects. I focus on the area of electronics and mechanics as well as programming.

- I synthesized and developed from the idea of conviviality a concept of dynamic equilibrium in the interplay between different modes of learning and teaching.
1.1.2 Empirical Level Contribution

- I illuminate patterns in the learning environment that are specific to a particular (Thai) culture and how they effect the implementation of the learning framework.

- I reveal patterns in the dynamics of the evolution of projects. I describe carefully and in detail: the development of learning activities; how the activities can go through phases; effects of the existing culture; importance of trust and respect. The emphasis of this research is on the initial reaction of learners who have never been exposed to any learning styles other than the traditional practice of schooling.

- I probe the complex relationship between a child’s work and real community applications.
1.2 Motivation

The basis of this thesis is to present a qualitative analysis of a learning environment that is different from and often runs counter to the traditional education paradigm. The general tone for the framework follows the belief Papert and Cavallo have that [Papert and Cavallo, 2000]:

- Digital technology is a powerful force that is already changing practices of learning.
- Though the movement is massive, it is unacceptably limited.
- The fundamental limiting factor is the deficiencies and rigidities in thinking about learning.

According to Papert and Cavallo, the development of digital technology has outpaced the development of cultures that make effective and humane use of technology in learning environments. The learning framework presented in this thesis is intended to contribute to this overlooked area. The hope is that this work, together with many others, would serve as evidence that a learning revolution is possible and would contribute to the public realization of the time, effort, research, resources, and commitment required for such revolution to come about.
1.3 Conviviality

1.3.1 General Idea

Conviviality is the term that Ivan Illich uses to define a society that prefers the maximization of individual’s creativity, imagination, and energy to the maximization of outputs, where the latter usually leads to an industrial mode of production. The traditional schools are clearly the opposite of conviviality, as it focuses on the production of students in an industrial mode [Illich, 1973; P.19]. Students are put through a standardized process that would transform them into an educated person. Thus, in order to be educated, a person is required to spend x number of years in schools, to study what they are told, and to pass a set of test. Anybody who can manage to handle this process deserves to be called an educated person.

In a convivial environment, the emphasis is the opposite of shaping and squeezing people though a standardized process. Conviviality aims to reach out to each person’s diversity and make the most of the interest, energy, and imagination each has. Learners’ primary motive in a convivial environment is not to gain a higher social status through the acquisition of an education degree. Rather, learning takes place by the desire to know
more about the world and to enrich their environment with their personal meaning.

**1.3.2 Implementation**

In addition to the theoretical framework, I need to decide how to form the implementation of the learning activities. I believe there is more than one way to build an environment that nourishes conviviality. However, I suggest in this research a practical framework that evidently shows a good result. Here are the design-decisions I made to carry out the case studies presented in this thesis:

**Learning activities:** The activities were project based. Digital technologies (e.g. computers, Lego Mindstorms\(^2\), and digital cameras) were the primary tools and were used to construct artifacts (e.g. computer programs, Lego cars, and electronic light switches). This constructionist approach resonated with Illich’s emphasis on using tools to promote conviviality. By constructing artifacts, they were engaged in planning, problem solving, and reflection of their work. These activities promoted a process of externalization and re-internalization of learners’ ideas, which were based on their interaction with the physical object and the

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\(^2\) See more information about Lego Mindstorms in Chapter 4
environment [Papert 1993; P.142]. Externalization of ideas has proven to be a preferred process in an environment that promotes learners’ imagination and creativity. The case studies presented in chapter four shows examples of what I mean.

**Activity development:** I focus on the interplay between different modes of teaching and learning. Though activities that emerge from the students are preferred, it does not mean the teachers’ interest and knowledge should not have any valuable influence. Thus, though the final decision of what to do belongs to the students, I concentrate on developing relationships in the learning community that leads to a collective and collaborative development of ideas. Only few researchers have focused on this process (as mentioned in 1.1.1). I present a detailed documentation and discussion of the process in chapters four and five.

**Time and participation:** The learning activity was carried out as an after school program. Participating students were able to come and leave as they wanted. This arrangement was necessary. An environment that learners are forced to participate would not provide an ideal condition for students to develop projects that are personally meaningful and that exercise their energy and imagination.
1.3.3 Tool Construction

One of the important contributions I have made in this research was my emphasis on identifying activities that involve tool construction as a theme that fosters a convivial environment particularly well. In chapter two, I discuss how learners’ fluency with their tools and how their interaction with their community play an important role in the development of conviviality. The case studies suggest these two aspects happen felicitously in tool construction projects. For example, one student built a programmable power switch. Because it was supposed to be a general-purpose tool, the student had to generalize the design not to include any features that would tie the use of the tool to any specific device. It was a process that made the students go one step further in the design process thereby gaining more fluency with the tools used to construct the switch. Towards the end of the five-week project, the switch was used at a fish farm to control lights that attract insects. The project involved student’s parents who benefited from the use of the switch. Thus, the use of the tool created an interaction between the toolmaker and his or her community, which was beneficial to both parties.
Tool construction also benefited students in the learning process. For example, students' tools served as a tangible unit that contained the toolmaker's ideas and experiences. Since the tools were meant to be applied in different situations, the embedded ideas and experiences were portable and conveniently reusable. New ideas were built on top of existing ones for each new use. In addition, because tools were most likely to be used by many people, they created a feedback loop for the toolmaker. The feedback allowed the toolmaker to reflect and to further develop his or her ideas in the making of the tool. Examples of these benefits are shown in the case studies.
1.4 Case studies.

In chapter four, I present a concrete example of a learning environment that was developed based on the framework presented above. Chapter five reflects the underlying ideas of the learning framework and presents crucial issues that must be taken into account when a theoretical framework is transformed into learning activities. These issues include the reaction from students, mindset changes of teachers, resource constraints, and cultural behaviors. Some examples of the case studies include:

- Situations where the teacher and the student have different motives and how positive outcomes can happen when the teacher is opened to students’ ideas and let go of his or her total authority. This is a case of a dynamic tension [Cavallo, 2000] that the teacher has to deal and has to make decisions based on the specific situation in order to keep students ownership over their learning activity while not losing the opportunity to learn new ideas.

- How a student that failed completely in the traditional school could perform and learn extremely well when he is given the respect of his
learning interest, pace, and style. I document how I gradually develop a relationship of trust and respect that leads to the change.

- How teaching can still be part of the learning activities without depriving students' from their ownership of the learning activity. I discuss how teaching is used in a convivial way. That is, teaching is used to empower the students based on what they need and not as an activity imposed by someone else.
In this chapter, I discuss my learning framework in more detail. My primary inspiration is Ivan Illich’s notion of conviviality, which argues that people need tools to “make the most of the energy and imagination each has” [Illich, 1973]. I have added two ideas in order to build a strong practical ground for the construction of a digitally rich convivial learning environment. First, I emphasize the development of tools following a constructionist approach [Papert, 1993]. This emphasis on “making” and “building” tools gives the learning activities a general theme that resonates with how Illich believes tools should be used.

Conviviality also asks for a methodology that allows learning activities to emerge from learners, as opposed to being prescribed by the teacher. Here, I use an “Emergent Design” framework recently developed by David
Cavallo, which uses the practice of applied epistemological anthropology and an analysis of learning behaviors to both probe the existing skills and knowledge, and to identify the learning potentials of a learning community [Cavallo, 2000]. The following sections discuss each of these ideas and their relationships in detail.

2.1 Realization of the crisis

In the most general sense, Illich uses the term conviviality to create a realization of the destructive side effects of institutions that focus too much on growth and productivity. We live in a society that favors higher outputs, lower cost, and better equity though standardization. According to Illich, this industrial mode of production used in institutions such as education, health care, and transportation appears favorable at first. But over time they will quickly pass a critical point that will begin to create destructive side effects, or even work against its initial goals.

Automobiles

The growth of automobiles is a good example of Illich’s point. The car is one of the most remarkable inventions of human kind.
With this technology, people can conveniently and affordably travel greater distances than ever before. However, when personal automobiles became affordable for most people, it started to overwhelm other modes of transportation. Thus cars gradually became what Illich calls "radical monopoly." The following examples set the tone of what this phenomenon means.

In Chiangmai city of northern Thailand, personal vehicles (predominantly cars and motorcycles) have precluded city buses and other metropolitan public transportation. Only few bus routes survive and still operate today. Thus, it is not practical for most people to travel anywhere without owning a car or a motorcycle. The suggested solution was to produce more cars and make them affordable to more people by offering long-term installments plane. An economy car in Thailand would cost more than fifty times the standard salary of a person holding a bachelor's degree. The time it takes to pay off a car installment is often longer that the lifetime of the car itself. This burden does not include gas, tax, maintenance, and other expenses the car owner has to pay. Thus, people have to work harder to own cars. They end up in a vicious circle where a huge portion of their time are spent either working for a car or in the car itself.
With too many cars, traffic congestion becomes a problem. People end up spending more time traveling than ever. Take a large city like Bangkok as an example. In the past four decades, the number of cars in Bangkok has increased dramatically. The traffic congestion causes people to spend more and more time driving. An average driver spends anywhere between two to eight hours on the road each day. Yet driving seems to be unavoidable, as it has become the standard mode of transportation and there are no other preferred choices. Many children have to wake up as early as four o’clock in the morning to get to school in time. People often say Bangkok children grow in cars instead of in their home. Then there are other effects such as nose and atmospheric pollution that cars have created.

The Thai government attempts to solve the crisis by spending large portions of their budget on new highways. These highways not only failed to match the increasing number of cars, they make cars even more necessary, as only the people with cars have the privilege to travel relatively faster. This is an example of a feedback loop that is a result of a society that overly focuses on growth.
The School institution

Similar to automobiles, the school is an institution that has been put into the industrial mode of production [Illich, 1973; P.19]. Schools have become compulsory for most children. School learning has precluded most other possible ways of learning and has been accepted as the only right way to give children the knowledge they need for their future. It is clear that schools have become a radical monopoly. According to Illich, there have been harmful side effects resulting from schools, most of which are unrecognized.

When the modern school was established in the seventeenth century, it was the first time that seven or twelve grades of compulsory learning were proposed. It was believed that a blueprint could be designed so that every child could go through stages of development and could be transformed into a "new type of man who would fit into an environment created by scientific magic" [P. 19]. With this blueprint, schools could be replicated, which would make education cheaper, better, and available for all.

Schools have become an institution that transforms learning into a commodity called "education." Schools are carefully designed to put learners through multiple stages on an assembly line that is supposed to transform
them into gold. But no matter how hard schools tried, they always conclude that the majority of learners are unfit to be enlightened. Thus, most learners do not deserve the better life that the few good students would gain [P. 20].

When most people fail to be categorized as the elite, the A+, or the top ten, teachers and concerned parents react by imposing the only remedy they recognize: more schooling. For example, it is most likely for students in large cities of Thailand to spend one or two extra hours in special tutorial courses after school. Much of their weekend time is consumed by these tutorial courses as well. Vacations between semesters are becoming shorter. Students are spending more and more time in classrooms, but no matter how hard they try, most of them still fail to become the elite. As children's life style becomes more stressful, they continue to be blamed for their failures.

