Technology and the Future of Educational Crafts

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Craft activities—constructive, creative activities with tangible materials—have been a venerable and delightful element of childhood education for centuries; and they have always been a reflection of contemporary technology. In the coming decades, children's crafts will become integrated with novel technology in ways that can (potentially) serve to make the craft activities more educationally powerful and aesthetically appealing. This article is a review of various research projects under way in the author's laboratory—projects that seek to explore the ways in which computation and materials science can expand the horizons of children's craft activities. The article concludes by arguing that the educational technology community at large would be well served by devoting a far greater degree of attention to the advancement of educational crafts.

Introduction

Academics have the unfortunate reputation of getting bogged down in definitions: before proceeding with a discussion, we say, we have to know what our terms mean. And then, once we have our definitions, we have to know what the terms inside the definitions mean, and so forth; and by the time all the defining is finally done, it's generally time for lunch. In other words, definition becomes an excuse for procrastination.

Nonetheless, at the potential risk of a little academicism, it is worth a moment or two of preface to ask what we, as a community, mean—what we really wish to mean—by a term like "educational technology." Historically, "educational technology" often has tended to mean something rather specific—too specific, in fact. "Technology," in this widely-held view, means "the desktop computer": that is, a largish box with a monitor screen, keyboard, mouse, and (more recently) Web connection. By the same token, "education" generally tends to mean "classroom education," with its implication of crisply defined subject matter and an emphasis on information transmission and skill acquisition.

There's nothing intrinsically objectionable about the desktop computer or classroom education; but, in tandem, they make for a narrow definition of educational technology. Both "technology" and "education" admit of much more expansive and exciting definitions. At the very least, we could enrich our notion of technology to include (among many other possibilities) new directions in personal fabrication, embedded computation, and materials science; and we could enrich our notion of education to include the sorts of creative, content-rich, often leisurely activities—activities with tangible materials—that have long enchanted children. In other words, rather than turning the act of definition into a pedantic exercise, we can use our definitions as a means toward expanding and rethinking our overall enterprise.

This article is a discussion of a different style of educational technology—one that focuses on children's crafts, and the ways in which novel technologies can enrich those crafts. In making this our focus, we implicitly challenge the classroom-centric view of education in a number of ways: thinking of activities (rather than formal disciplines) as the natural divisions of educational effort and time; thinking of craft projects as the units of progress and subjects of analysis; focusing on the child's development of long-term interests, and the growth of his or her professional identity (as engineer, as scientist, as artist), rather than skill acquisition, as the central purpose of education; expanding the natural environments of education to the home, backyard, garage, basement, museum, clubhouse, garden, neighborhood, and so forth (rather than the classroom alone); and attending to notions of creation, construction, and design. By the same token, we implicitly challenge the desktop-computer-centric view of technology by including—along with desktop machines—an increased attention to (among others) embedded, mobile, and ubiquitous computation; advances in fabrication devices that permit children to "print out" physical objects of various sorts; and developments in materials science that herald the availability of new "stuff," new craft materials, for children to use.

In our Craft Technology Laboratory at the University of Colorado, we have been exploring a variety of such themes in "computationally-enriched children's crafts." Essentially, our interest is in using children's activities with physical materials as a foundation for educational design. In some cases, the physical materials in question are "traditional," e.g., paper and string, while in other cases, those materials are recent or "high-tech"; but, in each individual case, we try to identify...
the purpose and content of the activity in question and to investigate how technology can be used to make the activity more educationally powerful, more personally motivating, more aesthetically appealing, and more expressive.

In the remainder of this article, we will describe in greater detail our research in the Craft Technology Laboratory. In particular, we will discuss four central themes of our work:

- the creation of design applications that permit children to construct more complex, personalized, or beautiful craft objects;
- the exploitation of newly accessible fabrication devices and tools that collectively expand the space of children’s crafts;
- the use of embedded computation to endow craft materials themselves with novel or dynamic behaviors; and
- the exploration of new (and often “smart”) materials that suggest exciting new possibilities for children’s crafts.

In the final section of this article, we will step back from a focus on our own particular projects to discuss related work, and where the culture of children’s crafts may be headed; and we’ll conclude by arguing that “educational technologists,” as a community, would be well rewarded by an increased focus on such craft activities.

