

The Homeowner as Constructor
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Nature of Constructionist Learning
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Construction for Adults

For most adults, the word construction evokes images of wood, nails, and plaster, drilling and hammering, dust and dirt; a gradual process leading to a building structure; foundation, framework, walls, and roof. The most personal connotation of construction might be in relation to home, being custom built, remodeled, or repaired.

Home construction can be agonizing, an activity you watch anxiously from the sidelines. It's costly and slow and requires continual negotiation with building professionals, whom you may or may not trust. It is also, however, an expressive act, marking your success as an adult and communicating your faith in the future. At the end, you have something to share with your family and friends, structure your daily life, and give context to your memories.

What role should the homeowner play in this process? With the exception of the rare do-it-yourselfer who can do it all by herself or the fortunate few who can hire a skilled and insightful architect, most people are placed into an uneasy relationship with builders, contractors, and supply stores, not sure of what they can personally contribute or control. Home design, for the homeowner, may be reduced to basic aesthetic decisions ("traditional" or "eclectic"?) and the acceptance of canned solutions, resulting in just another cookie-cutter home. Too often, construction for adults is one more activity in which they must play a subjugated role.

But the act of construction can be so much more. This is clear from constructionism, a learn by designing, building, and constructing approach to education, pioneered by Seymour Papert (1980). Papert's work, and that of researchers and educators who followed (Resnick, (1994); Bruckman, (1998); Bers, (2001); to name a few), demonstrates that complex and abstract ideas can become more learnable when they are appropriated by the learner through constructive acts that result in a meaningful and sharable product. Constructing here means forging rich, personal connections; making decisions, constraints, and ideas explicit; tinkering and debugging in an iterative process of exploration and

improvement; and communicating through the sharing of your creation. Construction of a home should be all these things, not just for the builder, but also for the people who will live there.

The Role of the Client in Home Design

The House_n research group at the MIT Media Lab investigates tools for home design, fabrication, and customization. A basic query to these projects may be, why does the home matter? Why should people expend effort on improving the home? Aside from the fact that people already do commit a sizable amount of time and money to purchasing, building, maintaining, repairing, and customizing the home, it is useful to consider what a home does for its inhabitants.

Your home is an extension of your identity and structures your behavior. It can affect health and lifestyle decisions: an awkward kitchen is one more reason to grab take-out tonight. It can affect social interactions: a home that represents you and your ideals will be one that you want to share with guests. These are subtle influences on the way you live; the most tangible impact may occur near the end of life, when you injure yourself and have to give up your independence because your home no longer supports you. The transition from home to an assisted living facility often marks a significant downturn in quality of life; most people would rather remain in their homes, or at least have the choice to do so. With more people working and educating themselves from home and with longer lifespans that include home-care for chronic conditions, the opportunity is widened for supportive interactions with personal space, as well as inconveniences and injuries.

The advancement of building and digital technologies may permit homes to become more customizable and livable. Rather than being a static entity, the home may evolve, through changes to exterior, infrastructure, and interior, to meet the needs of the inhabitants. Materials may be easier to assemble, repair, and change out. Display and monitoring technologies may allow the home to interact with its inhabitants, rather than just

be acted within and upon. Many aspects of home design and construction have been slow to change, but there is possibility now for significant developments.

One approach to these advances is to couple them with AI-enabled home design tools that automatically generate custom plans for the homeowner. These smart systems would theoretically replace the design expert, but consequently also replace the contributions of the homeowner. There is a real challenge to the creation of such systems, which would have to act on a complex set of rules, variables, and constraints, even to create a workable, much less ideal, solution to home design. Tools that recommend partial or simplified solutions may be more achievable.

Assuming, however, that a complete and powerful system could be created, there will still be need for reliable and informative input about the requirements and resources of the homeowner. Budgetary issues, physical impairments, family size, activity patterns, and aesthetic preferences will vary across individuals. To create an optimal solution, users will have to provide the system with descriptive information about their lifestyle and values and the system will have to translate this information to design solutions. Although the homeowner is an expert about him or herself on some level, he or she may not know what information is relevant or takes priority, and much of what he or she does, needs, and believes may be so tacit, it is difficult to surface without critical reflection. There should continue, therefore, to be a role for the homeowner, as the best source for understanding his or her needs and values, through a thoughtful and reflective process.