One of the worst consequences happens when the school imposes an ideology on students about what counts as learning. Those who succeed get their post docs along with all the glory while the school dropouts learn that they are incapable. Thus, other possible ways of learning are skewed in favor of "school education." When the school curriculum and its tests are all that counts, students are inevitably put into a role of mere consumers. Self-
motivated learning and exploration decreases. They soon feel they need to be taught in order to learn anything at all. This stereotype is what Illich calls “overprogramming” [P.57].

### 2.2 Recovery

Defining the crisis of the school institution is only half the picture. Proposing and shaping the alternatives is the true challenge. In this research, I present conviviality as one possible alternative that should lead to the recovery from the destructive effects that the overwhelmingly desire for productivity have created. I will begin by elaborating what Illich means by conviviality. Then, I will narrow the scope down to a practical level that is used in this research.

Illich believes that we must not allow the commodities we invent to shape our society. People should not be forced, consciously or not, to accept any single tool or service as the mean to archive a specific goal. Instead, people must have the freedom to use tools to “make the most of the energy and imagination each has” and to “make things among which they can live, to give shape to them according to their own tastes” [P. 11]. Thus, in the context of learning, schools must reverse their ideology from being a place that shapes the students
according to a predefined blueprint to a place that supports students to discover themselves and maximize their potentialities.

Though Illich has a strong view against school institutions, he does not reject everything in schools altogether. Rather, he suggests a watershed that the industrial system should not exceed. Conviviality provides an alternate route that defines the equilibrium.

Illich defines the necessary changes from two points of view: a political view and a practical view. For any institution to change, the managers and policy makers need to realize the crisis and commit themselves to finding a new approach that will lead to a different organization. In the context of schools, this commitment needs to come from teachers, headmasters, and up to the very top of the organizational hierarchy. This is not an easy request. There have been many attempts in the past that came in terms of school reform. But most schools have not changed (See [Tyack and Cuban, 1995]). This change in the institutional level is beyond the focus of this work. I focus primarily on the grass-root, individual development level.
2.3 Tools for Conviviality

Illich emphasizes that conviviality could be achieved through the use of convivial tools. Tools serve as a medium that a person uses to express and reflect him or herself in their society and “to the degree that he masters his tools, he can invest the world with his meaning; to the degree that he is mastered by this tools, the shape of the tool determines his own self-image” [Illich, 1973; P.22]. Convivial tools are “those which give each person who uses them the greatest opportunity to enrich the environment with the fruits of his or her vision” [P.22].

Illich uses the term tool broadly. It includes not only physical tools like hammers, drills, scissors, computers, telephone but also productive institutions that produce tangible and intangible (services like education) commodities as well [P.20]. The scope of this work is to provide learners with both physical convivial tools and a productive environment that nourishes conviviality.
In terms of physical tools, Ricky Goldman Segall concluded in her thesis that "conditions of a convivial tool are that it be accessible, easy to use, and beneficial to humankind" [Segall, 1990]. I use these definitions as guidelines for my work. However, I emphasize the need to make users fluent with a tool more than making the tool easy to use. Fluency in this context means more than the mere ability to use the tool. A fluent person should be able to transform an intuitive idea into the implementation of that idea using tools [Resnick et al., 1998]. This argument does not mean it is not necessary to make tools easier to use. I consider fluency as a better way of thinking about tools for conviviality than ease of use. A personal computer can be a convivial tool although it is not necessarily easy to use. But when a person is fluent with the computer, he or she could better use it to express himself or herself. Thus, fluency elevates the convivial relationship he or she has with the computer.

Accessibility points to tools that "can be easily used, by anybody, as often or as seldom as desired, for the accomplishment of a purpose chosen by the user" [Illich, 1973; P.23]. Students usually have a convivial relationship with computers that they own at home more than the ones at school. In schools, students are usually bound to use the computers only during computer classes and only for the purpose defined by the teacher.
On the other hand, computers at students' homes are usually more accessible both in terms of access time and purpose.

In the context of this work, tools that are beneficial to human kind are those that are used with good intentions. Knives can be used both in ways that are beneficial and ways that are threatening to other people. Without this guideline, a murderer’s knife may still be counted as a convivial tool. In this sense, a tool will be convivial when it does not deprive others from their liberty. In a more positive sense, convivial tools are those that are used “in caring for and about others” [P.11].

2.3.1 Constructionism and Digital Technology

Providing convivial tools to learners would mean nothing unless they also work in an environment that nourishes conviviality. It would be silly to believe conviviality would happen automatically when we throw convivial tools to the learners. There is a need for a framework that gives a good grounding that can lead to convivial use of the tool. Here I use Seymour Papert’s idea of constructionism. Though constructionism focuses primarily on how learning happens and how digital technology can enrich the learning process, it
also includes practical grounds for the learning activities that may take place as well. As the name confers, constructionism emphasizes on "making" and "building" personally meaningful artifacts. There are clearly overlapping ideas between constructionism and conviviality. In this research, I leverage the practical ideas along with some digital tools that have been developed and used in constructionist research, namely Logo programming language and Lego construction kits (see more details about these tools in chapter 4).

Computational technologies are particularly well suited for this kind of activity. Students can easily customize and modify programmable tools to serve the functionalities required. Computational tools can also serve as "object to think with" connecting students to ideas and knowledge domains desirable in the context of learning [Papert, 1980].
2.3.2 Making tools

This work has emphasized the construction of tools, not merely the use of pre-constructed tools. I suggest in the case studies that tool construction activities foster learners’ convivial relationship with their tools particularly well.

Similar to Idit Harel’s observation that “the best way to learn a subject is to teach it,” [Harel & Papert, 1990] I argue that the best way to master a tool is to build it. Learners will not only learn the body of knowledge embedded in the construction process, learners will also have the ability to apply and modify the tools to work in different applications as well, thus, maximizing learners’ development of their fluency with the tool.

When developing tools, it is, by definition, assumed that many users would use the tool. Thus, tool construction is a way that inherently makes that tool beneficial to others. In addition, when others use the tools, the toolmaker is likely to receive feedback that creates an intellectual feedback loop preferred in the context of learning. It can also enrich social interactions that further nourish conviviality.
2.3.3 Emergent Design

We now have the tools and the type of projects we want. The final piece needed for the framework is the method by which we can develop the projects. Here, I use “emergent design,” which is “a theoretical framework that emphasizes the practice of applied epistemological anthropology to probe for skills and knowledge that reside in the local learning community. It puts a spotlight on the need to study the conceptual space where the purposeful stance implied by the word design mates with the openness implied by the word emergent” [Cavallo, 2000].

I take for granted that emergent design is necessary and I build on top of it. In Cavallo’s thesis, he focuses on using emergent design to build applications. For instance, he worked with a group of villagers in rural Thailand using Logo programming language to think and visualize local agricultural issues. These issues include agricultural field layouts that take advantage of the topography of the terrain, water conservation and the efficiency of water delivery [P. 126-127].

In this research, I focus more on using emergent design to build tools. For example, students write programs that friends can use, they build computer controlled light switches
that can be used in many applications. By making tools, I believe the underlying philosophies, including emergent design, Constructionism, and Illich's notion of conviviality, will support each other and become most fruitful.

I propose that the learning framework formed by the ideas above can create a new practice of using digital tools in learning environments which will produce outputs that are much more meaningful for students than the traditional practice of instruction generally used in schools. Students will benefit from the development of self-image from convivial use of tools, the development of self-control from the process of transforming impulses into productive purposes guided by emergent design, and more personally meaningful knowledge gained from the constructionist approach.
3.1 The National Educational Act of B.E. 2542 (1999)

Thailand had come to realize that the future of the nation depends on the knowledge and the skills of their children. As the world is moving into the age of globalization and knowledge-based economy, Thailand recognized that their long rooted drill and practice educational system does not prepare their young generation for the forthcoming new world of economy, culture, politics, and society. Thus, Thailand’s first National educational act was promulgated in August 1999. It serves as the fundamental law for the administration and provision of education and training [Onec, 2000]. The general goal is to build people’s capacity to “kit pen, tum pen, rean-rue pen,” which is translated as being...
able to think, take action based on their ideas, and learn what is necessary for them.

The Educational Act sets forth an ambitious vision for the nation. The principles in the new framework reflect the need for profound changes in the provision of education and the administration of learning institutions. The following is a brief summary of the primary features included in the new act.

Education provision is based on three principles [Section 8]:

1. Life-long learning for all;
2. All segments of the society participating the provision of education;
3. Continuous development of the bodies of knowledge and learning process.

The organization of system, structure, and process of education basically calls for diverse implementations of education provision based on the local needs. This means the authority would be more distributed, providing freedom to define the learning content, methodology, and assessment [Section 9].

Although the new educational act gives an ambitious outline of a superior education system, it does not provide a concrete guideline for how such a system could come about. The act consists of nine chapters, most of which focus on establishing the law required for the administration and management of the
new education. Only chapter four focuses on the reform of the actual education provision itself. It broadly states that education will be based on the principle that “all learners are capable of learning and self-development, and are regarded as being most important” [Section 22]. No practical outline existed about how the preferred learning environment could come about.

Because all schools in Thailand have to change in accord to this new act, much debate about the practicality of the new act have been generated. Some see the new learning environment merely as the escalation of the current school-practice. That is, to invest more effort and resources in teaching. Some others view student-centered learning as a softer or in-direct approach of introducing a subject to students. For instance, the following is a teaching idea suggested by a first-grade teacher:

When I step into my first-grade classroom I would say “Hello students, should we go for a field-trip today?” Of course, the students would say yes and start suggesting places they want to go. I would then gradually persuade them to go and look at the flowers and trees in front of the school. I know there would be something from the trip that I can teach them. Students would eventually follow what I teach [NEC, 2000; P.24; translated from the Thai original].

There have been many other similar ideas presented. Though they are, in some ways, better than the traditional approach, they all fall not far from the traditional system. The
3 - Context

traditional ideas of teacher-defined curriculum, teacher teaching, and standardization are still dominant.

3.2 Project Lighthouse

Initiated collaboratively by the Suksaphatana foundation and the MIT Media Laboratory in 1997, project lighthouse aims to develop more profound ideas about learning. The goal is to “break mindsets about what education must be by providing concrete examples” [Cavallo, 2000]. Project lighthouse is based on constructionism as a learning philosophy. Similar to the educational act, constructionism views the learner as the agent who constructs his or her own knowledge. Thus, in both cases, the learners are considered as most important. However, project lighthouse introduces radically different approaches both in the learning organization and in the actual learning environment. Here are some examples:

In terms of organization, there is an emphasis on eliminating subject, time, and age segregation. The learning process happens through personal or group projects, special attention is invested in developing examples of ideas like how teachers can work collaboratively with students, how students could learn not only the knowledge-content but
also acquire problem solving, planning, and researching skills. Pilot sites have been created in the areas of non-formal and formal education, rural development, and teacher training.

In addition to the learning ideas above, there is a strong emphasis on using digital technology as a learning tool and an incubator of the education paradigm shift. For example computers are used not to merely teach computer software, but to mediate knowledge to students in an engaging, personally meaningful, and joyful manner. Students construct their own projects like games, stories, and drawings with the computer. The dynamic and interactive nature of the computer environment allows students to receive feedback resulting from their ideas. It allows things to go wrong in a way that does not punish the students, but, instead, engages them to debug and get their project to work. Through this process, students not only learn the knowledge required to finish their work (e.g. geometry or variables), but also learn the skills necessary to pursue their own ideas.