Computation and Children’s Crafts: Four Central Design Themes

In this section, we explore in greater depth the four themes mentioned at the close of the introductory section. It should be mentioned that these themes are clearly not mutually exclusive; indeed, some of the sample projects that follow illustrate multiple themes in varying degrees. Nonetheless, treating the four themes individually serves as a useful structuring device for the remainder of this discussion.

Design Applications for Children’s Crafts

The most straightforward way of employing computation in children’s crafts is to create software applications that enrich the process of design. An example along these lines is the HyperGami program. This is a system for the creation of polyhedral models and sculptures in paper. HyperGami has been described at length in several earlier papers (Eisenberg & Nishioka, 1997a, 1997b); briefly, the basic idea behind the program is that the user creates a three-dimensional shape on the computer screen, and the program then “unfolds” that form into a flat pattern (known as a folding net). The HyperGami user begins a session by selecting one of many available “classical” mathematical polyhedra; but he she may then customize that form in a wide variety of ways (e.g., by adding a new vertex above a face, “slicing” a polyhedron through a specified plane, stretching or shrinking a shape along a specified axis, and so forth). Through these means, the user is able to create folding nets for an endless variety of polyhedral forms. The nets themselves may then be decorated using paint tools (such as color or texture fills), and once decorated, they are printed out on a color printer and folded into physical models in paper. Figure 1 shows several representative HyperGami constructions (and a Java version of the program may be downloaded as freeware from our laboratory’s Website, noted in the References).

Space considerations preclude anything like a thorough description of HyperGami here; but several general points deserve mention, as they are relevant to much of the later discussion. First, HyperGami is an example of a design application in which the user begins by doing design work on the computer screen...
Figure 2. Popup cards designed with the PopUp Workshop program.

(or, to put it alternatively, by doing design work in the "virtual" world of the computer program); that design work is subsequently realized in physical materials (here, paper). This general notion—that one can do a certain amount of design in software that informs craftwork with real materials—is a recurring idea in the software design that takes place in our lab. Second, it is worth noting that there are powerful advantages to using a computer application (such as HyperCami) as an aid to children’s crafts. For instance, unlike traditional books on building polyhedra, in HyperCami the child is given a tool with which to vary and customize the traditional mathematical solids. Thus, rather than treating the craft of polyhedral construction as a fixed collection of assignments, we tend to view it rather as the basis for a creative avenue of expression for children. Moreover, HyperCami’s paint tools permit the user to decorate folding nets in far more interesting and elaborate ways than would be possible by hand alone. HyperCami users may additionally decorate their folding nets by hand once those nets are printed out; and, before printing, they may save their folding nets as computer files and read them into graphics applications, such as Adobe Illustrator (see References), for additional decoration.

Polyhedral modeling is just one instance of a (relatively traditional) children’s craft activity; but in our view, there are myriad such activities for which “HyperCami-like” design applications could be created. Another ongoing project in our lab is PopUp Workshop, an application that permits children to create popup cards in paper (Hendrix & Eisenberg, 2004). In PopUp Workshop, the user specifies a series of cuts to make in a (“virtual”) sheet of paper; the software automatically constrains those cuts so that they correspond to standard popup folding patterns. As the user places the popup elements on the screen, he or she simultaneously can view a three-dimensional rendering of the eventual popup card as it opens and closes. Finally, once the desired popup form has been achieved, the user decorates and prints out the paper template, makes the appropriate cuts in the printed-out sheet, and creates a physical popup card. Figure 2 shows two creations made with the program (again, the current version of the system may be downloaded as freeware from our laboratory Website, noted in the References).

Fabrication Devices and Tools

The sample applications of the preceding paragraphs—HyperCami and PopUp Workshop—make use of the color printer as a “typical” output device in children’s computing. This has not always been a foregone conclusion: in the very earliest days when HyperCami was being developed (i.e., the early 1990s), we were often warned that color printers were prohibitively expensive for schools, and thus that few children could ever afford to print out decorative folding nets for polyhedra. The intervening years have shown how unrealistically pessimistic those warnings were. Currently, there are a batch of fascinating (and increasingly affordable) output devices that greatly extend the range of personal fabrication, and that in our view will likewise come to take their place beside the color printer in the landscape of child-accessible tools.