It is also unclear whether people would accept a solution that they don't understand or own in some sense. The problem with "magical" solutions or frameworks is that they must be accepted or rejected as "all or nothing" units, rather than provisionally adopted for their underlying ideas. If homeowners detect one detail that is not consistent with their understanding of themselves or their vision of their home, they are likely to reject the entire solution. Homeowners will also have to share these plans with design experts or resources, and unless they can express and argue for the critical concepts as modifications are made

over the course of the building process, those concepts are not likely to be adequately represented in the final plans. Homeowners need to be advocates of ideas.

Placing homeowners in a passive role is not consistent with the overall goal of making livable homes. Removing their voice from the process has resulted in homes that don't respect individual differences and don't reflect actual living practices as they change with the times and over the lifespan. Homeowners can catalyze the industry by demanding usability and accessibility and informing industry about the way they live, what they value, and their in situ solutions to day-to-day challenges. Homeowners can only do this if they see themselves as valuable contributors and inventors – as co-constructors of home design.

Home Design from the Homeowner's Perspective

A consistent goal of constructionist environments is to give learners access to “powerful ideas” (Papert, 2000). Powerful ideas are not important because they meet some nationally determined curriculum or because they are part of an archaic rite of passage – something through which everyone has to suffer (e.g. sentence diagramming, trigonometry). Instead, they empower the learner to approach a subject domain and beyond with a model or process that is both view broadening and personally intuitive. Powerful ideas in constructionist environments have included algorithmic thinking (Logo; Papert, 1980), decentralized thinking (starLogo; Resnick, 1994), moral decision-making (Zora; Bers, 2001), and mentoring (MOOSE Crossing; Bruckman, 1998). Given this tradition of powerful ideas, it is useful to ask, what is powerful in home design?

Home design is about aesthetics, but it's also about usability, accessibility, safety, efficiency, maintainability, and durability. It is about layout, but also about materials, lighting, infrastructure, technologies, behaviors, and practices. It necessarily involves trade-offs, the balancing of constraints, and consequences of chained decision-making. If done well, it anticipates the future, as the designer thinks forward in time. It is also nostalgic and visceral, expressing cultural and personal histories and giving form to identity (“this is who I

am”) and emotional well-being (“protection”, “independence”). It is both science and art and necessarily involves processes and ideas representing both domains.

To design well, assumptions about what is required and what is possible need to be examined. Why is there always a window above the sink in the kitchen? Will I only need to think about issues like safety when I’m older? Do I want this feature just because my mom had it in her home? Does a decision about flooring affect any other decisions I make? Recognizing assumptions based on outdated cultural norms or unconscious emotional associations can change how the homeowner thinks about the source of knowledge, possibly leading him or her to question behaviors or beliefs in a variety of everyday contexts.

Seeing everyday contexts and activities as material for critical reflection invites homeowners to appreciate their personal expertise. They build up a lifetime of experiences within homes, interacting with spatial structures, adapting behaviors, ordering activities, and occasionally, getting injured or inconvenienced when their space doesn’t support them. In these experiences, they have answers and solutions, counterexamples and cautionary tales that could trigger innovation, or at least, if recognized, match them with particularly effective designs.

The homeowner who connects with these ideas, the complexity of design, the necessity of reflection, and the recognition of everyday expertise, must then enter into a communicative relationship with building and design experts. Such an interchange, between client and supplier, novice and expert, is repeated in many other adult activities, including health care. To be able to describe needs, express ideas, and argue for one’s vision, while benefiting from the specialized knowledge of another adult, expands one’s expertise and knowledge in a way more powerful than any personally held information.

Ideas from Constructionism

In educating themselves about home design, most people draw on information resources, such as books, magazines, and web sites, and CAD software marketed to non-

professionals. Adults come to the task out of their own volition and in pursuit of a strongly personal goal that involves the application of the information, not just the information itself. The collection and selective application of information is a kind of constructionist act, where the homeowner creates his or her own theory of good home design. If he or she can appropriately synthesize this theory, apply it to the specific personal context, and express the result to a builder, he or she can already play an active role in the design process.

