

# **New Literacies and the Learning Sciences: A Framework for Understanding Youths' Media Arts Practices**

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**Abstract:** This paper turns our attention to the arts and New Literacy Studies as an understudied area in the learning sciences. Our study documents, describes, and analyzes urban youths' Media Arts Practices within a Computer Clubhouse, drawing on the New Literacy Studies movement and work on authentic practices. Results indicated that youth engaged in at least eight literate practices aligned with professional communities in the arts, media, and new technologies. We organize these practices into the technical, creative, and critical practices of Media Arts production and offer a new conceptual framework for this emergent field. Media Arts are particularly relevant to the learning sciences because of the shared focus on new technologies and computation. The new field of Media Arts is not well understood in the research literature but has the potential to teach us about learning and literacy in the age of multimedia.

## **Introduction**

As technologies for communication, design, and entertainment become more ubiquitous, our notions of literacy expand. Educators and researchers in the field of new literacies are diversifying traditional notions of literacy to include decoding, evaluating, and producing electronic media, particularly by studying the out-of-school and informal literacy practices of youth (see for example Moje, 2000). Our work is situated within the New Media Studies movement, and focuses on urban youth as authors of these new media texts, such as videogames, interactive art, and animations. While many researchers acknowledge the role of authoring new media in meeting technology fluency, media literacy, and visual literacy goals (National Research Council, 1999; Greenaway, 2001; Kress & van Leeuwen, 1996), very few within the field have empirically examined this topic, particularly in which ways youths' media culture and practices can be used to support an expanded view of literacy and learning. The need for this type of work also overlaps with the emergent efforts of learning scientists to examine the impact of new technologies on learning and literacy today. As Palincsar and Ladewski (2006) point out, new literacies, despite being an understudied area, share many parallels and points of intersection with the learning sciences, which suggests that much could be gained from the cross-fertilization of these two fields. In fact, the two fields have a great deal in common, including an understanding of literacy and technology as being intertwined (Reinking et al., 1997); a core focus on modeling learning in authentic contexts (Kolodner, 1991; Scribner & Cole, 1981); and recognition that literacies are multiple and situated (Nixon, 2003).

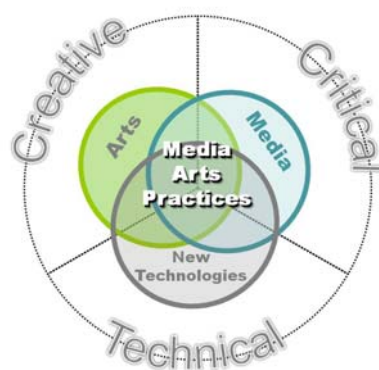
The purpose of this paper is to present a framework to document, describe, and analyze urban youths' Media Arts Practices within the context of a design studio in a Computer Clubhouse. "Media Art" is used here to encompass the creative, technical and critical practices involving or referring to all forms of art that makes use of electronic equipment, computation, and new communication technologies (Paul, 2003). We define Media Arts Practices (MAP) as literate events in which one engages in Media Arts and the reasons and motivations for doing so, building on prior research on the literacy practices of adolescents in out-of-school settings (Moje, 2000). We were especially interested in authentic practices that are developmentally appropriate versions of expert practices in the field of media, new technologies, and the arts. We have chosen to limit our analyses to those events that involved media or Media Arts texts, particularly those that involved the use of visual programming software called "Scratch" (Resnick, Kafai, & Maeda, 2003). This enabled us to study how urban youth choose to combine oral, aural, visual, and written practices of the arts, new media, and technology and interconnect these modes of language as literate practices. We utilize a mixed-methods design that analyzed data from participants' observations and Media Arts projects archives.

## **Conceptual Framework for Defining Media Arts Practices**

Today, literacy can be broadly defined as including any type of communicative interaction involving speaking, reading, listening, and writing with text in print and non-print forms (Hagood, Stevens, & Reinking, 2002), which largely characterizes the field of New Literacy Studies (see for example Barton & Hamilton, 2000; Moje, 2000). Commonly, this group of scholars posits that literacies are best understood as a set of social practices, which can be inferred from events and mediated by written, visual, and other types of texts (Barton &