Computers also often lead to desirable changes in the learning environment. Changes happen both with the students and with the teachers. The highly responsive nature of computers engages students in their own learning activities in a way not usually seen in regular classrooms. Thus, the quality of
knowledge learned and students’ relationship with the term “learning” are profoundly deepened. On the other hand, computers may affect teachers and how they operate the learning environment. For instance, students usually learn the computers faster than the teachers. Thus, teachers’ mentality of knowing more than their students and being able to answer all questions is not sustained. The role of the teacher needs to change. Teachers, in many cases, may learn from students; they can play the role of a facilitator, using his or her mature experience to push students’ projects forward, make suggestions of how a problem could be solved, and connect the students’ project to related knowledge domains.

3.3 Lumpang Circuit

In Lumpang province of northern Thailand, a group of eleven primary schools in the Maeta sub district started collaboration with the Lighthouse’s Constructionism Lab and the teacher training college to create example of learning programs based on the ideas presented above. The unique strength of Lumpang circuit is the connection between four supporting parties.

1. The constructionism lab. The lab provides support in terms of
equipment (e.g. Lego Mindstorms, digital cameras, lab space).

2. Suksaphatana foundation. The foundation supports some schools with computer labs and Internet connection.

3. Teacher training college. The collaboration leads to the preparation of the new generation of teachers who will become future facilitators equipped with the new educational ideas.

4. Maeta district primary school supervisors. The supervisors provide the school with full support from the administrative level.

3.4 Tongtip School and the Sarnfun Project

Tongtip is one of the most active Lumpang circuit schools. It is located approximately twenty kilometers from Lumpang city. Tongtip is an extension school. That is, it offers secondary education (grades seven to nine) while it holds a primary school status. Tongtip is located in an agricultural community. Like most other agricultural communities in Thailand, rice is the dominant crop grown.
Lead by Ajarn Sawat, an English teacher and a highly regarded activist in the school, the school reorganized a computer lab and formed a learning program with a group of eighth grade students. Because of Ajarn Sawat’s technical skills and his personal interest in computer technology, he was able to push forward students’ projects to reach a relatively greater depth than in other Lumpang circuit schools. His enthusiasm also led Tongtip School to move one step forward by planning a whole school reform effort. Suksaphatana foundation provided the school with additional eight computers and an Internet connection.

A rather remarkable outcome became evident when some students enjoyed the experience with the technology so much that they want to pursue a career in the computer industry. These ambitions are not common for students who live in a rural agricultural community. That was when the "Sarnfun sai sai hai pen jing" (translated as "making a glorious dream come true") project was started (we call the project Sarnfun for short).
I based my research on the Sarnfun project for a couple of reasons.

- The ages of the students were suitable for the types of projects I had in mind (using the Lego Mindstorms's RCX brick and making electronic circuits).

- The students are familiar to the computational tools normally used for project development. They have used the computers for more than a year. They have experience with Logo programming language. I was able to push forward the technologically rich digital technology for conviviality.
learning environment to produce useful project examples and learning stories for other sites.

- The constructionism lab could provide support in terms of digital tools, lab space, and human resources. I was able to use the lab facilities to introduce digital video editing to the students. There is a sufficient number of Lego Mindstorms available. Also, three researchers assisted me with project development, data collection, and transportation, during the five-week Sarnfun learning activity.
After months of preparation, the time had finally come to start my research fieldwork. Refreshed from a two-week vacation with my family, I set off from Chiangmai, my hometown, to Lumpang province. I had organized a five-week after-school learning activity with a group of eighth-graders at a public school, Tongtip, located in Mae-Ta district of Lumpang province. I went to Lumpang one day before the activity began to make sure I had enough preparation time with Dr. Suchin Petcharugs, my main coordinator of this learning activity and director of the Constructionism Lab at the Northern Region Non-Formal Education Center. Unfortunately, Dr. Suchin was away for the day. However, I talked to him on the phone and he said everything was organized. He arranged three researchers, Nung, Aek, and Ore, to help me throughout the five-week activity.
I went to Tongtip School in the afternoon to meet with the principal and Ajarn Sawat, my coordinator at the school. The principle gave me a warm welcome and confirmed that they were excited to host this activity. Their motivation is driven primarily from the need to experiment how technology could be used to support the new education act (as described in chapter 3). Originally, more than twenty students wanted to join this activity. However, we decided to keep the group small, which would allow closer observation of each student. So, we reduced the number to ten (though by the second week, three more students joined).

The Suksaphat foundation supported a lab with fifteen computers in early 2000, some of which are networked and could connect to the Internet though a modem. Tongtip had some power drop problems, which had already destroyed power supplies in some computers.
Luckily, Ajarn Sawat knows how to fix and maintain computers. He managed to keep most computers running throughout the five-week activity.

4.1 The First Day

It was an exciting day for everyone. I arrived at Tong-Tip school around 15:30 and found that all ten students were already waiting. They started to giggle as I walked in. I knew some of the students before and have even been in e-mail contact with one of them. The students were not sure what they would be doing in the coming weeks. I did not want to give them a feeling that they were in a school class or a special training program, which I felt was the general impression of the students. So, I told the students that this activity is an after school club. They should feel comfortable to come and leave as they wish. They could work individually or in groups. They could work inside or outside the computer lab as they want. My goal was to make the environment as casual and relaxed as possible. I can, then, get to know the students, see what they had already done, and start developing project ideas from there. Hence, I was building a convivial learning environment from the very beginning. In order to reach into students’ potentials, it was important that students did not feel obliged to join or to do a specific task imposed by the teacher. This is the reason why I made the Sarnfun project an after school activity and did not make it compulsory.
However, I felt that the students were not sure what I meant. They were waiting for me to do or teach something. I soon realized that I had to start working on projects right away. I had a few Lego Mindstorms sets with me. So, I opened the boxes and invited students to join me. Meanwhile, I made sure I mentioned to them that not everyone had to stay. Students who are not interested in Lego are free to work on other projects. Since it was their first experience with Lego Mindstorms, all the students were interested and wound up playing with Lego. Everyone enjoyed making cars, adding motors, and making the cars run. I took that opportunity to talk to students and to get to know them better. The first day was a success! We were able to get past the traditional ways of teaching and learning.

### 4.2 Ideas for Children’s Day

While we were playing with Lego, I was reminded that the coming weekend was Thailand’s children’s day. I noticed that the students were excited about it and were looking forward to the school’s children’s day festival on Friday. There would be no classes. Instead, there would be games and sports for the students to play. I felt it would be a great event for which students could make projects. So, on the second day, I suggested to the students that we could build something for children’s day, something
that other students could enjoy. The students liked the idea. After a short discussion, we concluded that we would divide into three teams, each making a game. The students formed groups and went off to talk among themselves about projects they wanted to do. I decided to make my own game as well. I wanted the students to see that I was not there just as a teacher or supervisor. It would also allow me to demonstrate new tools that I had. It might capture a few students’ interest and lead to new projects. The practice of a teacher working on his or her own project together with the students also sets a different tone to the learning environment.

The first group had two members. They decided to build a Lego car and a controller for it. Lek, 14, said she saw other junior students wanting to play with the Lego car she built the day before. So, she wanted to make a better car and give everybody a chance to try. I happily agreed and started to ask about what features she and Tan, her partner, wanted the car to have and how they would implement the ideas. The first functionality they wanted was obviously to control the car so that it could move forward, backward, and turn.

The second group had six members. Although the group seemed too large and I had suggested that they break into two groups, they insisted on staying together. After their meeting, the group decided to create a Dance game, which would imitate a, at that time, famous arcade
game called “Dance Dance Revolution” (Figure 4-4). The basic idea of this game is to make the player dance by stepping on floor mats following the sequence and rhythm seen on the screen.

I was not so sure whether making the dance game would be a feasible idea. Though the students were thinking of simplifying it by using the keyboard instead of the floor mat, the game still sounded too complex for them to finish within two days. However, they were determined. So, I did not say anything against it. Ore, one of the research assistants from Lumpang Constructionist Lab, offered to help me facilitate this project. I suggested to Ore that she should discuss with the students how to divide the program into smaller parts and, may be, try to simplify them. I was worried that they might lose their confidence if they could not get the game working on time.
Figure 4-4: Dance Dance Revolution.
This arcade game was extremely famous among teenagers. Driven by
dance music, the player has to step on four different arrow mats
following the sequence showed on the screen.

The final group had two male members: Non and Pan. They did not come up with any
ideas at all. They felt left out, as they did not feel
fit with neither the all-girls dance game group or
the Lego car group. So, I offered them to help me
with my game. They agreed, though without
much motivation. I could see that they were not
so excited about the whole children’s day idea.

4.2.1 Saving the Princess

Since I had to build my own game, I
wanted to utilize the opportunity by making a
project that uses a tool that the students have
not seen before. In this case, I wanted to use the Go-Go kit: a new tool that I had developed. The Go-Go kit basically provides a channel for Microworlds to sense and control the environment through the Lego Mindstorms’s RCX brick. The general idea was to use my project as a mean to introduce the tool to the students.

To make the game interesting for young children, I made up a story to go with it. The player would imagine himself as a prince who has to save the princess from an evil king. The princess awaits the prince in a cage that is hanging on a piece of rope. The evil king could destroy the cage by burning the rope and let the cage fall to the ground. A fire would gradually move upwards until it reaches the rope. The prince has to stop this fire before the princess falls.

With the general story set, I initially planned to create the prince as a character in a computer game created with Microworlds programming environment. The princess, on the other hand, would be represented by a doll hanging on a piece of rope in the physical world. The player has to win the computer game in order to save the princess. A candle controlled by a Lego mechanism would, if not stopped by the prince, eventually burn the rope and the princess would not survive. The two parts would be integrated with the Go-Go kit.
4.2.2  A New Game Emerged

Non and Pan were not so impressed by my game idea. I was not surprised, as the game was totally my idea and they did not have a clue how the game could be implemented. However, they wanted to contribute to the children’s day activity. So, they offered to help me design and build the Lego mechanism that would lift the candle.

Just when I was about to program the Microworlds game, Lek who had overheard the details of my project, came up with an alternative game suggestion. Lek thinks the game would be much more interesting if we used her Lego car to represent the prince. That is, the players would maneuver the Lego car and trigger something to stop the fire and save the princess. I remember myself being so excited about the idea, as it truly made more sense to everyone. Lek’s idea would put her Lego car into a story context. The game would suddenly have a character and a mission for the players to accomplish. It would also lead to interesting and open-ended questions, as we would need to think about how the car could stop the fire and what would indicate that the princess has been saved. I was happy with this new game idea, though it meant I would lose my opportunity to use the Go-Go kit altogether. But to me, getting students to suggest and work on their own ideas was more important. After all,
my focus is on student-driven projects not teacher-driven ones.