However, even with some of the better information sources and design tools, ideas in design can remain abstract, diffuse, and difficult to integrate. Most resources fail to situate knowledge in personal contexts, address possible preconceptions, or make visible the source and development of design concepts. The vague authority and static nature implied by non-interactive resources can leave homeowners unclear about how they can bend, alter, or build upon ideas to create a custom solution. Design software applications frequently give the impression that the main role of the homeowner should be to select among predefined aesthetic categories (“Southwestern”, “country”), or they provide complicated 3D interfaces that primarily succeed in underscoring the importance of hiring a professional to determine exact spatial dimensions. Unless the homeowner is particularly adept at visualizing usable solutions, these tools fail to leverage his or her expertise.

Given that adults are in a good position to learn about home design, having independently chosen to do so and in pursuit of a personally meaningful goal, how can information resources and design tools help make the powerful ideas in home design learnable?

In constructionist environments and using constructionist tools, children have generated graphics (Papert, 1980), built robots (Resnick, Bruckman, & Martin, 1996), made their own scientific instruments (Resnick, Berg, & Eisenberg, 2000), and tackled issues of social justice (Bers, 2001): skills and ideas beyond what many people would think them capable. An immediate response might be to zoom in on the “learn by designing” aspect of

constructionism and assume that any activity involving design and construction will translate to powerful learning experiences (Papert, 1991).

By this criterion, Bob Vila's 3D Room Design Studio, a web application that invites users to design their new kitchen, should be considered a constructionist tool that empowers and educates. Yet, most of what users come away with is a frustration with spatial arrangements and confusion about what a good design should be.

Users search and "collect" products, which they can drag into a 3D room in a slow, tedious process. In addition to permitting spatial relationships that defy physics (a chair in the middle of a table), it is very easy to create unusable configurations, that block access, that lack standard elements, and that are unrecognizable at the level of kitchen functionality. That the user can create bad design is perhaps not a critical failing, but there is no way, other than visual inspection, to evaluate what a design implies for use. Although three-dimensional, it is quite different from a real home, lacking utensils, food items, and most significantly, people. This tool is deficient in several qualities of effective constructionist tools, preventing it from approaching the ideal.

Redefining Authoritative Knowledge

Implicit in much standard education is the message that you cannot contribute or be the authority until you have done the time and can use the tools of the domain. You are not a healer unless you have been trained in modern medicine (Jordan, 1989). You are not a mathematician unless you can manipulate complex equations (Papert, 1980). You are not a home designer unless you can generate detailed floor plans and speak the language of design. A consistent theme in constructionist environments is a reassessment of who can contribute to a domain and when. Children can build robots or program physics concepts without having the prerequisite years of math classes (Resnick, Bruckman, & Martin, 1996; Papert, 1980). They are able to do this because their materials, tools, and mentors let them speak in their own language, making personal connections, and constructing at a

meaningful level. So physics doesn't have to be manipulated at the level of equations, but instead can be explored through behaviors and patterns. Similarly, home design shouldn't have to be generated at the level of measurements and spatial relations, but in a form that draws on the expertise and personal experiences of the homeowner – a language of use.

Making Process Explicit and Consequences Self-Evident

Constructionist activities are characterized by a focus on process, whether in the programming of algorithmic steps or the slow build-up of robotic pieces. The constructed artifact represents the decisions to date and can change again to reflect updates to the learner's model and goals. Through tinkering, the learner is able to recognize the consequences of chained decisions, as the artifact succeeds or fails in behaving as expected in the relevant environment. A child building a robot will know something is not right when it spins incessantly in circles, and instead of evaluating the robot as an indivisible unit, something right or wrong, he or she is able to break open the "black box" and test out relevant modifications (Resnick, Berg, & Eisenberg, 2000).

Even though home design and construction is extended in time, usually taking months, and sometimes years, to complete, there is a sense once it is completed that there is no going back; the structure is built and any "revisions" will require significant effort, best put off for several years down the line. Unless the homeowner is a do-it-yourselfer, he or she may feel uncomfortable tinkering, trying out ideas and considering the implications of decisions. To let the homeowner play, explore, and revise, might both give him or her an opportunity to find the most optimal design and shift his or her model of the home as something that is made of interlocking, and changeable pieces, that can continue to be modified, to recreate the whole. Although tools such as the Bob Vila application permit tinkering, it is at a level that is not meaningful, and in fact quite tedious. An environment or tools that supports homeowners in constructing and revising at a usability and livability level would make tinkering seem more powerful, more enjoyable, and more meaningful.