One example along these lines is the laser cutter, a device in which a computer-controlled mobile laser is pointed downward at a flat sheet of material (such as wood or acrylic). By following instructions for movement from the computer, the laser cuts out shapes...
Figure 3. A mechanical sea monster whose cam elements were created in the MachineShop program. The wooden mechanical elements and foam core pieces of the monster herself were printed out on a laser cutter.

from (or, at lower power, etches designs into) the material underneath. (For those who have not encountered one of these devices, and who—who the author—are old enough to remember line plotters, a laser cutter may be thought of as rather like a line plotter in its design, except with a laser instead of a pen.) Laser cutters may be plausibly thought of as a new type of “printer” for craft applications, except instead of printing out designs on paper, we may now output designs in a variety of sturdy materials such as wood, cardstock, or acrylic.

As an example, Figure 3 depicts a construction made with yet another design application, MachineShop (Blauvelt & Eisenberg, 2002). The basic idea behind MachineShop is that it permits children to create a wide variety of customized mechanical elements (such as cams, gears, and levers) for use in the design of personalized mechanical toys and automata. Once the child has created a mechanical element appropriate for his or her project, that element may be “printed out” in, say, basswood for use in the project. The automaton of Figure 3 is a mechanical sea monster designed via the program (and printed out on a desktop laser cutter).

Again, there is insufficient space here to describe MachineShop in greater detail; but it is reasonable to think of the program as a kind of “HyperGami-like” system that uses the laser cutter as its output device. The essential point, for our purposes, is that by making materials such as wood and plastic available for children’s creations, it is straightforward to allow young students to design such things as gears and cams. Indeed, anyone who has tried to cut gears out of paper, to take one example, knows well that such a task is near-impossible; but now that children can print out objects in wood, entirely new domains of educational crafting suddenly become feasible. And, again, as with HyperGami and PopUp Workshop, the purpose of the MachineShop application is to serve as a design tool appropriate for making an endless variety of mechanical toys (rather than being simply a “kit” for the creation of pre-designed toys).

Laser cutters may be used for a variety of other types of craft projects as well. Figure 4, for example, shows several wooden models of “sliceform” surfaces (see Sharp, 1999) whose pieces have been printed on a laser cutter. Here, the models are created from two sets of pieces assembled at right angles to each other; one set has slots running from the bottom to the center of each piece, the other set has slots running from the top to the center. By lining up the appropriate slots of the pieces, we can create physical models of complex surfaces and solids. Figure 5 shows yet another way of using the laser cutter—to create frames for mathematical “string sculptures.” Here, the laser cutter has been used to cut precise holes in sheets of basswood; the user then assembles several pieces of wood into a frame structure, and passes brightly-colored string through sequences of holes to create complex mathematical forms (see Eisenberg, Rubin, & Chen, 1998).

The laser cutter is not, by any means, the only novel fabrication device worth exploring for educational crafts. Still another instrument, the 3D printer (or 3D
Figure 5. A mathematical string sculpture. The frames for the sculpture were printed in wood on a laser cutter.

prototyper, as it is sometimes called) is an output device that takes as input three-dimensional models in one of several standard computational formats and prints out physical renderings of those models in some specified material. (The printer in our laboratory outputs in plaster; other models use plastic as their output material, and still other devices are able to print out in metal.) While implementations vary, the typical 3D printer creates a model by laying down a succession of very fine cross-sections of the desired solid; our laboratory's printer, for example, would create a sphere by laying down successive circular cross-sections in plaster until the entire sphere had been created. 3D printers are probably not as close to "classroom-ready" as are laser cutters; they are slower in operation, involve somewhat messier materials (e.g., plaster as compared to wood), and are more expensive. Nonetheless, they are also significantly more versatile than laser cutters, at least in the sense that they can output three-dimensional forms rather than (essentially) two-dimensional "slices" like the laser cutter.

As an example of the sort of project that can be undertaken with a 3D printer, consider the printed-out knot form of Figure 6. This figure shows the output from a program under development in which a 3D Logo turtle moves in space, and the path taken by the turtle may be printed out and inspected. Thus, if the turtle moves in a particular closed knot form, that form may be created in plaster, as in the Figure 6 example. Still another system-under-development in our lab is a prototype program that permits children to design and print botanical forms such as trees: the user specifies a few parameters of a "tree-growing" program (see Prusinkiewicz & Lindenmayer, 1990) for the geometric techniques that underlie this idea), and once a suitable tree has been created on the screen, it may be printed out in physical form. By such means, children could eventually have design tools that allow them to create and print out (say) gorgeous, personalized dioramas of various sorts.