After spending some time discussing ideas about the final implementation of the game, we came up with the following plan:

- The Lego car would carry an RCX brick on it. The brick would constantly send an infrared (IR) signal as a "key" to stop the fire. Though the students have used infrared before (for example, in remote controls), this was the first time that the idea of using an IR signal to transmit data was demystified. The students were learning to use concepts that are usually exposed only to engineering students.
- A second RCX brick would control Non and Pan's mechanism, which periodically raises the candle and would stop only when it receives the IR "Key" from the Lego car.
- The princess would be tied to a rope. The rope would be wound through pulleys to a motor also controlled by the second RCX.
- When an IR "Key" is detected, the second RCX would stop the candle and lower the princess. The Lego car must catch her before she reaches the ground.
Releases the an IR key
The first RCX in a Lego car would constantly send an IR signal (key) to stop the candle and lower the princess

Motor

The Candle will eventually burn the rope if not stopped in time

The princess

Controls the movement of the candle

IR Key

Second RCX

The first RCX in a Lego car would constantly send an IR signal (key) to stop the candle and lower the princess

Figure 4-7: The game plan
Lek and Tan were responsible for the Lego car, while Non and Pan were in charge of the mechanism necessary to control the movement of the candle.

4.2.3 Depression

Just when we were starting to make the game, I noticed that Tan had lost his interest with the Lego car. I was surprised because I remembered seeing him motivated during the first day. When I asked Tan how he was feeling, he told me he does not enjoy using Lego. He preferred to go back to programming. Although he still wanted to be part of the car project, he kept his distance. Lek remained active with the construction of the Lego car.

Non and Pan were not motivated as well. At that point, they were doing the project just for the sake of having something to do. The fact that they were not familiar with Lego made the situation worse. On top of that, thinking about
how to implement the candle mechanism was an open-ended question. There were no instructions to follow. It was clear to me that they did not know how to tackle the problem. I tried to make them feel more comfortable by helping them divide the project into sub-tasks. I introduced them to Lego gears and how they could gear-up or gear-down the motors to increase or decrease rotation speed. I hoped these ideas would give them schemes for building the structure. However, both of them were very passive and quiet. At that point, I was not sure how successful the project would be. Three out of four students were not motivated. The situation was awkward.

4.2.4 Recovery

The twist came when all the game pieces started to work together. Non and Pan programmed an RCX brick to periodically turn on a motor, which lifts a candle upwards slowly. Lek tested her car and figured out how much time the player should have before the candle burns the rope. Everything started to come together. I was surprised how Non and Pan changed. Now, they want to make their project work! They started to talk and respond to my questions and ideas. When their Lego mechanism broke, they created a more stable motor and gear structure. The environment changed. Ajarn Wiratchai, the school’s science teacher, who was helping me that day, initially did not want to stay later than six o’clock. But in the end, he also got interested
and stayed with us until the very end (around seven). I was both amazed and relieved by the attitudinal change.

### 4.2.5 Showtime: The children’s day

On children’s day, I arrived at the school early in the morning. The students were already waiting for me. The festival was held at the school’s primary education department located half a kilometer away. We took two computers and the Lego structures we had made over to the festival. The teachers arranged a space in a cafeteria for us to show our work. The setup process was fun and every student contributed.

Non and Pan had arranged a wooden desk for their Lego game. We actually did not have time the day before to test the whole system. So, everyone was anxious to see whether everything would function as planned. Non hammered a nail to the desk (point 1 in figure 4-9). Pan taped the motors in place (point 2 and 3). They both continued working quickly on the remaining parts. We got all the elements in place and ready for testing within half an hour. Lek had some problems with her RCX and discovered that the batteries’ power were low. Luckily, we had some extras for her. We reprogrammed the RCXs and ran the first test.
Figure 4-9: Final implementation of the game

When received the IR key from the Lego car, the second RCX would stop the candle by turning off the motor at point 3. Then, it would turn on motor at point 2, which would lower the princess. The Lego car has to catch her in time before she hits the ground.

After the test, we discovered that two crucial parts were not functioning correctly. First, the rope that was supporting the candle was winding on the two axels differently (point 3 in figure 4-9), causing one side to move up faster than the other. As a result, the candle tilted while moving upwards and would eventually burn its own supporting ropes. The other problem was that the candle was not aligned to the rope it was supposed to burn. Thus, even if the candle had made its way up to the top, it would not burn anything. With these two bugs, we had a game in which the evil king not only fails to kill the princess but also tends to burn himself down.
Figure 4-11: Fixing the bug.

(Left) Pan, Lek, Non, and Dr. Suchin (From left to right respectively) thinking of how to solve the problems the game was facing. (Right) Pan adjusting the motors.

As time was critical, all three students dived in and tried to solve the problems. I jumped in to help them too. For me, it was a wonderful time. The situation was totally different from when the group started working on the project. Now, the project had real meaning to them. Non and Pan are not doing the project just to have something to do anymore. The questions and problems are still open ended, but that did not matter any longer. The way they were thinking about the problems was probably as intuitive and spontaneous as the way they would think about other issues in their daily lives.
Figure 4-12: A successful game

Children gathered around the game area hoping to get a try. The game was easy to play and had an interesting story, which led to its success.

After tweaking the system for sometime, we finally got the game to reasonably function. So, we asked the schoolteachers to make an announcement inviting children to come and play. It did not take long before the cafeteria was filled with curious children. Since it was not obvious how the game works, Lek had to tell the story and explain the rules to the crowd. She was nervous about this unexpected task but she managed to do a good job. Speaking in public is a not a small act for students in the Thai culture. Thus, it was a significant accomplishment for Lek that day. Everyone enjoyed the game, including a few schoolteachers who were there.
4.2.6 The Dance Game

The dance game was a great success as well. The game was already finished the day before the festival. I was completely wrong to think the game was too complex. I was thinking in traditional computer science terms, where every problem should be implemented with the best data structure and algorithm. Instead, the students (of course, with Ore’s support) had much simpler ways to implement what they wanted while maintaining a joyful game experience. For example, the most difficult aspect of the game to me was the synchronization of the game play and the music. I could not imagine how the students could ever implement this function. It would be a challenging task even for a fluent computer programmer. However, the student made the game work without caring about this synchronization at all. That is, the key sequence a player has to press had no relation with the music whatsoever. The game was still perfectly playable and was indeed enjoyable. The mindset I had from my computer science experience blinded me completely from thinking differently about how problems could be solved and how some problems are, in fact, not problems at all.
4.2.7 Reflection

From the number participants we had and from the laughter of the audience, it was clear that everybody enjoyed the games. Though there were some difficult moments, all turned out well in the end. This first week alone reflected at least three important aspects of the convivial learning framework. Ironically, they all come from cases where students felt unhappy with what they were doing.

A. First Reaction from the Students

When implementing a new learning environment, one of the first difficulties is what to do on day one. In my case, though I described to the students how the format of the learning activity would be, the students simply did not know what to do. Here, there is a parallel with the educational act that defines how the learning environment should be, but schools were stuck not knowing how to start implementing the new learning environment.

The case study that I have presented suggests that there has to be a context or a goal built concretely enough to motivate the changes to take place. My first day in Tongtip School was a success because we played with Lego. The students were new to Lego. Thus, students’ motivation that day was to fulfill their curiosity of the new tool. However, this kind of motivation
fades away quickly. It is similar to the case where a child gets a new toy. If there is no other motivation added to the use of that toy, the toy could quickly become boring. Based on the constructionist approach, developing projects is, in this context, a means to sustain learners’ motivation. Construction tools are beneficial in this sense, as they support a wide range of project ideas.

Another source of learners’ motivation is context for which the constructed artifact would be used. In my case, students were motivated to build a game for the children’s day festival. This motivation was what kept that learning environment going. Combining this motivation with the project that the students developed, the students were sufficiently engaged in the activities of the new learning environment.

It was clear that by constructing artifacts (the Lego mechanism to lift the candle) and putting them into a meaningful context (children’s day festival), Non and Pan were able to eventually immerse themselves in the project. Non and Pan’s example evidently proves that a constructionist approach is preferred in an environment promoting conviviality.
**B. Source of Authority: An Equilibrium**

I have shown many examples of how I changed the way I was thinking or planning about projects as new (and sometimes conflicting) ideas emerge from the students. It clearly shows how I value students' ideas. I sacrificed the chance for me to introduce the Go-Go kit for Lek to use her Lego car as part of the game, I respected the dance game group’s decision not to divide into a smaller group, I let the dance game group continue working on the game even though I was not sure whether it was a feasible game to build, and I respected Tan’s decision not to work with Lego. These are all practical examples of emergent design. When we emphasize on reaching into each learner’s potentialities to make the most of his or her energy and imagination, it is not possible to maintain a system that imposes learners with predefined activities or with teacher centric decisions.

However, an emergent environment does not mean everything goes. I had my own integrity of what was happening as well. When the prince game did not work properly on the children’s day, my role changed. I became much more active, less opened to students self exploration, as we needed the project to work. I was instructing how gears work to Non and Pan in a way similar to the teacher-teaching approach. However, the instruction was context driven to supply what was needed.
These examples show how conviviality defines the equilibrium between the traditional practice in schools and its extreme opposite. For many people, when they are exposed to ideas of alternative education, the new education has to avoid everything that happens in the old school. This is the case that John Dewey calls an Either-Or philosophy [Dewey, 1938]. During the time when I was working with project Lighthouse before coming to MIT, I have experienced situations where people would say teachers must not interfere with the students’ learning activity, as it is good if the child is having difficulties because they are learning how to cope with such situations. To some degree this argument is true, but not to an extreme. Sometimes we swing back from the traditional school so much that we become too anti-schooling.

An example of the equilibrium is how Non and Pan’s learning experience developed from an idea that did not belong to them. On one hand, I would prefer projects that come from students’ own ideas. On the other hand, I could not leave them alone until they came up with their own ideas. Given the situation where neither Non or Pan were familiar with the tools and the learning environment, I made a decision to push them forward with my project idea. But while the idea was mine, the type of activity remained open ended. I did not tell them exactly how to build the Lego mechanism. In fact, I was not sure myself how to make the structure work. I introduced them to ideas of using gears, pulleys,
and motors that I believe would be useful for them. But, it remained Non and Pan's project to make the mechanism work.

C. Tan's Resistant to Lego

Tan, who stopped working on the Lego car after the second day, told me that he does not like building physical structures. “Lego is not my thing,” he said. He prefers programming. I told him that it would be okay for him not to work with Lego if he is not interested. But, one can argue that Tan avoids things that he does not like, which is not the way things are in real life. I agree with this argument in some ways. It would have been better if Tan had not left the project and if he had helped Lek to finish the Lego car. However, forcing Tan to work on the project would definitely have been a mistake. The little more work gained would come at the expense of Tan’s personal freedom and my peer relationship with Tan. Thus, it would not lead to a convivial learning environment. This is a dynamic tension that was mutually irresolvable. However, later on when Tan works with Visual Basic projects, it would become evident that supporting Tan's personal preference is a preferred choice.
4.3 An Introduction to Electronics

As we started the second week, I focused on developing new project ideas. One strategy I used was to introduce new tools that could lead to new projects areas. I was interested in using electronics to build sensors to control external devices (e.g. light switches). The existing RCX brick serves well as a processing unit, but it has been used mostly with projects that involve robots, cars, and a few other types of toys. The input-output devices are limited to the ones provided with the Mindstorms set. I wanted to extend the scope of possible projects. The following is a summary of the key ideas that I had:

- Use the RCX brick as a general computer for projects that are not just related to Lego construction (e.g. robot, car).
- Work on projects that involve thinking about making one’s own sensor.
- Introduce new output devices. I focused on attaching the RCX bricks to relays (Figure 4-13). Relays open up a wide range of projects, as they can turn on or off any high voltage electrical device.