Hamilton, 2000). Hence, the basic unit of a social theory of literacy is that of literacy practices, defined as the general cultural ways of utilizing language (Barton & Hamilton, 2000). Researchers from a variety of fields have demonstrated that a text is no longer a sequence of alphabetic characters on a piece of paper; rather social arrangements, tagging, type of dress, singing, drawing, and dancing can all be viewed as texts. While previous studies have focused on literate practices of youth in context of science (Barton & Rivet, 2004) and other out-of-school settings (Moje, 2000), we have chosen to focus on the literacy practices of youth engaged in Media Arts production, which we refer to as MAP. The texts that will be the focus of this study will be Media Arts texts—written texts, software programs, media images, oral discussion about media or media artwork, or the Media Art objects, themselves. These Media Arts texts and events (i.e., youths' Media Arts Practices) will be explored as the basis of this inquiry. By introducing MAP, we are trying to broaden our view of literacy practices to describe the ways in which individuals use literacy and learn to be literate within the specific context of new media.

To investigate MAP, we're drawing upon situated learning theory, which places importance on social interaction as being fundamental to learning. Central to this theory is the notion of "communities of practice," which serves to reinforce the values and behaviors to be learned (Lave and Wenger, 1991). Starting at the periphery of the community, learners begin as novices and move toward fuller forms of participation, as they become more knowledgeable participants. We have focused on a subset of youths' MAP that could be described as "authentic practices" because they parallel what experts do in three key disciplines: Arts, Media, and New Technologies. Authentic practices have been defined within the Learning Sciences as engaging students in "developmentally appropriate versions of the situated and meaningful practices of experts" (Sawyer, 2006, p. 5). In this study, we expand on this understanding to include what authentic practices might look like within the context of Media Art. However, since the Media Arts are an emergent field with a short history (Paul, 2003) that draws on several established disciplines, we have focused on the intersection of professional practices from the arts, media, and new technologies as the basis for our understanding of the situated and meaningful MAP of experts (see Figure 1). In Figure 1, the three inner circles represent the fields that provide a foundation for our conceptualization of Media Art. Any overlap of two or more circles creates an area that we describe as MAP. This conceptualization is grounded in our earlier reflections (Peppler & Kafai, 2007) as well as from interviews with professional Media Artists (Peppler, 2007).



**Figure 1.** Situating Media Arts Practices as an interdisciplinary field, heavily drawing on our understanding of the arts, media, and new technologies. The overlaying pie chart situates the three main coding categories that were of interest to this study: the Technical, Creative, and Critical practices of Media Art production.

This framework represents a mixture of emic (insider) and etic (outsider) perspectives on the local culture (Erickson, 1979). The question of authentic participation we are assessing is the following: What constitutes participation or learning in each of these individual disciplines (i.e., the arts, media, and new technologies)? Professionals assess knowledge in each of these domains differently. The outer circle of Figure 1 is segmented into three parts to reflect this distinction: the creative, critical, and technical practices of Media Arts. For example, creative practices are rooted in an artistic tradition, while critical practices are rooted in a media education tradition, and technical practices are rooted in the work on new technologies and technology fluency. Although practices that would be recognized by experts in each field are distinct, they also share similarities with the other fields. This is reflected in the figure by lines stemming from the outer circle, dividing the circle in thirds, but not entirely on the boundaries of each field. For example, creative practices are not entirely the domain of the arts; they can be a part of the practices of those working with new media and technologies. Professionals working on these margins might be web designers and animators. The same applies for critical and technical practices of production—we argue that discussing participation as a synthesis of all three disciplines more accurately describes Media Arts learning and the multiple literacies of the Computer

Clubhouse. In the upcoming passages, we take a closer look at each segment of the outer circle in Figure 1 and point to how this informs our framework for this study.

## **Technical Practices**

Those in the field of new technologies would be interested in the ways in which youth engage in a wide variety of technology fluency goals, including intellectual capabilities, information technology concepts, and information technology skills (e.g., sustained reasoning, managing problems and finding solutions, programming, and using graphics and/or artwork packages to create illustrations, slides, or other image-based expressions of ideas). We use the term “technology fluency” here as being distinct from computer literacy because the latter term is often reduced to basic functions such as word processing and web surfing (National Research Council, 1999). Technology fluency includes higher-level skills and concepts such as algorithmic thinking and programming, for example. While traditional programming projects have tended to focus on mathematical and science content (Papert & Resnick, 1993), here we emphasized graphic, music and video applications—media that have been found to be at the core of technology interests for youth. Overlapping with these goals, Media Art projects often use programming as a means to understand the production and manipulation of familiar media (Maeda, 2004; Reas, 2006). Programming within the context of Media Art is particularly important because it allows individuals to manipulate the computer as a medium of expression. In this context, we emphasize the programming or software design of media applications as a pathway toward technology fluency. In an effort to introduce the essentials of software design to young software designers, we argue that learning to code is an important building block for originality and expression in digital media. We have chosen to focus on some technical practices of the youths’ MAP that coincide with these technology fluency goals including Programming, Debugging, and Repurposing events (see Table 1).

