Perpetual Teaching Across Temporary Places: Conditions, Motivations, and Practices of New Media Artists Teaching Computing Workshops

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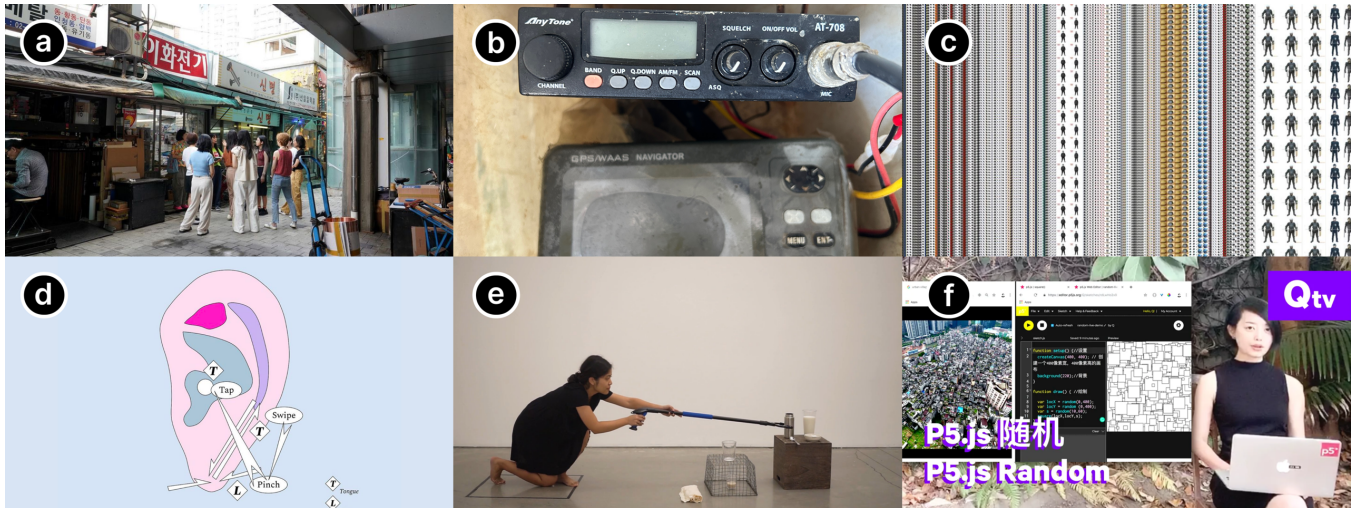La Jolla, California, USA
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Figure 1: Examples of computing workshops taught by the 18 new media artists that we interviewed: a) Guided tour of Eulji-ro, an industrial district in Seoul, Korea specialized in electronics and hardware that was historically less accessible (Credit: WOMAN OPEN TECH LAB). b) Field trip to a local fishery to demonstrate coding with data within a local context to address local issues; a radio and a navigator used in fishing activities in Phan Ri Cua, Vietnam (Credit: Nhan Phan). c) Guided coding tutorial on creating artwork using a repurposed web scraping tool; a digital collage of scraped images from an online marketplace for search result terms like "riot gear" and "human labor." (Credit: Sam Lavigne). d) Speculative design workshop where the artist-educator's work is presented as a metaphoric framework to discuss and reimagine sexuality; an application where a user interacts with an ear to "satisfy" the app (Credit: Nahee Kim). e) Performance class that explores the concept of "user" and interaction from various angles where the exploration is presented as performance art pieces (Credit: Celynne Ianne, Lauren Lee McCarthy). f) Friendly short tutorial videos of the p5.js library in Mandarin shared on BiliBili, TikTok, YouTube, and Instagram (Credit: Qianqian Ye).

ABSTRACT

Why and how do new media artists teach computing? Over the past decade, computing has become a part of the standard curriculum in university art and design departments, along with the advent of influential informal learning communities and self-organized schools. This paper is the first systematic attempt to map the diverse conditions, motivations, and practices of new media artists teaching computing. Interviews with 18 new media artists from 5 countries and 17 different sites revealed that teaching computing is closely integrated with their art practice, with a shared aim to cultivate new cultures in computing rather than only to transfer knowledge. We gathered new media artists' accounts of precarious work, lack of time and place for their practices, and unrealistic expectations for instant results they face in their teaching. Within these precarious conditions, they developed a unique set of practices for "perpetual teaching," which promotes self-reflective, critical, and situated learning. Our findings from this study are a call for further investigation of educators' roles in creating cultures in computing, especially incorporating practices outside of conventional computing education settings.