I announced to the students that I would demonstrate a new tool and those who are interested could come and look. I did not force all students to come, as I knew not all of them...
would be interested. However, all students decided to join the session. I started by showing them a basic LED circuit using a 9V battery. The circuit consists of an LED and a resistor. Then, I replaced the resistor with a potentiometer (a variable resistor). I showed them how light intensity of the LED changed when I altered the resistance. At this point, a few students dug out the components from the toolbox and replicated my circuit. I, then, replaced the 9V battery with the RCX. I programmed it to toggle the on-off state of the output port every one second. This program made the LED blink. Subsequently, I introduced the relay and talked about how it can control lights bulbs, water pumps, and other electrical devices. I drew the necessary circuit on the blackboard and started to use electronics symbols and vocabularies. The intention was to create a language for the students to talk about circuits. The session took about half an hour. Some students continued playing with the circuits and some went back to Microworlds.
The next day, I discovered that only three students (Lek, Non, and Khomphet) wanted to work with electronics. Though I had hoped for more, three were sufficient to start on a project. We talked about projects ideas. I knew that most students live in an agricultural community. So, I assumed that students would be interested in projects that related to their farms or crops. Thus, if our discussion leads to some interesting issues or problems that they or their parents were having, it could provide an ideal area in which to develop projects using sensors and electronics. The projects would be engaging, contextualized, and beneficial to both students themselves and to their community. Though this assumption was not totally wrong, I learned that my assumption did not quite match the reality.
4.3.1 A Disappointing Project

After spending some time with the students, I realized that the conversation about agricultural projects was not going so well. I did not know much about what crops or farms they had at home and the students did not know what to say about them. Talking about how to use the RCX and sensors with agricultural problems seemed so abstract and alienating to them. I realized that it was never the students’ role to suggest ideas about agriculture to their parents. Thus, the situation was difficult because I was trying to suggest ideas that not only go against the school culture but the local culture as well. After some time, the students proposed that they want to work on a door alarm system. They wanted to monitor the computer lab’s entrance so that when someone would try to break in, an alarm would go off.

I did not like this idea. Compared to what I was expecting, the door alarm project sounded so uninteresting to me. It seemed like a typical school project, a project that is totally unrelated to the students’ lives. Why would they want such a system? The project would never find a practical use anywhere. I tried to broaden the students’ ideas, but they felt most comfortable with the door alarm project. I did not want to push them too hard. So, I agreed with the idea. I took the project on as a short-term experiment that would help the students develop their
fluency with the tools. Then, hopefully they would move quickly on to something else.

### 4.3.2 Planning the project

We started the project on the next day by talking about features that the students wanted to include in the alarm system. I asked them what would happen when the door opened. I started to feel a tension in the conversation. My presence made the students feel uncomfortable. They were extremely quiet and passive. They eventually came up with a few ideas, but the conversation was more like "the teacher asks and the student answers" than a discussion. I felt I was intimidating them too much. So, I decided to

![Figure 4-15: Group discussion](image)

The students were extremely passive whenever I tried to talk about projects ideas. Though they were interested in the project, they felt uncomfortable thinking about open-ended questions like what features they want to have, who wants to do what, and how they should start. This is true specially when I was present in the conversation.
I went back a little later to see how they were doing. Lek said she wanted to turn on the computer lab’s main lights when the door opened. I asked her how she was thinking of doing that. The students pointed to a power breaker. I went over to observe it and found that that switch was large and stiff. The students asked me whether they could use the relays to replace the switch. In this case, using relays was not practical, as the power level was too high and we did not want to mess up the school’s electrical capability.

I suggested that one possibility would be to create a Lego structure that would provide a pull strong enough to snap the switch. It was an interesting challenge for the students. I tried to push the ideas forward by asking how they thought they could make sure that the Lego structure did not fail. Lek suggested that she could use a light sensor to detect the success of the Lego mechanism. If the light sensor did not detect an increase in light intensity, it would indicate that the light mechanism had failed.

Then, I asked what they would do if the lights failed to turn on. That was when I felt the tension once again. The students were quiet and it almost seemed as if they felt guilty not being able to answer my question. I found it hard to

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engage them into a discussion when the only thing that mattered was what I said, not what we were thinking collectively. I did not blame them, as they grew up in an environment where teachers have the dominant authority over what matters.

Figure 4-16: Door Alarm System
This diagram shows how the system was designed. The RCX would monitor the door sensor. If someone would try to enter the room, the RCX would turn on the lights in the room by initiating motors that are arranged to snap the light breaker. The Light sensor then tells the RCX whether the first mechanism had failed or not. A backup system (consisting of a light bulb and an alarm) could be activated by triggering the relay.
I gave them some time to talk more among themselves. We finally came up with an idea of creating a backup alarm system that would turn on a light bulb and make a loud noise if the first Lego mechanism fails. The project turned out to be considerably more complex than I had anticipated. Everybody was satisfied with the ideas, including myself.

4.3.3 Komphet

Komphet was one of the students who worked on the door alarm project. He was not originally part of this learning activity. He only joined us in the second week. Komphet did not do well in school. In fact, I heard from a teacher that Komphet is the kind of student that teachers would give away grades just to help him get through school. He is an orphan and lives with his aunt in a house without electricity. When I visited his house and talked to his aunt, she complained about how badly Komphet performed in school. She did not think Komphet would be able to accomplish anything significant for his life. After he finishes middle school, Komphet’s aunt wants to send him to work at a friend’s garage in Bangkok city.
My experience with Komphet is totally different from what I heard from other people. I first met him at the children’s day festival. While we were setting up the Lego game, he was hanging around and was very interested in what we were trying to do. He was particularly interested in the Lego car. He saw that we were busy trying to setup the game, so he offered to help with other parts that we did not have time to handle. He also lined up the children and taught them how to control the car. He fixed the car when parts fell off. By the end of the day, it seemed as if the car belongs to him. To me, his enthusiasm made him one of the most outstanding students. I was surprised to hear the opposite opinion from the schoolteachers. I decided to invite him to our evening activities. Luckily, he did come. The door alarm project was his first project.

As we started to implement the door alarm system, Komphet chose to work on the
Lego mechanism that would lift the breaker switch. I recommended that he should start by playing with the motors. First, he tied a piece of rope to the rotating axle of a motor. He tied the other end of the rope to a dummy load. As the motor turned, it wound the rope around its axle, providing a lift. The single motor obviously did not provide enough force. He quickly chained three motors together. But, it was still not strong enough. At that point, I knew it was time to introduce him to gears to increase the force. In fact, I knew from the beginning that Komphet would need to use gears. However, instead of telling him from the beginning, I waited. I knew that the situation would be instructional by itself. I put two gears with different sizes together and showed him that when a smaller gear drives a larger gear, the larger gear will have more power. I added that it is the same idea used in bicycles. Almost instantly, he got the idea and was able to apply gears to his mechanism. I could tell he understood the idea by looking at how he optimized the gear ratios. He used Lego’s smallest gear to drive the largest gear. This arrangement produces the most power. After testing and trying for sometime, he finally came up with a design that he believed was strong enough. Here again, I did not see him the way other people had described him to me.
Figure 4.18: Komphet’s first Lego Construction

I was amazed how fluent Komphet was in putting together the Lego pieces to test out his ideas.

At the end of that day, all students gathered and talked about what they had accomplished. I invited Komphet to talk about his work. He was nervous and did not know how to react or what to say. But, I could see that he knew he has something good to show. Again, make in a presentation in front of people is a significant accomplishment in a Thai culture, as it does not happen very often. Komphet finally decided to talk. After the presentation, Komphet realized that his friends acknowledged his work and thought he did a wonderful job. It was a special moment for Komphet. A school-defined dumb kid receiving this kind of regard for his intellectual accomplishment is rare. Many of Komphet’s friends are perceived as clever students in the school. Though I do not know how Komphet really felt that day, I know he

Figure 4-19: Komphet’s presentation

Though extremely nervous, Komphet made his presentation and received a big round of applause from his friends.
views himself differently in terms of what he is capable of and what he feels able to accomplish.

### 4.3.4 Lek and Her Electronic Tool

While Komphet was working on the light breaker mechanism, Lek developed an RCX-controlled switch using the relays. She needed the switch to control the light bulb and the alarm used in their backup system. Lek had experimented a relay circuit before during the first electronic session that I gave. She started with the most obvious and simple design. That is, she inserted the relay in between the power outlet and the device she wanted to control (shown in figure 4-20). However, this design constrains the use of the relays to the particular device it is attached to. With small modifications we can build a general-purpose switch that can be used with any device. With an emphasis on developing tools in mind, I introduced the idea to Lek. With assistance from Nung, a research assistant, who has a background in electronics, Lek reconfigured the circuit by attaching the relay to an outlet. She mounted all the components on to a wooden board (figure 4-21). We wound up having a general-purpose computer controlled power switch. This switchboard turned out to be a very useful tool. It would be used later on with Lek’s fish farm project.
The development of the switchboard reflects the methodology I used student’s projects to suggest the idea of making tools. Though my research emphasizes making tools, I did not tell students to do so directly. Instead, I kept the projects as diverse as possible and, while working together with the students, let the tool-construction idea emerge from the situation itself. When I introduced the switchboard idea to Lek, she saw how useful the switchboard would be. If I had tried to convince her right at the beginning, the idea would most likely have been too abstract for her to understand the value of the more general design. Moreover, the tool I suggested might not have been the switchboard, as it is difficult to foresee what an appropriate tool for a project will be. More examples of tools that were developed through this “emergent” methodology are discussed in other case studies throughout this chapter.

4.3.5 Changing Plans

Everything was going well until Komphet discovered that the power breaker did not actually control the lights in the computer lab. Instead, it controlled the power supply to the computers. The actual light-breaker was located two rooms away, and was much stiffer than the power supply switch. This fact was a nightmare for everyone. It was no longer feasible to turn off the main lights, which meant a redesign of the...
whole project. At that point, the project was getting much attention from the schoolteachers and they wanted the group to finish the project in time for the Mae-Ta district science exhibition. The exhibition was only one week away. Everyone felt the pressure and redesigning the project was discouraging.

The redesigned system was much simpler than the original. We decided to use the relay-controlled lights and siren as the primary alarm. We did not feel the need for a backup system, as the relay mechanism would be reliable enough. I felt sorry for Komphet because his Lego mechanism would not be used anymore. However, we came up with a substitution idea for him. We decided to place a camera in the system that would take a picture of the burglar while he or she attempts to break in. Therefore, we needed a Lego mechanism to snap a picture. I was relieved thinking that this would keep Komphet happy.
4.3.6 A Mistake

Because time was tight and I was concerned that the Lego mechanism for the camera would be too complex for Komphet to develop all by himself, I decided to make a semi-functional model for him. I hoped that it would give him a solid start. I thought it would keep him from losing interest in the project. I was wrong. Having a pre-implemented model turned out to be alienating to Komphet. While I was showing him the model, he said to me “You made it because you know I can’t.” I was not sure whether it was a question or a statement, but it made me felt like I had been caught.

Komphet acknowledged the model, but he never treated it as his own work. Though the mechanism was not fully functional, Komphet did not want to improve it. He eventually abandoned it altogether. I soon realized my good intention was a mistake. I was offering too much help too soon. An open-ended design challenge had become a clearly defined task, a task like the ones Komphet receive everyday in school, like the ones that he fails so often. I do not claim that suggesting ideas is wrong. My approach might have worked for many other students. However, for Komphet what was important was not finding a solution or an easy way of doing things. Rather, it was the freedom and respect that he received to express himself as a capable person.