## **Creative Practices**

For those in the arts, participation involves expanding beyond some of these technical dimensions of production toward creative or artistic ends. Many of the goals that artists have overlap with visual literacy goals, such as the importance of being able to interpret and express original ideas in a variety of modalities (such as through music, dance, sculpture, or dramatization), and are frequently able to make meaningful connections between two or more of these modalities (Kress & van Leeuwen, 1996). In our analyses, we have highlighted these two literacy events as either “making artistic choices,” which is the practice of learning about and appreciating artistic principles within any particular modality, or “connecting multimodal sign systems,” which is the practice of crossing between two modalities (e.g., visual and sound, visual and movement or gesture, and sound and movement) to convey an artistic idea (see Table 1). For example, choosing an image of a forest and then finding colors to augment the idea that the forest is scary versus making it a friendly space is considered “making artistic choices.” Importing an audio file of “Take Me Out to the Ballgame” into an illustration of a baseball diamond in order to make the scene appear “real” is an example of “connecting multimodal sign systems” (in this case, visual and sound). While the first practice creates the opportunity for learning traditional skills in any one discipline (e.g., perspective, movement, melody), the latter practice demonstrates the youths’ ability to depict objects and ideas as a combination of stimuli, and is an important aspect of meaning-making and learning how to convey certain ideas in the Clubhouse space.

## **Critical Practices**

For those in the field of media education, participation involves critically viewing media and using this understanding when creating original work. As youth begin to take advantage of living in a digital world by capitalizing on the wealth of images, sounds, and videos accessible as “materials” to reuse in their own work, media educators are particularly concerned about the ways in which youth are either reinscribing or questioning existing dominant norms (Buckingham, 2003). Critical practices of production that are of interest to media educators (and arguably are of interest to those in other fields as well) include being able to critically reflect on and evaluate media texts, understanding references made in popular texts, and deconstructing and interpreting the meaning behind such texts (Buckingham, 2003). These overlap with the coding categories that we have derived for the critical practices of Media Arts production (see Table 1). We should note that, in this work, we are primarily interested in youths’ ability to author these texts and we are not necessarily interested in their ability to read such texts (although arguably reading and writing overlap a great deal). This decision was made, in part, to call attention the understudied area of creative production within the field of media literacy, as previous studies have already focused on reading and critical reflection (Buckingham, 2003; Peppler & Kafai, 2007). By observing the critical practices of Clubhouse youth in this way, we gain an understanding of the extent to which young designers understand and question the popular texts that they incorporate in their portfolios, apart from what they learn about software programming and the arts.

Accumulatively, these technical, creative and critical practices of Media Arts production paint a more detailed picture of the types of learning that occur in our study. The participants in this study become

transitional members of all of these communities because part of their work connects in very specific ways to each of these disciplines. However, we want to note that this perspective may also at times undermine the uniqueness of the discipline of Media Arts. In short, Media Arts are more than the sum of each of these disciplines; there are unique skills and concepts needed to participate in Media Arts that are not found elsewhere (Reas, 2006), which we explore in this paper and in our other work (Peppler, 2007).

## **Portrait of a Design Studio: Contexts, Participants, & Tools**

Since 2004, we have engaged as mentors and researchers at the design studio in South Central Los Angeles, California, seeking to better understand youths' MAP. The Clubhouse is situated at a storefront location in one of the city's poorest areas and annually serves over 1000 high-poverty African American and Hispanic youth, mostly between the ages of 10 and 16. The Computer Clubhouse is not a stand-alone center; Not only is it part of a local community organization, it's also a part of world-wide network of over 100 design centers funded by the Intel® Corporation, designed to embody constructionist principles that acknowledge that youth learn best when they are actively engaged in design activities (Resnick, Rusk, & Cooke, 1998). Although each center shares some similarities with others in the network, they are uniquely adapted to the local context through the help of the partnering community organization and Clubhouse coordinators.