An Object-to-Communicate-with

The constructionist process is not like end-of-chapter exercises; it results in a product that can be shared as a relevant contribution to the task or domain. This makes sense because truly powerful ideas shouldn't be about just one person, they should affect the learner in such a way that he or she wants and needs to share them, and perhaps even does so unconsciously in what he or she says or does. For the domain of home design, the sharing can be with family members, other homeowners, or design experts. Artifacts, such as design briefs, stories, and diagrams, can support these sharing interactions, by providing a common language or space that can be acted upon and referenced.

Within families, a common vision needs to be developed, in order to achieve a home that represents everyone. One family member may be interested in what the home reflects about aesthetic preferences; another may be more concerned about whether a particular activity will be adequately supported. An effective product would therefore be an "object-to-communicate-with" that helps families make their contrasting and complementary perspectives discernible, to carry to the next step of synthesis and compromise. Creators of home design tools may here take a cue from a "cultural constructionism" school (Hooper, 1998), where children and adults construct to convey their cultural and community identity or from Zora, an environment for the exploration of moral values (Bers, 2001). In these environments, learners feel comfortable expressing themselves, hearing from others (in their culture and outside it), and constructing a group identity.

Although you wouldn't know it from lonely home design web sites, where tumbleweeds practically roll on by, you're not alone in home design. Homeowners face the same challenges, in deciding on needs, interacting with builders, and dealing with the consequences of poor design (e.g. when grandma falls on the slippery bathroom floor). Most people are not accustomed to life in the home as a topic of conversation, but when queried, they can quickly think of war stories from home construction or fond memories of their

childhood home. Bulletin boards and chat-rooms can be used to exchange solutions or ask questions, but they fall short of making homeowner expertise a valid commodity.

Supporters of situated cognition have argued for the value of a “community of learners,” that is neither solely student-run nor teacher-run, but instead involves all members as legitimate participants in meaningful work (Rogoff, 1994, Lave & Wenger, 1991). In such a community, the experts are recognized for the experience and interests they bring and even the novice or inexperienced can make valuable contributions.

Such legitimate participation can be also aspired to for homeowners and design experts, both in the application of design to specific projects and in the general metamorphosis of the industry. Homeowners shouldn't have to be transformed into architects and builders; that would be similar to expecting every child who creates with Logo to become a mathematician. Instead, their expertise in use should be recognized for the unique contribution it can make to the exercise of design. Builders similarly should still be able to apply their professional expertise, working with homeowners to create the best solution. A long-term goal for research on tools that educate and empower homeowners in design will be to mediate and enhance interactions with building professionals, to support co-construction of the home.

Homeowner as Constructor

At House_n, in designing tools for homeowners, our initial thought was to address deficits in livability and usability of homes by devising a system that would generate custom design briefs that employ universal design. Universal design refers to principles of accessibility and usability that can meet the challenges of physical and cognitive impairments, while also benefiting people with normal functioning. Universal design can assist older adults and children, the disabled, injured, or just tired, the tall, the short, and the left-handed. The lever door handle that is easier on arthritic hands, is also easier to

grasp by small hands, hands encumbered with groceries, or sticky-hands covered in cookie dough.

Builders don't automatically incorporate accessibility features, resulting in houses that may work okay when a family first moves in, but don't adapt well to changing conditions, such as disability and aging of the inhabitants. Any changes to building practices need to come from consumer demand, so the best approach to achieving wide-scale usability is through the homeowner.

In our efforts to collect and describe the rules that would define usability for the home, we recognized that input about the inhabitants would be necessary: usability is more about the people who use the interface, tools, and space, rather than the materials and objects. In designing a kitchen, we would need to know how many cooks there are, if any inhabitants already had special requirements, such as sufficient space for a wheelchair, and whether entertaining meant banter while chopping vegetables or a formal affair where the food is seen but the cooking isn't. This meant that before any custom plan could be generated, the homeowner would need to describe his or her lifestyle and needs.