Beyond the laser cutter and 3D printer, our lab is exploring still other types of output devices (including a relatively inexpensive milling machine and a computer-controlled sewing machine). We believe that the advent of such devices over the next decade or so will effect a sea change in the range and expressiveness of children's crafts.

Embedding Computation Within Craft Items

The previous paragraphs have focused on craft activities in which the constructed objects are composed of materials such as paper, string, wood, and plaster. In this sense, the craft materials themselves are "non-computational"; but it is also possible to explore the use of small, inexpensive embedded computers to create craft objects endowed with computational capabilities. That is, rather than limiting children's crafts to "static" materials, we can imagine new types of crafts in which the materials have interesting, complex, or child-programmable behaviors.

A sample project from our lab along these lines is illustrated in Figure 7. The figure shows a collection of small cubes or SmartTiles (Eisenberg, Buechley, & Elumeze, 2004), each of which contains an embedded
Figure 7. A five-by-five cellular automaton array of *SmartTiles*. Each tile is running the automaton rule associated with the well-known "Game of Life." Most of the cubes here display their "on" state through a simple red LED. The cube at bottom right is connected to a commercial mechanical toy; each time that this cube is in its "on" state, a motor turns the mechanical toy.

We think of the Figure 7 system, therefore, as a prototype of a construction medium in which each of the elements may be given its own distinct running program; the cubes are rather like individual snippets of behavior that may be combined into a larger array. Moreover, the elements in the array needn't be in the shape of simple cubes, nor need their state be reflected in an on/off light: that is, each construction element might be (say) connected to an audio synthesizer, a mechanical device, or a monitor screen.

Thus, the Figure 7 prototype, simple as it is, should be thought of as a first step toward a craft medium in which each connected piece is associated with a visible bit of behavior (whether that behavior is manifested in light, sound, or action). Indeed, the figure actually shows a collection of pieces in which one single cube has been replaced by a motor connected to a commercial mechanical kit; whenever the running program causes that position to be "on," the mechanical toy twirls about. This is just a hint of the wildly complex and creative behaviors that could be realized by a full-fledged computational craft medium.

Innovative Materials and Children's Crafts

Buried in the preceding description of the *SmartTiles* project was a mention that each of the cubes in Figure 7 includes a piezoelectric disk that makes each cube touch-sensitive. *Piezoelectric materials* are substances that convert mechanical deformation along some particular axis into a voltage difference along that axis; in practical terms, when such a material is placed on a surface, that surface can be rendered sensitive to the pressure of a child's touch (Eisenberg, 2005). Piezoelectricity as a phenomenon has been known for over a century; but the advent of inexpensive piezoelectrics (just to take this single example of a new material) suggests fascinating directions for the design of children’s craft activities. One might use these materials to design, for example, touch-sensitive beads, or mosaic tiles, or bits of fabric, or craft-related instruments (such as woodworking tools or knitting needles). In the case of *SmartTiles*, the use of embedded piezoelectric materials means that the cubes in a running simulation may have their states changed simply by running one's hand along the array.

Piezoelectric materials are in fact one instance of a much larger genre of novel, responsive materials of various sorts—materials that over the next decade are certain to find their way into children’s activities. This new landscape of “stuff” includes shape memory alloys (substances that change shape in response to temperature change), electroluminescent materials (substances that “light up” in response to an applied voltage), electrorheological fluids (that change viscosity in response to applied voltage), temperature-sensitive films (that change color in response to temperature),...
and many others. Collectively, such materials represent extraordinarily fertile territory for exploration in the design of new children’s crafts. Just to mention a few possibilities: We could imagine creating glowing multicolored string sculptures or surfaces (similar in spirit to the Figure 5 example) composed of electroluminescent wire; or child-controllable wave-tank patterns made from electrorheological fluids; or mechanical sculptures whose movements are in part dictated by the alterations of shape memory alloys. Such projects are only possibilities for now—but they represent highly plausible directions for experimentation (see Eisenberg, 2005).

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**Children’s Crafts as a Focus of Educational Technology Research**

The previous section described a representative (though not exhaustive) sample of the projects in our Craft Technology Laboratory. Having looked at these examples, it is worthwhile now to step back and address the question of why children’s crafts represent a promising focus for educational technologists. Or, to put the question in terms of the initial discussion: Why should educational technology research place proportionately more focus on these types of children’s activities and (inevitably, then) proportionately a bit less on screen-based classroom-type instruction?