CCS CONCEPTS

• **Social and professional topics** → **Informal education**; **Computing education programs**.

KEYWORDS

new media art, tech workshops, creative coding

1 INTRODUCTION

Digital art, or *new media art* [63], has gained significant prominence in contemporary culture over the past few decades. This term encompasses artworks that proliferated with the emergence of digital new media or "the genealogy of the computer as an expressive medium" [63]. Popular examples include AR/VR experiences, AI art, media facades, procedural design, game art, and computer animation [2, 21]. In addition, there are many other longstanding forms of practices that follow the vein of research-based critical practices and public art – projects that focus on critically examining technology through research and building local communities of learners.

New media artists must learn computing to build the skills necessary for their craft. Programmable media is not only taught as workshops in university art and design departments but also in self-organized schools and other informal settings. For example, the School for Poetic Computation (SFPC) based in New York City is an artist-run organization that has been hosting artist-led workshops and events under the motto "more poetry less demo" since 2013 – emphasizing a place for exploring the poetics of computation rather than being a "technical bootcamp" [8]. These workshops relevant to computing education are often taught by practicing artists.

These artists' motivations for teaching are in part practical: Aside from integrating teaching with their art practice, they also need to make a living and sustain their art financially often through service-oriented work (e.g., teaching, community outreach, event organization, consulting, etc.), similar to other types of precarious cultural workers [18]. Especially for digital art, this form of artwork has become highly reproducible [4], dispersive [47], and requires constant maintenance [61], which makes it less financially marketable than traditional mediums like painting. *With few exceptions, many of these new media artists' career paths are precarious, fragmented, and unsustainable for the long term.* This reality suggests that the conditions in which new media artists teach and learn may significantly diverge from traditional computing education within universities, K-12 settings, and tech industry professional development seminars. Thus far, the computing education research community has not yet focused on this unique set of pedagogical conditions. This notable gap motivates the central questions that drive our research: *What does teaching computing mean for new media artists? What are the focal points of their pedagogical projects and how do they connect to the rest of their art practice?*

In this paper we present, to our knowledge, the first study to investigate artist-driven pedagogical projects for teaching computing by interviewing 18 instructors, all of whom are actively-practicing new media artists who also teach inside or outside of formal institutions. Due to changes in the art market and the pressure to constantly "stay up-to-date," artists must engage in "perpetual training" [10, 61, 62] to keep their technical skills current. Our study finds that artists strategically understand and respond to these conditions, developing what we call *perpetual teaching* – reframing the internalized duty or responsibility of perpetual training into pedagogical frameworks. These new frameworks help participants (both instructors and learners) discover their own needs, generate their own new dialogues, and situate themselves within a community. As shown in Figure 1, perpetual teaching manifests in diverse forms across varied contexts, from teaching oneself how to use a novel tool, to collectively writing code in a self-organized workshop, to teaching undergraduate students how to think computationally, to guiding newcomers to open-source software communities. *For the new media artists we interviewed, teaching, learning, and art practice often blend together.*

Figure 2 summarizes our main findings: We identified the conditions of perpetual teaching and the personal values and motivations behind the design of artist-led computing workshops. We found that artist-educators are motivated by creating spaces to unlearn ineffective conventions and incubate new cultures rather than by technical knowledge transfer alone. Furthermore, they intended to design their workshop materials (e.g., prompts, activities, reading lists) to prepare participants to create critical interpretations of computing outside of mainstream tech career pipelines.

Our study contributes to computing education research by *expanding the boundary of what it means to teach computing* to include the experiences of a unique population of practitioner-instructors operating far outside of university computer science departments and K-12 STEM contexts. We discovered that new opportunities arise when new media artists took on the challenges of perpetual teaching and made them into participatory projects or workshops. When enough momentum is gained, communities of learners emerge where the boundaries between teachers and learners are blurred. From here, teaching not only plays a significant role in their art-making process but also opens up space for independent pedagogical ventures. We also confirmed that a broader set of cultural practices exists in introductory computing courses within art departments and self-organized schools.