By talking with architects, we learned that getting clients to express what they really do and need is not always an easy task (personal communication, Thomas McLeish, Ed Steinfeld, Jarmo Suominen). A request for a large kitchen, upon careful inquiry, may be revealed as a desire to capture something about one's childhood home, rather than reflecting any real interest in cooking. A rejection of a window placement or room ordering may have more to do with a stereotyped conception of a house than an understanding of functional implications. Tools that would help people be reflective and then expressive might be a welcome enhancement to the interaction between professional and client. We also heard that there is a lot architects and builders don't know about the way people live and how space structures activity; the opportunity to learn more about real people, after the honeymoon with a new home ends, is appealing to many professionals in the design community.

By talking with homeowners, we learned that while there is concern about adequately filling a more active role (“I’m not a designer”), there is also interest in workable solutions to issues of usability and accessibility. We asked a few people to comment on the current resources on the web; they responded with pleasant surprise over the variety of ideas they discovered at information sites, but frustration with design tools. They liked being informed, but felt uncomfortable fiddling with measurements and spatial relationships.

Where we saw the most dramatic response, however, was in regard to personal experiences with the home and ideas about how to improve it. In a short meeting with the MIT SilverStringers, a community of older adults who publish their own web newsletter, we heard idea after idea, tied in with personal stories of home construction, injury, and life events, several of which described actual, if not commonly available, products. One woman told me her idea for shower knobs on the back wall, “so you wouldn’t have to reach through the hot or cold water to adjust the temperature.” Another woman recounted how she and her husband had put in stair rails for their young children that were used again when her ailing mother-in-law moved in. One man sent us a multi-page list of ideas for everything from oven burners to electrical infrastructure

Although we continue to research the translation of usability and universal design into workable design rules, our focus is now not so much on smart tools, as it is on smart users. We want to create environments and tools that help homeowners recognize their preconceptions and reflect on their needs and behaviors. We want to assist homeowners with translating their experiences in use to the language of design, so that they can better communicate with builders. Finally, we want to elevate the expertise of homeowners, so it can inform industry and most importantly, so homeowners can own not just their homes, but also the design ideas that created them.

We are investigating what form these environments should take, with a particular eye to the above discussed constructionist qualities. Design storytelling may offer homeowners the chance to explore what-if scenarios, accumulate decisions, and synthesize

designs in a language that is their own. Rather than expecting homeowners to embrace open-ended stream of consciousness storytelling, a more structured interface would allow users to assemble stories, based on decisions, common activities, roles, and possible events. To give homeowners creative power over the medium, they might create their own story-arcs, using visual associations between behaviors, objects, and places, or contribute their custom solutions or reasoning. Constructionist environments such as MOOSE Crossing and Zora having taken advantage of storytelling as a method to get learners involved and help them express themselves (Bruckman, 1998; Bers, 2001). Storytelling is also used as a means of problem solving in day-to-day activities (Jordan, 1989). Homeowners should be able to ask, "why am I choosing this and what will it mean?" and be able to return to those decisions, later in the process, through a context (personal story) that makes sense. This is part of making the process of decision-making, and hence design, explicit. Ultimately, they should be able to ask, "is this the story I want to tell?"

Interfaces such as storytelling, or design games or exercises, may be combined with a design community, where homeowners can share experiences and ideas and get feedback from other homeowners or experts. The object and place centered nature of the subject is an added advantage for structuring discussion and virtual objects, such as design stories or design briefs (accumulated decisions, possibly represented as visual 2D or 3D spaces), can mediate interactions. A design toolkit or palette, where users can select from features relevant to use (handles, human-dimensioned heights and widths), has the potential of assisting users in sharing inventions.

With any user contribution-based resource, there is a question of value; how much are you willing to sift through to find the important kernels? This is a particular challenge in content-generic interfaces such as bulletin boards, but resources tailored to a particular content area (e.g. Amazon, Photos.net) can take advantage of common reference material (books for Amazon, photos for Photos.net) to aid searches and member-standings (rate the raters for Amazon, member portfolios for Photos.net) to help clarify authenticity and

expertise. In constructionist environments, such as Zora, learners do more than offer flippant observations or suggestions; they create stories, places, and objects that they must stand-by as representations of themselves and their ideas (Bers, 2001). Perhaps virtual artifacts of home design can serve a similar validating role.

Still, there will likely continue to be doubt among users about other homeowners' approaches and ideas. In the end, if some of the doubt remains, maybe that's not such a bad thing; after all, there is a kind of power in homeowners questioning the validity, and authority, of design.

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