**Integrating Computational and Physical Media**

In fact, there is a growing interest in integrating computational and physical media in children’s activities. Much of the most interesting work in this regard is due to Mitchel Resnick and his colleagues at the MIT Media Lab. Many of Resnick’s “digital manipulatives” (Resnick et al., 1996; Resnick et al., 1998) are certainly close in spirit to the “craft items with embedded computation” discussed earlier. Resnick’s group is in turn influenced by the notion of “Constructionism” described eloquently by Papert (1991), and focusing on the use of computers to create public artifacts (though not always tangible artifacts; many of Papert’s most prominent examples focus on the construction of programs, abstract models, and simulations of various sorts).

A number of other contemporary efforts focus on the use of computational media in children’s activities. Notable examples include the “computational construction kit” work of P. Wyeth and G. Wyeth (2001), and the integration of computational tools into natural settings described by Y. Rogers and colleagues (2004).

All of these various efforts can be seen as placing a greater emphasis on blending computers, powerfully and tastefully, into children’s tangible lives. The emphasis of the work described here is more explicitly on children’s crafts—on the use of physical materials to create physical (or mixed physical/computational) objects that illustrate or resonate with mathematical or scientific ideas; but clearly this emphasis is part of a larger spectrum of related work in educational technology.

**Why Study This Subject?**

Nonetheless, it is still fair to say that a great deal more work in this direction needs to be done; and that the still relatively sparse community of researchers interested in children’s crafts (and other physical activities) could benefit from an explicit statement of purpose. To return, then, to our question from the beginning of the section: Why study this subject? Why should the community of researchers in craft technology expect to (or deserve to) grow?

**Cognitive Reasons.** We believe that there are several ways of replying to this question. The first is what might be called the cognitive reasons—the activities that children undertake with materials—with “stuff”—arguably form a central element in the growth of their ideas about mathematics and science. By the same token, a purely screen-based introduction to mathematical and scientific ideas is liable to be, in cognitive terms, shallow and incomplete: that is, we would not expect a child whose scientific and mathematical education consisted purely or predominantly of such materials to form deep understandings of those subjects. Admittedly, this is a delicate argument to make, and requires a good deal more space than could be afforded here.

One might begin making the case for this argument informally, by looking at the biographies, autobiographies, and reminiscences of professional scientists. Often such references are scattered about, but a reasonable sampling can be found in the recent book *Curious Minds* (Brockman, 2004), a collection of interviews with adult scientists about their formative experiences. While such material is admittedly “anecdotal evidence” (it’s hard to see how biography in general could be anything else), and while generalizations are always subject to revision, it is fair to say that a number of patterns emerge from this literature. Adult scientists and mathematicians, when pressed to recall how they became interested in the subject, typically talk in terms of activities (as in, “I used to spend hours working at...”), of settings (as in, “I used to haunt...”), and role models (a teacher, parent, relative, girlfriend, or boyfriend).

In other words—at the risk of oversimplification—scientists recall their budding interest in the field as a matter of things that they did or built, special places that they occupied, and people that they knew. Rarely in this tradition of reminiscence do we find a central place for the classroom (and although books are often mentioned, those books are themselves often
biographical narratives or inspirational descriptions of science rather than books focused on skill acquisition).

For a researcher interested in mathematics or science education, it would be hard to come away from this literature with anything but an emphasis on children's activities, and the settings in which they occur. To put the matter a little more aphoristically, math and science educators should worry about providing purpose, not skills, as the primary imperative; the biographical evidence suggests that a child with a goal will find ways of achieving the skills to meet that goal, while a purposeless child with a bunch of skills (like doing geometric proofs or factoring equations) will never show up in a book like *Curious Minds*.

There is more to this argument, though, beyond biographical evidence. A thorough discussion of the matter would draw on the extensive literature surrounding “hands-on” science education (in which activities with materials play a central part in the growth of understanding of the natural world); the burgeoning cognitive science literature around notions such as “embodied cognition,” in which problem-solving activity is often linked to kinesthetic activity and physical intuition—see Clark (1997) for a general introduction, or Lakoff and Núñez (2000) for a discussion related to mathematics in particular; and even more recent literature on the role of physical movement, such as gesture (Goldin-Meadow, 2003) in cognitive development. In short, there are ample reasons to believe that a focus on children's long-term activities with tangible materials constitutes a foundation for their cognitive growth in a way that purely screen-based activities cannot match. Again, the argument is not that such “abstract” activities are counterindicated; only that they are, if unaccompanied by more craft-based activities, radically incomplete as a basis for math and science education.