Figure 4-23: A Too Complex Lego Structure for Komphet?
I proposed Komphet with a Lego design hoping that it would help Komphet. Instead, it prevented him to feel the ownership over the design. He eventually abandoned it altogether.
I admit that Komphet might have continued working with the model if I had spent more time encouraging him. I also admit that Komphet might have left simply because he was not interested in the camera mechanism, or because he felt the mechanism was too hard for him. However, I know for sure that Komphet would have spent more time on the project if I had worked together with him from scratch and treated him as a co-designer. I can still imagine myself suggesting that same design idea to him, but treating him as part of the team, and letting him decide what to do. It would have been a much better way to balance the source of authority needed for a convivial environment.

We finally finished the project and showed it at the science fair. It was an interesting project for visitors. Lek did most of the presentations. Komphet was still very shy, but he cared about the project enough to present it when Lek was not available.
4.4 Lek and Her Fish Farm

The science fair was the second milestone for Lek. The children’s day project and the door alarm system had given her fluency with the RCX brick and relays. I encouraged her to continue working in the same direction. Although she was rather tired of electronics and wanted to do something else for a change, she came up with another project idea. Lek wanted to use the RCX-controlled switchboard she previously made to control lights at her fish farm at home. In Thailand, it is common for fish farms to have black lights installed to attract insects, which fall into the water serving as food for the fish. Lek’s fish farm is located about one kilometer from her house. She or her parents have to travel to the fish farm at least twice a day to switch on the lights at dusk and switch it off two or three hours later when there are no more insects. Lek’s idea was to automate this task. It would not only save her family the trouble of going back and forth between the house and the fish farm, but would also keep them away from dangerous creatures like snakes and scorpions (ironically, Lek’s mother was stung by a scorpion on the day Lek started this project).
Lek's idea was to attach a light sensor to the RCX brick and use it to automatically trigger the black light on and off at the appropriate time. She easily adapted the switchboard she previously built for the door-alarm project (See figure 4-25).

Figure 4-25: The switchboard adapted from the door alarm project.
A light sensor tells the RCX when to switch on the black light.
It may seem that this project is technically straightforward and one can easily imagine using a simple timer instead of the RCX. But, if we look beyond the technical aspects and the end product, we would see that Lek has experienced a learning environment that is profoundly different from her regular school days and it is an environment that I would call convivial. Lek had gradually gained fluency with her tools from the children’s day game and the door-alarm project. It was her fluency that led her to the fish farm project idea. The learning environment did not impose any purpose of using the tools to her. Rather, she felt empowered by the tools and was free to use them to enrich her environment according to her own taste. Lek learned to realize that she was not obliged to follow any kind of curriculum, but had the autonomy to define for herself what she saw as interesting and worthwhile for her to learn.
There was no test or scale that would define her as good or bad, better or worse than others. She defined her own success, which was accepted as her identity in her community. She recognized her ability to learn and realized that learning does not only mean being taught. She was confident that she could implement the fish farm project on her own. She was sure that she could overcome any obstacles she might encounter. After all, she knew she could always get the support from me later if she needed it. Lek’s fish farm project had a special ethical value, as the project was developed not only for the benefit of Lek herself, but also for her family. This project also changed the role of a child in her family. As I have mention before that it is not the child’s place to suggest ideas about how their parents could do things differently. But in this project, Lek actually worked on the project together with her father.
4.5 Tan’s Obsession with Visual Basic

After the children’s day festival, I asked Tan what he wanted to do. He instantly replied, as if he had been waiting for the question, that he wanted to learn how to make menus, tool bars, and other components that are familiar in most Windows programs. These are features that Microworlds cannot create. Tan had been using Microworlds for more than a year and he said he wanted to try something different. So, I decided to introduce him to Visual Basic. I chose Visual Basic because it would allow Tan to create the type of program that he wants without getting involved in the complexity of windows programming. Forms, menus, dialog boxes, and other common program components could be easily created.

Eak, a research assistant, volunteered to help Tan with Visual Basic. Eak had little experience with Visual Basic, but he was personally interested in it. Eak and Tan turned out to be good collaborating peers. They spent hours and hours learning together. Eak was a good computer hacker. His fluency with the web allowed him to search for websites and chat rooms that gave him information he needed. This was obviously an important skill that Tan could learn from Eak. Unfortunately, the Internet connection at Tong-Tip school was broken during
the time I was there. So, Eak could only show Tan how to use the search and chat rooms when they were at the Constructionism Lab in Lumpang City.

After a few days, Eak started to notice that Tan was loosing his pace learning Visual Basic commands and features. Tan wanted the program to work but he did not care much about the necessary code. At that time, he was trying to build a web browser. He wanted to add buttons, toolbars, and other components that are common in a web browser. But, he was not fascinated with the code he had to write. He would come up with ideas and relied on Eak to give him instructions about how to implement them. This, of course, made Eak felt uncomfortable. Eak felt Tan was not learning anything. I felt the same way too, and we both tried to convince Tan to spend more time learning how to program. We gave him a Visual Basic manual, we showed him example codes, and we introduced him to the on-line help. But, Tan was not interested. It took me some time to realize that we were blinded to see what Tan really wanted to do.

After some reflection of what we thought was going wrong with Tan. I realized that Tan was not really interested in Visual Basic programming. Rather, he was attracted by the ability to mimic and customize interfaces of programs he like. Tan enjoys chatting on-line with friends and strangers. So, he wanted to make his own version of an Internet chat
program and customize the look and function. Though he was excited, he did not really enjoy learning how to code it. Tan was interested to play a role of an architect more than an engineer. He could spend hours placing buttons and text boxes in the right place, creating his own color scheme, adding images to the background. But when it came to coding, he would just try to get it over with.

This was the second time that Tan refused to work on things that he did not like. The first time was when he moved away from using Lego. One may criticize Tan as being too selective and say that he needs to learn how to cope with things that he does not like. After all, we cannot do only what we like in real life. So, why leave him with this false attitude?

Maybe Tan does need to cope more with things that he does not like. But, it is very wrong to deprive him of what he enjoys. If I had forced him to learn Visual Basic programming, it would be alienating to him. By the time he learned all the necessary programming, if he ever did, he could have lost his excitement for the project altogether.

In the education system today, most learners do not get a chance to discover what they really like until they graduate. In Thailand, during the time I taught at the engineering department, I saw many of my students confused about what they wanted to do. Many realized after finishing their degree that they did not
want to be an engineer at all. Some of them wound up working as an airhostess, an insurance salesman, or even a music instructor. In Tan’s case, he is, indeed, discovering what he likes. Of course, he needs to manage less interesting things in order to remain part of his community. But, we must be careful when we define the balance between the two. A convivial environment requires us to weight personal preference above external interventions.

### 4.5.1 Chat as a Tool

Tan’s self expression through the user interface design was pushed to the next level by the practice of making tools. I encouraged Tan to distribute his chat program to his friends. This idea not only motivated Tan to further design and decorate the interface, it created a feedback loop for Tan to reflect on his ideas as well.

Since Tan’s chat program was implemented with a true network library (TCP/IP socket), it allowed its users to send messages across the network. Given that many students like to use Internet chat, Tan’s program was interesting for them. Friends’ comments like “I think the yellow background is too bright,” “I like your flowers on the form,” “I don’t understand how to connect to my friend’s computer” helped Tan to reshape his design and provide ideas for
further development. He learned that too many colors on the screen actually made the program hard to use. His chat program initially supported only two users, but after receiving requests for more simultaneous users from his friends, Tan redesigned the interface to support multi-users (Fig 4-30). Many other designs were added and changed because of the feedback he received.

When creating a tool, it is implicitly assumed that many people will be using it. Therefore, the toolmaker needs to place special attention on making the tool usable to other people. The emphasis on tool construction is where ideas of “tools for conviviality” and “constructionist learning” become most fruitful.

![Image of chat interface evolution](image)

**Figure 4-30: User Interface Evolution**

The first design (top) allowed two users to chat at the same time. Tan, motivated by friends’ demands, redesigned it to support unlimited simultaneous users (bottom).
4.6 Digital Video as a Convivial Tool

In addition to computers, Lego RCX and electronics devices, digital video was another appealing tool for students. There is something magical about digital cameras that capture children's attention. No matter where I go, children are always excited when they see themselves or their friends on a screen. I remember one time when I was in Senegal with my colleges, a little girl approached our group asking for money. When we started to show her our video cameras, the girl got so excited that she totally forgot about the money. The excitement was no different with the students at Tontip. When I introduced them to the video camera, everyone wanted to get their hands on it. They would go around and shoot. Then, they would gather in front of the camera’s small monitor and laugh as they playback the video.

I made the video camera easily accessible to the students. I would leave it on a table together with the Lego pieces. The goal was to make the camera as accessible as possible so students would use it. Of course, this creates more risk of damaging the camera. Initially, I showed them some basic precautions (i.e. to always wear the shoulder straps) and my observation of how students use the camera suggests that they actually took good care of it.
Nothing much came out during the first week that the students had access to the camera. I was not expecting much to happen neither. My main goal was to allow the students to be acquainted with the camera. I also wanted a chance to see who used the camera the most and who would potentially be interested in doing a project with digital video. I knew it would be hard for students to come up with a project idea by themselves because they have not used a camera before and did not know the potentials. They would raise ideas of making movies, but they needed encouragement and support to actually pursue those thoughts. This situation provides another example of the need to balance the acquisition of knowledge and individual initiatives. While we could not expect students to develop the necessary skill by themselves, it does not mean teachers should take over the activity and develop projects for students. Conviviality asks for a balanced control in a different dimension. The following case demonstrates what I mean.

Figure 4-32: Students exploring the Video camera

Students had free access to the digital video camera. Everyone wanted to get their hands on it. They quickly developed their fluency through the fun and joy of shooting their friends and playing back the video.
4.6.1 Kib's Proverb Video Project

Kib was one of the students that joined the project without much idea what she wanted to do for a project. She started a game project in Microworlds. But she was only following what most of her friends were doing. However, I noticed that Kib would always give special attention to me when I talked about video. It was quite obvious that she wanted to show me that she was interested, but she was shy to do so directly. However, when I tried to talk to her one on one, she would feel nervous and back off. I realized that I needed to use a gentler approach.

A project with digital video started on the second week. Kib was working with two other students on a Thai proverb project. They were planning to implement a game in Microworlds. The general idea was that the player would have to match the proverb with its meaning. I saw this as a good opportunity to suggest a video project idea. I suggested to them that they could add a short video to their game demonstrating a situation that reflects the meaning of each proverb. Then, they could incorporate the video into their Microworlds project. The students were interested. So, I continued talking about how movie making involves script writing, directing, and editing. This opened up a whole new dimension to what they can do with video. Kib was most interested in the process. She was excited about writing scripts, and casting her
friends as character in her stories. We agreed to start shooting together on the next Saturday.

Here again, the development of the video project emerged from the current interest of the students combined with the insights of the facilitator. There are a couple reasons why my approach worked. First, the video idea connected to what the students were currently doing. Second, I knew Kib has interested in video. Finally, this was a group project. I learned earlier that Kib would feel uncomfortable talking one on one with me. So, having friends join the conversation made it easier for her. The project development is situation specific and often requires some patience from the facilitator (as they do not always succeed). In fact, Kib and her friends had rejected a video project I suggested to them earlier. The situation was very similar but it involved speaking English, as it was related to an English comprehension game. The students did not want to video themselves speaking English. So, that attempt did not work.