At this particular design studio, there is a rich assortment of creative software and various other artistic materials, such as digital cameras, microphones, and musical instruments, that are utilized by the Clubhouse members in an integrated fashion, oftentimes building on work created or recorded in one environment and altered in another. Youth have access to an impressive variety of software, including the Microsoft Office suite, Bryce 5, Painter 7, RPG Maker, and video, photography, and sound editing software. Of particular interest is one media-rich programming environment, Scratch, which was specifically designed for the Clubhouse environment to facilitate media manipulation (Resnick, Kafai, & Maeda, 2003). Scratch differs from other visual programming environments by using a familiar building block command structure, eliminating thorny debugging process of syntax errors. Programming objects can be any imported graphic web image, can be uniquely created or drawn, or chosen from a personal archive of work created with other software programs including Painter7 and Bryce5. Additionally, designers can create or incorporate existing sound files, video, and other input/output devices, such as with homemade input/output devices, making design projects truly media-rich.

## **Research Approach**

We used a concurrent mixed methods approach (Creswell, 2003) involving participant field notes, video capture, and a Media Art archive because it was appropriate for recording the interplay between MAP and Media Arts learning at the various levels of activity within the Clubhouse. A mixed methods design also supported triangulation among distinct data sources and allowed us to examine different, yet sometimes overlapping, multilevel facets of the research site. This represents a novel approach to research in the field of new literacy studies. Prior methods that have been used in informal settings have included ethnographies (Thorne, 1993), case studies (Barton & Rivet, 2004; Moje 2000), and surveys (Gallagher, 2006). This study integrates multiple types of data sources, including the use of archival data stored on a central server and the weekly collection of Media Arts projects in order to document individual and community involvement in MAP over a three-year period of time. We analyzed the data based on the following research question: What are the multiple literacy practices, specifically those related to visual, media, and technology literacies, of the members participating in Media Arts events at the Computer Clubhouse? We examined how MAP served as sites for multiple literacies. Thus we coded events that involved repurposing, programming, debugging, making artistic choices, connecting multimodal sign systems, observing, deconstructing, evaluating, reflecting, referencing, reworking, and remixing Media Arts texts (see Table 1).

Several undergraduate and graduate student field researchers took extensive participant field notes over a period of three years. During this time, other artifacts were gathered that were important to understanding and documenting the local Clubhouse culture and were used to amplify the field notes, including occasional videotapes, information posted on the Computer Clubhouse Network website ([www.computerclubhouse.org](http://www.computerclubhouse.org)), and other types of artifacts generated at the local Clubhouse. Since literacy practices are general cultural ways of utilizing language, it was important that our analyses extended beyond the particularities of individual experiences to examine MAP, as they were instantiated over time and across a variety of members and mentoring relationships. For that purpose, we randomly pulled 20 percent of the field notes ( $n = 58$ ) from the larger field note archive ( $n = 284$ ) to use for further analyses. Our analysis indicates that this was a fairly representative sample of the range of literacy events that took place at the Clubhouse during this time. For example, the number of field notes that contained Scratch events constituted 59.5% of the total field note archive ( $n = 169$ ) and constituted 58.6% of the random sample ( $n = 34$ ). Data was coded primarily by the first author and an outside coder and discussed at weekly research meetings. If disagreement existed on the meaning or application of codes, we debated differences until consensus was reached on 100% of the data coded.

Table 1. Table of Media Arts Practices by Event Type.