**Social and Affective Reasons.** Beyond the cognitive reasons for studying children's crafts, it should also be mentioned that these sorts of activities play a social and affective role in children’s lives. In our own work with children, we have noticed this sort of phenomenon repeatedly in the context of crafts and construction. Children who create, for example, polyhedral models often incorporate their creations into their social lives: Models are kept as souvenirs, given as gifts to parents or teachers or friends, assembled into displays, even given pet names. It is rare to see this sort of “social currency” held by purely screen-based artifacts (we don’t often see a program file or simulation given as a gift or treated as a souvenir). Any educational researcher with an interest in motivation and personal development—that is, with an interest not merely in how children learn about science, but in how they become scientists—should be interested in this craft- or activity-centered view of education.

**Intellectual Reasons.** There are likewise strong intellectual reasons for educational researchers to study the integration of computational media and children's crafts. We have found that the sorts of projects described in this article are remarkably fertile sources of fascinating research problems of all sorts. In some cases, the problems have a strongly mathematical flavor. To take one example: In *HyperGami*, the task for the program is not merely to unfold a polyhedron into a folding net, but to do so in a way that produces a relatively easy folding net to assemble. This is a problem that blends together algorithmic elements (how to unfold a polyhedral surface) and interface elements (how to produce a humanly manageable folding net). Or, to take another example: The *PopUp Workshop* system includes a (rather sophisticated and still not altogether reliable) algorithm for adjusting the three-dimensional structure of the proposed popup card as that card is opened and closed.

Beyond issues such as these, there are still other intellectual challenges in the area of computational craft technology. Developing design applications for crafts, for example, necessarily involves a deep reappraisal of what the fundamental tasks of a given craft activity might be, and what sorts of formalisms might be needed to support that activity. (In the case of *MachineShop*, for instance, a program session typically begins with the user making a qualitative judgment of what sort of transfer-of-motion pattern is involved in creating a mechanical toy—a fundamental decision that is rarely discussed explicitly in the presentation of non-computational kits for mechanical construction.) In short, then, researchers in computationally-enriched crafts needn’t worry about a lack of technical and scientific problems to tackle (nor need they worry about a lack of papers to write!).

**Philosophical...Reasons.** We cannot conceal the fact that there are philosophical—or, perhaps, political and economic—reasons for studying children’s crafts and their evolution. Much has been written over the past several years about the problematic nature of a commercial culture that relentlessly encourages children in their role as consumers; see Linn (2004) and Milner (2004) for particularly interesting discussions of this issue. We believe that the culture of child-friendly design acts as something of a counterweight to the surrounding culture of consumption.

As the technology of crafts continues to develop through means such as fabrication tools and novel materials, we would hope to see a burgeoning culture in which children are able to create and personalize (rather than purchase and re-purchase and re-re-purchase) the items of interest to them. Indeed, we feel that an examination of even the best and most educationally rich items of children's culture—items such as mathematical puzzles, kaleidoscopes, tops,
tterra, animal models, mobiles, and so forth—will increasingly become the objects of children's design rather than objects of purchase. Even more exciting is the prospect that children can have a hand in creating the objects, the interests, and—by extension—the selves that will see them into adulthood.

### Conclusion

For most of this article, our focus has been on the various projects going on in our laboratory, and the design themes that underlie those projects. But the last section, focusing on the "why" question—why do this sort of design at all?—hints at a more important subject, one that goes beyond the particular projects of any one research group, one that indeed goes beyond the topic of technology (or computers) per se. That more important subject is the role of children's activities in education.

We believe that educational designers should devote greater attention—far, far greater attention—to the vocations that children seek out, over long periods of time, of their own volition. Not all these individual activities are educationally oriented, of course, and arguably not all are worth encouraging; but, at their best, these activities form the most fertile, optimistic aspects of children's lives. Craft activities in particular are among the most creative, idiosyncratic, patient, fascinating things that young people do in the course of constructing their own adult selves. It is through the design, enrichment, and study of such activities that educators—whether they happen to be interested in technology or not—can make the greatest impact on children's intellectual lives.

### References


### Websites


Craft Technology Group: [www.cs.colorado.edu/~ctg](http://www.cs.colorado.edu/~ctg)

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