On that Saturday, all the students visited the Constructionist Lab in Lumpang city. Kib finalized her script with her friends and started to select the cast. By noon, they were ready to shoot. Kib both directed and shot the scenes herself. It was clear that Kib was not a shy person when she had the space to work with her friends. I let them work for a while and then stepped in. The instant playback capability of the digital camera allowed me to give suggestions on shooting locations and camera angles. It was a
The students would crowd around to see the video after each cut. By the end of the day, they already finished four proverbs. We hooked the video to a television and showed the video to all the students. Everybody had a big laugh.

I was more involved in the process during the second shoot. Having the first set of videos made it easy for me to point out some issues that could be improved. "I think the pacing was a bit too fast," "you should make sure the volume is not too low," "Did you notice that the actors were not facing the camera?" were the type of comments I made. I saw that she acknowledged the comments, but was not quite sure what to do next. So, I decided to work closely with Kib on the first proverb she shot. I took the chance to talk about the editing process as well. I introduced her to the idea of cutting between shoots and switching between different camera angles. She learned that she could shoot the same scene many times, each with a different camera angle, and edit them into one single movie. After we finished the first movie, Kib continued with the project on her own. We watched the new movies at the end of the day and saw many improvements. Kib had a chance to digitize and edit some of her movies on a computer as well.
5.1 The Essence of Conviviality

5.1.1 The Komphet Phenomenon: An Evidence That Goes Against the Industrial Mode of Production

I believe the story of Komphet is the clearest example of the most devastating affects of school institution. I mentioned earlier that the schoolteachers would giveaway grades to Komphet just to help him pass secondary school. Komphet's parents do not see a point in supporting his continued studies; they want him to work in Bangkok. Nobody thinks there is any hope for Komphet. But from my experience working with Komphet, he is not an unintelligent child at all. Quite the contrary, he learns well and he is fluent no less than any
other student in his class. I have described how fluent and quick he built and learned about Lego gears. But, that was not the only evidence that led me to my conclusion. I also learned about Komphet from other personal interactions and activities. For instance, we played basketball together sometimes and I noticed how much he thought about where he should position himself. When his team defended, he would place himself in a position that allowed him to run forward quickly in case his team stole a ball. I also drove Komphet, along with a few other students, back home on days that we work late. Those rides gave us time to talk casually. He is no different from any other young teenager; he is curious about the world he is living in, he enjoys social events, he also has a bright dream about his future. Perhaps what is wrong with Komphet is that he is too smart. His mind could be so alive and curious about his environment that the school system just could not handle it. He denies following school’s standard because he does not see the point of doing it. Schools do not except students who behaves differently from their expectations. Thus, Komphet is categorized as problematic.

The worst affect for Komphet is not his low school grades or the lack of opportunity to pursuer higher education, it is the degrading image he has of himself. He may, one day, come to believe the imposed definition of
himself as an incapable person that deserves to be a badly paid worker in Bangkok; in accepting this he will also come to believe that he is not able to do anything about it. Once he develops this mindset, he could become part of the vast Thai population who view themselves as poorly educated people who cannot improve their lives without help from the elite.

From the school's point of view, Komphet has a problem. The remedy for him has been the teacher's mercy to let him pass exams even if he actually failed. If Komphet were to live in a developed country like America, he would probably have been sent to a special education program. This treatment is generally accepted as being the most straightforward and reasonable by schools. It hides what schools see as wrong with the student. Since these students cannot keep up in regular schools, they should be in a place where the materials are made easier and are taught at a slower pace than usual. This therapy often poisons the student even more. Seymour Papert had observed a similar case when he was working with a group of teenagers in a juvenile jail. He describes what he sees as a classic pattern of what happens to students in special education programs:
A kid who cares about ideas finds precious few of them in an elementary school where he is expected to learn facts and skills that he experiences as excruciatingly boring. He refuses to do it. School responds by classifying him as having trouble learning and so places him in special classes that are supposed to be easier. This is exactly the wrong response: “easier” means even more boring … and so begins the downward spiral [Papert, 2000].

Papert concluded that many students do badly in school not because they are incapable, but more because their style does not fit the style of school learning [P.721]. For many students, memorizing facts and practicing skills that cannot be put to any meaningful use is simply their duty. But for other students, they feel imprisoned and refuse to do it. Putting them in to special education programs does not change anything and many times it makes things worse.

The special educational program is an example of solutions favored by the school institution that governs the industrial mode of production. It is not only unsuccessful, it misses the problem altogether. The negative perception of Komphet’s abilities based on his performance within this industrial mode of school is simply inaccurate.
5.1.2 A Suggested Recovery

There are two things that Komphet received during the Sarnfun project that made him perform in a radically different way than in his school classes. First, he received trust and respect as a capable person. He realized that the facilitators were interested in what he liked and supported him to work in the way he prefers. Towards the end of the activity, Ajarn Sawat came up with an idea of making a Rice grinder to produce brown rice. Ajarn Sawat sees making brown rice as a way to add value to rice. Komphet was interested in this project. Though Ajarn Sawat was too busy and never got to pursue the project, I discovered that Komphet had gone to the school’s library to find information about the rice grinder. He saw a picture of it and started to think about the necessary materials. Then, the next day he came to school with a long piece of bamboo that he had cut from a bush near his house. All of this was done without anybody knowing. This is the kind of engagement that can happen in a convivial environment. It also shows that Komphet has the ability to show initiative and to learn, abilities which the school system failed to recognize.

Komphet also had an opportunity to concretely exercise and explore what he could do though the use of tools. This is the role of
constructionism. By making the Lego mechanism to control the light breaker, he was able to work and think the way he prefers. Also, Komphet was able to learn new ideas (e.g. gear ratios) from the tools he used. The artifact he produced served as an object that could be admired, appreciated, questioned, or critiqued by others. This mix of externalizing and re-internalizing allowed him to reevaluate and further develop his style and tastes.

Tan’s story shows how compulsory learning based on a central curriculum and a single style of learning is not the approach to make the most of learners’ potentialities. Tan’s case may seem less radical than Komphet when we look at it in terms of school grades. However, Tan has the same characteristic as Komphet in the sense that he would refuse to do what he does not feel comfortable doing. We have seen that when Tan had a chance to choose and pursue areas that he truly feels excited about, he exercised engagement, enthusiasm, and concentration of a much higher quality than in the normal school environment. If I had forced him to continue working with Lego or to continue learning Visual basic coding, he might have been able to tolerate my demand. But his performance and joy would definitely have been much less.

Kib’s experience with digital video is another example of how students’ performance can increase dramatically when they are
engaged in a personally meaningful project. Kib performs well both in school and in the Sarnfun project. So, in a way, she is not perceived by her community as a student with learning problems. However, her learning experience had a deeper quality when she discovered digital video. She invested as much time and energy as possible joyfully writing the scripts, filming the movie, and editing the video. It is this level of investment, interest, excitement, and joy that makes a convivial environment desirable. It makes the most out of each learner in their own unique way rather than defining them as good, normal, or poor on a standard scale.
5.2 Nourishing Conviviality in Learning Environments

By looking back at overall development of the learning activities, we could see that the students were at first shy and felt uncomfortable with the activities that were different from their school experience. It was hard for me to discuss project ideas together with them, as they were extremely passive. They were not used to dealing with open-ended questions like how to make a Lego structure that functions the way they want (e.g. making a mechanism to lift a candle). However, the situation gradually changed. They started by making games for the children’s day festival. Some students continued working with the RCX and built the door-alarm system. Tan learned that it was okay for him not to work with Lego and to switch to Visual Basic. Then, towards the end of the Sarnfun activity, the projects started to become more useful, such as Lek’s fish farm project and Tan’s chat program. This development happened only over time and after students had developed the trust, respect, and confidence with me and other teachers. Thus, it was important that I provided them the time, space, and environment to build this new relationship. I constantly showed them that I was not trying to impose my ideas and values to them. Rather,
I tried to make students realize that I valued their interest; I saw them as capable people and valuable contributors of ideas that determine the activities that were to take place. This approach was radically different from the industrial approach in schools where students were expected to only follow the pre-defined procedures and where students’ wishes had no effect on the learning activities. The following subsections discuss the convivial approach I used in more detail.

5.2.1 Whose Ideas Count? Building Trust and Respect

I have explicitly described how I was disappointed and opposed to some of the students’ projects when they were first developed. It raises an important point about how a project or an activity is valued. I admit that I often value students’ projects using my own values, which was a mix of my mature personality, engineering background, schooling experience, and culture values. I started the Sarnfun project aiming to help students produce projects that would be appreciated by the schoolteachers as intellectually beneficial to the students. However, what was meaningful for me was, most of the time, not interesting for students. For example, I believed that agricultural projects would be a
useful application for the electronics tools, as the project could be used with students' crops at home. However, as it turned out, only three students were interested in using the electronic tools, and all they wanted to do with them was to make a door-alarm system. Other students were interested in making games. In the case of the video camera, I was hoping that the students would use the camera to make documentaries of their local culture or disease in their own rice fields. Instead, all they wanted to do was to film their friends and make fictional love stories.

The cases studies have shown how I gave the students' ideas a higher priority than mine and how it eventually leads to something useful. Though I was sometimes disappointed, I knew I had to keep the projects truly meaningful to the students. In the end, these seemingly disappointing projects turned out to be better than I had anticipated. They also opened up new doors and resulted in creative project ideas that were impossible to foresee. The door-alarm project is a good example. It became much more technically challenging than initially anticipated and, most importantly, it lead to Lek's fish farm project, which was one of the highlights in this research. This discussion shows how the development trajectory of a project was dynamic and depended on the students, the teacher, and the local context. Thus, it was
necessary that the development process be emergent. The children’s day project emerged from students’ excitement; the group of students who worked with the door-alarm project emerged from the children’s day project and so on.

5.2.2 A New Source of Authority

When I say I gave a higher priority to students’ projects, I do not mean that my ideas were not valued at all. Such an extreme approach would lead to what John Dewey called the Either-Or philosophy, where “the knowledge and skill of the mature person has no directive value for the experience of the immature” [Dewey, 1938]. For sure, my existence in the environment had an influence on what the students did. I would not say Lek’s fish farm project was a fortuitously accident. Lek knew I was interested in agricultural projects and I am sure this awareness, more or less, contributed to the development of her fish farm idea. The project might not have made sense to her if I had had a different interest.

Another area that requires careful consideration is teaching. I do not advocate that there should be no teaching in a convivial learning environment. Quite the contrary, teaching is still appropriate to many situations,
and there were numerous occasions during the Sarnfun activity that I taught. Nor is conviviality necessarily achieved by merely reducing the time used to teach in a class. For me, teaching served a valuable function when used to introduce new ideas and motivate students to further develop their own projects. I spoke for almost twenty minutes when I introduced the students’ to the electronics tools. The goal was to open a new paradigm of possible projects to students. I also taught Kip about camera viewpoints, cuts between scenes, and other fundamental knowledge about filming. My teaching was different from school teaching in the sense that there was no predefined curriculum and students’ projects were still the primary activity. I was teaching on a need-to-know basis rather than providing all the necessary information upfront. Finally, I did not teach for long periods of time (usually less than twenty minutes).