MEDIA ARTS PRACTICES	EVENT TYPE	DEFINITION	SAMPLE EXCERPT FROM THE FIELD NOTES	Percent of Docs	Number of Events
Technical Practices of Production	Programming	Practice of computer programming (e.g., use of loops, conditional statements, user-interface design, etc.)	<i>Chandelle... finally found the "glide" command and got really exited explaining to me what it was. (02/09/06)</i>	28% (16)	28
	Debugging	Practice of persisting when confronted with technical problems either prior to or during production.	<i>She got an error message... I came over to her and explained that she needed to first open the application... She looked for the Scratch shortcut on the desktop, but couldn't find it. (01/19/06)</i>	22% (13)	25
	Repurposing	Practice of reusing earlier ideas or chunks of materials to build upon in a single or in multiple works.	<i>Kaylee asked me, "Do you know how to copy scripts to another Sprite by dragging them there?"... She then demonstrated this a couple times. (05/22/05)</i>	14% (8)	13
Creative Practices of Production	Making Artistic Choices	Practice of learning about, appreciating, and applying artistic principles within a single modality, including choosing objects' color, size, and movement.	<i>Darlene said... "Look cousin! I am going to draw a house, a red house." (02/01/05)</i>	21% (12)	21
	Connecting Multimodal Sign Systems	Practice of learning about, appreciating, and designing interrelations within and across multiple modalities (images, word, and action).	<i>[Alejandra] had an image of Scooby Doo and was working on making it change colors and say "Happy early birthday"... she had added a long message... and made the whole image change colors gradually with the "change color by effect" command. (02/01/05)</i>	22% (13)	28
Critical Practices of Production	Observing and Deconstructing Media	Careful observation by youth looking more closely at everyday objects and deconstructing texts.	<i>I asked [Jorge] how he made the sketches for the animations (he had approximately 3 sheets full of drawings depicting how the characters should look in each frame of animation). He said, "I play the game, and draw it based on that." (02/05)</i>	10% (6)	9
	Evaluating & Reflecting (AKA Critique)	Practice of peers deciding what constitutes a good product.	<i>The other mentors and members...made comments like "whoa that knight just did a sneak attack" or "dang that's awesome!" [when they were viewing the Ashley's dragon project]. (05/16/06)</i>	21% (12)	21
	Referencing, Reworking & Remixing	The practices of creating original works that make knowing reference to previous works. Wholly original work produced as art fall into the category of playable art and are excluded from this category.	<i>I asked him what he wanted to make and he told me that he liked that popular radio hip-hop/pop song, "Lonely" by Akon. (06/02/05)</i>	21% (12)	19

## The Multiple Literacies of Media Arts Practices

For members of the Clubhouse community, Media Arts are enacted as a set of interconnected literacy practices that are a mix of established literacies, ranging from traditional, to visual, to media literacies and technology fluencies. Although it's somewhat artificial to separate and dissect their practices and map them onto traditional understandings, much can be learned from this undertaking, such as observing how the entire ecology of MAP fits together and how youth not only engage in technical and creative practices but these practices can also intertwine in interesting ways with critical practices. The collection of practices presented in this section of the paper is a starting point to give the reader a feel for the complexity and range of MAP that have developed at

this particular Clubhouse over the past three years. It's important to note that not all designers partake in all of these practices, and even central participants engage in these practices unevenly. In the following summary table, the number of field notes from the random sample containing at least one node with each of the practices examined in this study is recorded below (see Table 1).

Overall, youth seem to most frequently engage in the technical practices of production. We envision that some of these technical practices of production form a foundation for legitimate participation in the Media Arts activities (i.e., opening and exploring Scratch and then saving a project file are fundamental to being counted and included in our boundaries for constituting participation in this community). Creative and critical practices seemed to stay relatively constant with no discernible trends over the course of the study. However, there is some indication that these practices became more culturally engraved over time and we would like to point out three longitudinal trends that will be highlighted in the corresponding discussion on the multiple literacies of MAP. First, both debugging events and technical practices seemed to decrease over time. The trend for the meta-category, technical practices of production, seems to be driven primarily by debugging events as programming events actually demonstrated an upward trend in the field, indicating that programming was becoming a more frequent activity.

## Discussion

The complex array of illustrations, findings, and analyses that were presented here were a first effort to articulate what MAP are within the context of a particular setting. We found that youth were engaged in wide range of literacy practices—across what we might conventionally categorize as visual literacy, media literacy and technology fluencies—that youth interwove in interesting ways as they produced Media Art. Technical practices were perhaps the most frequently documented and ranged from repurposing, programming, and debugging events. When youth were engaged in these technical practices, they were learning about and demonstrating a range of technology fluencies. Secondly, creative practices were important to youth as they learned to communicate through multimodal forms of text and engage in personally meaningful and expressive work. These practices overlapped and extended what we know about youths' engagement in visual literacy to include a broader array of semiotic texts in their Media Arts projects. Lastly, youth also engaged in critical practices that would resonate with multiple fields, but especially with the goals of media education. The MAP framework presented earlier (Figure 1) provided a comprehensive way to describe and better understand the multiple literacies that youth are already engaging in at the Computer Clubhouse. Youth learn about programming, debugging computer problems, how to talk about and critique their work and the work of others, how to reference and remix popular culture texts, and how to use technology towards creative and expressive ends.