Conviviality is not the inverse of everything about the industrial mode of production. Instead, it is a dynamic balance between the two opposing ideas. Source of authority is an important force that needs to be carefully balanced. By saying balanced, I do not mean merely reducing authority of the teacher in a quantitative way. It is more about finding a new source of authority altogether. The way I helped Kip develop her proverb video project is an example. My idea was accepted by Kip in a
way that kept her the owner of the project. It was still Kip’s video project and she was still excited about it even as my idea became an important component of the project. On the other hand, unwanted help does not do any good, as in the case of Komphet when I made the camera Lego structure for him. Komphet acknowledge my design probably because he respects me. But he never took charge of using or modifying the design. Providing help is a very sensitive process. How much help to give, when help is needed, how to provide help are dynamic and to do it well requires a teacher that can adapt well to the situation.

5.2.3 A Culture of Obedience: Conviviality and The Local Culture

One particular difficulty I experienced throughout the Sarnfun activity is the passiveness of the students. A good example is when I was working with Lek, Non, and Komphet with the door-alarm project. Though they were interested, they remained extremely passive and quiet during the group meetings. It was difficult to collaboratively decide what features we needed and how to implement them. I had a similar experience with Kip when I tried to talk about doing a project with digital
video. Kip would always feel uncomfortable talking to me one-on-one and tried to back off.

Students’ personality and the fact that I was an outsider may have contributed to this difficulty, but if we look deeply at the root of Thai schools, there is a profound culture that depicts students’ relationship with their teachers as passive.

Before the existence of modern schools, Buddhist temple schools (rong rean wat or wat-schools) were the primary resource of knowledge for Thai pupils. Education at these wat-schools was designed to provide literacy and access to the teaching of the Buddha (dhamma). With religion as its foundation, learning was a process that required pupils’ humbleness and respect in the Buddha’s principles. A novice would join the palms of their hands together as they practice their prayers with the monks. Buddhism is a culture that nourishes the beauty of obedience that leads to the ultimate accomplishment of being enlightened (tru sa rue).

State-sponsored secular schools started to replace the monastic schools in the 1920s. The transition was peaceful and gradual. The government included the Buddhist moral instruction as part of the curriculum and invited Buddhist Sangha leaders to participate in the development of the new education system [Keyes, 1991]. Buddhist principles
remained a primary emphasis in the new education system and the Thai people did not conceive the secular schools as a radically different constitution. Here is how Charles Keyes (1991) describes the secular schools:

Despite the fact that it had a fundamentally different mission, the local school was often viewed as an extension of the wat by village monks and laypeople alike [Keyes, 1991; italics in original].

Because secular schools were perceived similarly to pre-modern wat-schools, the culture of obedience was carried forward. Therefore, despite the fact that teachers were assigned to have the authority over students, there exist an underlying culture that shapes the relationship between students and teachers. The culture of obedience had been part of the Thai schools from its beginning and remains active today even though the wats do not have much influence to the school system anymore. Students bowing to the teacher at the beginning and the end of each class and the Saluting of the teacher (Wai khru) ceremony are examples of rituals that still reflect this culture.

One may think I am trying to conclude that the culture of obedience is an obstacle for a convivial environment and that it should be eliminated. Quite the contrary, I think that it is important to respect and maintain this beautiful culture. If a convivial environment were to have the same characteristics
regardless of the local culture, it would be a step towards standardization that is the main root of the industrial mode of production. I am trying to point out that there are existing factors that have to be taken into account when constructing a learning framework. Practices such as asking students to make public presentations or express opinions that are common in American and many other countries may need more time and effort to conduct in Thailand. How these activities are valued has to be different as well.

Changes that would accommodate conviviality will have to come through the teachers. Students’ autonomy to use their imagination and creativity could be realized through the freedom provided by the power holder. There are probably many ways to do this, but I have focused on a project based, constructionist approach. Using tools to build artifacts had created an environment that served as concrete playground for both teachers and students to exercise the new relationship that is not driven by the teacher’s total authority. I have described how Non and Pan changed from being motiveless to enthusiastic when their children’s day project was concretized by the Lego construction and put into use in a meaningful context. I did not have to use my authority with them. I could work together with Non and Pan, provide them some of my knowledge and experience as a
mature adult. Though I address Thailand’s culture specifically, I believe the general idea of cultural adaptation and the strategies I used with the students are applicable at other cultures.

5.3 Digital Technology for Conviviality

It is evident from the case studies that the digital tools extend projects’ possibilities. The Lego RCX played a critical role in the children’s day project; it made the fun part of the game possible. The RCX enabled conditioning and programmed behaviors in the game design. Lek also benefited from the RCX when she made the switchboard. The computational tools allowed students to pursue tasks that previously need skills that are often introduced at a much higher level.

Along with the possibilities added, when tools were used to construct artifacts, they engaged students with the construction process particularly well. I have shown how Non and Pan changed when their Lego construction began to function. A project that seemed meaningless to them changed into something that they were curious about and that they wanted to complete. The artifact served as a tangible representation of their achievement. In most cases the artifact was
never a finished product. To the students, their project was always developing. Tan's chat program was always changing; he always told me that there were more features to add and more bugs to fix. This continuous development led to situations where students were constantly exposed to the process of debugging and idea-development. Thus, they strengthen learners' problem solving skills and exercise their ability to handle open-ended questions and challenges. These types of activities are different from the ones in schools where the activities are usually predefined, based on a onetime assessment method, and de-contextualized from students' interests.

Digital tools also lead to learners' intellectual development. Many of the ideas that students learned were considered advanced; under traditional models students would not be exposed to these ideas until they reach a university level. Students learned about infrared signals as part of the children's day project. Komphet learned about gears as part of making his light switch mechanism. Tan learned about networking and the TCP/IP protocol while writing his chat program. These ideas were demystified through their application. Though the students did not learn the technical details of infrared light, such as their wavelength and the equations usually associated with them, they learned that infrared is basically an invisible light, which led
them to understand why it is directional. Similarly, Tan did not learn all the underlying mechanism of the TCP/IP protocol, but he learned enough to understand what is needed for his project. Thus, learning happens in a need-to-know basis. This mode of learning supports conviviality, as learners learn to empower themselves and to use the knowledge in a self-determined way as opposed to the traditional goal of meeting the standards predefined by others.

The case studies also showed that digital technology could create a new relationship between students and their teacher. These new relationships supported the development of trust, respect, and confidence necessary in a convivial environment. Tan and Eak (one of the facilitators) worked collaboratively on the chat project. Eak was equally involved in learning how to make a chat program. He sometimes spent hours at night doing research on issues that needed resolution. This relationship where both the student and the teacher were engaged in the learning process is radically different from traditional teacher-student relationship in schools and is an example of the teacher-student relationship preferred in a convivial environment. My experience with Kib and her video project showed another type of change that happened through the use of digital tools. Kib first resisted talking to me personally about video ideas, which was a common teacher-
student relationship in Thailand where students are expected to obey everything the teacher says. However, through her use of the digital video camera, I was able to establish a new relationship with Kib. We worked together filming her story. I introduced her to camera techniques and helped her with the settings of the story. By the end of the project, Kib was much more confident while talking to me. Thus, the digital camera was a kind of facilitator of the relationship and led to activities that helped support the change.

In terms of the tools itself, accessibility is one of the important property of a convivial tool that was discussed in chapter two. I made all the tools as accessible as possible to the students. The RCX brick and other electronic devices were kept in a box inside the computer lab and everybody could access them freely. Though the number of digital cameras was limited, they were freely accessible. I would bring the cameras with me everyday and would leave them on a table. Students could use them without the need for my permission. As I realized that free access to cameras increased the chance of cameras being broken, I introduced students to some principals of care and all the cameras remained functional throughout the five-week activity.
5.4 Making tools

I have introduced the idea of making tools as a particular theme that can encourage conviviality. The case studies suggest that making tools strengthens the development of fluency, which can in turn lead to better self-expression and better use of the tools in a convivial way. Here are some examples.

In Tan’s case, giving his chat tool to his friends created a feedback loop that motivated Tan to both reflect on his ideas about user interface design and to further develop new features. Tan initially used many colors in his program, but he eventually changed to use a softer color pallet after receiving complaints from his friends. He gradually learned that too many colors actually irritate the users. Tan also changed the program design to accommodate multiple users instead of the original design that supports only two users. Thus, the feedback loop keeps pushing Tan forward. The fact that many people were using his tool made Tan felt his work was being appreciated and it satisfies him. He further developed his work to maintain this satisfaction. It is likely that Tan studied Visual Basic more than he would have if he had made programs just for himself. Thus, making the chat tool evidently helped strengthened Tan’s fluency with Visual Basic.
In the case of Lek's electronics project, the way she changed her design from simply inserting a relay between the power outlet and the controlled device to making a switchboard allowed her not only to work more with the relay, but also to think more systematically how the relay and the RCX could work together. Here again, making tools strengthened the development of fluency.

In addition, as Lek's switchboard was a general-purpose tool, it led to her fish farm project. In this case, tool construction promotes the process of reusing the tool with different applications. As a tool moves from one application to another, it serves as a unit that carries over the knowledge and experience the toolmaker had invested while making that tool. In this sense, tools make knowledge and experience portable and the toolmaker could conveniently construct new ideas on top without having to reconstruct everything again from scratch. Lek was able to develop her fish farm project without the need to reconstruct the relay mechanism. In fact, knowing that she could reuse her switchboard probably gave Lek extra thrust to pursue her idea. Thus, her tool also helped Lek to think forward about what she could add to her previous experience.
5.5 conclusions

Those who share a belief in constructionist learning would agree with me that when a learner constructs X, the most important thing is not X itself; it is the process that happens as X gradually becomes X. This is when the most learning takes place. Now, the next important question is what is X? Constructionism suggests that learning can happen felicitously when X is personally interesting and meaningful to the learner. This statement leads to the next question; how do we know what is interesting and meaningful to a learner? In fact, would the learner know what he or she likes? What should the teacher do on the first day the meet the learners? These are tough questions and I do not think there is a single answer waiting to be discovered. The work presented in this thesis contributes to the above questions by emphasizing the evolutionary nature of constructionist learning activities and the required supporting environment. The concepts of conviviality and emergent design have provided me a systemic and theorized framework to discuss and identify patterns of this process.

I have presented a case study that illuminates the dynamics of evolving learning activities. I have shown how my values affected the students and the learning projects that
eventually evolved. I have also shown how my values merged with students' values, how they sometimes conflicted with each other, and how I let the students know that their values were important and appreciated. I showed examples of how the dynamics of these interactions can lead the emotional phases relative to the learning activities (e.g. joy, depression, recovery from depression). I also emphasized the importance of trust and respect that the students have with the teacher and how these could strengthen the evolution of learning activities.

From the discussion above, I suggest that in addition to the knowledge each teacher has, he or she might also need to make his or her values and motivation visible to the students. Thus, the students would see the teacher not as someone who tells them what to do, but a person who is passionate in doing something to which the students could participate. This way, the students could convey their interests to go long, go beyond, or diverge from the teachers' interest. The issues of trust, respect, values, local culture, construction activities that have been discussed in this thesis all contribute to this process.
References