Given that this study aimed to build our conceptual understanding of the new field of Media Arts, it's worth pausing to reflect on the limitations of the study and, largely, of creative production in an informal site. In particular, what types of events or general practices were noticeably absent from this local community? The notion of developmentally appropriate practices (Sawyer, 2006) is significant as we think about the range of practices to encourage in this setting. For example, the differences that exist between professional Media Artists and youth on the valuing of popular culture are an important distinction. Although the findings from this study suggest that drawing on popular culture texts is key to entrance and persistence in MAP, this may get lost in future curriculum designs. After all, youth are not vying to become professionals, per se – which is also true for youth engaging in a broader range of practices, like science – they are vying to become recognized members of their local community. However, striving for recognition is common to both context of youth and professionals, while what is valued in each community clearly varies. In addition, there are some practices that could be further stimulated or encouraged in formal or informal contexts. For example, systematic reflection, thinking about and explaining the creative process was not a common practice rooted in the Clubhouse community. This would be the equivalent to the critique process in the arts classroom. When asked, youth are able to discuss their work and the work of others but this practice wasn't a formal part of the Clubhouse community. As a consequence, youth are learning the language of Scratch but not perhaps the language of computer programming, the arts or media that would be used in more formal or expert/novice discussions of the work. For example, youth commonly use words like Sprite, scripts, and background because they are labeled in the software but don't adopt other terms like perspective, warm and cool colors, loops, conditionals, etc. from the fields that are very much in line with their work. We have to wonder what impact this might have as we expect these types of skills to transfer outside of the Clubhouse community.

Literacy practices as a theoretical framework, in particularly the MAP framework presented here, have utility for revealing the limitations of current research in new literacy studies. Prior research often focuses in certain types of literacies in isolation from others (for example, visual literacy as isolated from traditional literacy, media literacy, technology fluency, etc.), while youth—especially those in this study—operate without recognition of these distinctions. The shortcomings of this perspective are that we miss out on the opportunity to cultivate relationships with other subject areas across the schooling curriculum. By contrast, the MAP

framework is the first effort to think about how youth engage in multiple literacies rooted in different disciplines during the process of media arts production. On a more practical level, this study suggests that several aspects of informal learning environments may be important as we think of bridging youths' after-school literacy practices into school settings. Important design considerations include the role of individual choice of project in the curriculum; the role of having ready access to mentors – at least on an occasional basis; the role of creating a school culture that allows for liberal offerings of peer assistance; and the role of working across software applications as schools generally focus on advocating a single software (at least it encourages serial exploration) instead of allowing youth to move across different types of software to explore which tools can be combined or are best given a certain objective. Furthermore, schools are still preparing youth to read and write only traditional types of text, while MAP values learning to author multimodal texts. With regard to the specific implications for Media Literacy Studies, the MAP framework discussed in this paper provides a wide array of teaching and learning opportunities for educators to capitalize on in the classroom. Depending on the educational goals and pedagogical framework, Media Arts production provides a context for learning about new technologies and for questioning popular media. More specifically, Media Arts production can be used as a springboard for critical engagement and reflection on reading and writing multimodal texts in the media education classroom.

We see Media Arts as an emerging discipline that can expand research and practice in the fields of the Learning Sciences, Literacy Studies and Arts Education. The Learning Sciences, since its initial conception, have been an interdisciplinary field dedicated to discussing issues that impact learning or are affected by learning in order to affect educational outcomes (Kolodner, 1991). Over the last 16 years, an impressive body of research has been built up, describing learning and teaching processes in science and mathematics classrooms. This research has documented learning in real-world situations; proposed alternative teaching strategies and alternative educational environments based on what we know about learning; reported on experimental work in the field; provided new conceptual or theoretical models of learning; and posed new methodologies, among a host of other research contributions (Sawyer, 2006). While impressive progress has been made, there are still noticeable absences (Goetz, 2007). For example, studies on new technologies and particularly computer programming have a long history within the learning sciences, whereas media studies and the arts have been virtually absent. Our work seeks to fill these gaps in the learning sciences research literature in at least three key ways. First, this study is one of the initial investigations into new literacies from a learning science perspective. Second, the focus here is on the arts as a subject matter rather than investigating new literacies within the context of science and math, which have a longer history in the field of learning sciences. Media arts have had a longstanding relationship with the sciences, enabling researchers to envision and model complex ideas to shape the field and theoretical understandings in significant ways. And third, this study has investigated MAP in the context of what urban youth are already doing in informal learning settings, which responds to the call for more research on marginalized youth.

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