In addition, building more contextual knowledge outside of computational thinking and specific technical skills – from personal to interpersonal to sociocultural to historical contexts of computing – was found to be equally valued by the community of learners whom these artist-educators taught in their workshops. Future work could investigate how such contextual knowledge can facilitate new cultures in computing. Prompted by these insights, we call for a more thorough investigation of the nature of computing education's field-specific norms and conventions, and the processes behind the intergenerational transmission of such norms.

CONDITIONS

| Precarious Work | Time-and-Place Limits | | Unrealistic Student Expectations |

- Inhuman scale and hype cycle of tech
- Legitimacy issues and alienation from platforms

MOTIVATIONS

| To Fill Gaps | To Reveal | To Produce Artwork | To Cultivate New Cultures |

PRACTICES

| Self-Reflective Practices | Critical Practices | Situated Practices |

- Reshape relationship with technology
- Develop metacognitive skills

- Cast technology into broader contexts
- Reinterpret the dominant discourse of technology
- Leave room for intentional misinterpretations

- Forking new communities
- Creating artist-led tech organizations

Figure 2: Summary of qualitative findings from our interviews with 18 artist-educators who teach computing, with emergent themes that reflect their conditions (Section 4), motivations (Section 5), and teaching practices (Section 6).

2 BACKGROUND

Here we present prior work in labor sociology, computing education, and situated learning, which forms the background for our interview study.

2.1 From New Media Art to Immaterial Labor to Self-Organized Schools to Creative Coding

The term *new media art* encompasses a wide range of artworks created with electronic and new media technologies – "computer programming, graphical human-computer interface, hypertext, computer multimedia" and networking [63]. For several decades, new media artists' practices have been extensively studied by sociologists as an example of precarious cultural work on immaterial labor [1, 18, 24, 43, 56]. Here cultural workers partake in portfolio careers – "ongoing investments in resources and development to create a portfolio of skills and experiences" [43] – to remain hireable in a precarious job market [43, 56]. In addition, the dependency of new media artworks on tech industry services and products has grown over time. Nowadays industry decisions "directly impact the creation of [users'] work; its longevity; and, often, their own perceptions of it," [60] pressuring artists to engage in *perpetual training* [10, 60, 61] to stay aligned with industry standards and practices. Our study findings extend this idea to a term we introduce, *perpetual teaching*, where artist-educators continually teach and learn together with their workshop participants, and moreover encourage participants to develop sustainable strategies to teach themselves in the future.

At the same time, artists have long been keen on *school*'s potential as a site of fluidic experimentation and intervention [17, 57].

Ever since self-organized schools from artist communities developed in the 1960s, many experimental teaching projects have been replicated by subsequent generations [57]. These experimental learning environments share some of the ethos of democratizing technology with end-user programming [30, 31] and non-specialist teaching [32, 42, 51]. Our interview findings connect this historical influence to new media art and creative coding education in particular.

In parallel to self-organized schools, new tools created by artists and designers outside of the tech industry started to emerge, responding to the art and design field's domain-specific needs and rethinking artists' relationship with computational media. The most notable example of such an open-source tool is the *Processing* coding environment [48, 49] starting in the early 2000s, a comprehensive framework for making coding accessible for design and art communities by providing a programming language and IDE tailored to image and sound-making processes. With the advent of subsequent tools and platforms throughout the 2000s and 2010s (e.g., p5.js [15]), creative coding carved out its place in design and art programs, artist-run spaces [36], and other sites both inside and outside of formal educational institutions.

In recent years, the focus of new media art education moved to learning and discussing technology (from "how to make" to the "what and why to make" questions) [36], connecting to the fields of software studies and critical digital literacy. Newer published works that demonstrate this shift include *Aesthetic Programming* for learning "cultural thinking" of software (2020) [54] and *Critical Code Studies* [39] (2020) for applying "critical hermeneutics" to computer code. Another related interventional practice falls under digital literacy education, which aims to invite the general public to

critical discussions on technology through participatory workshops [25, 40].

Inspired by these lines of work threading sociology, artist-led schools, and creative coding projects, we performed the first research study that aims to capture the firsthand conditions and motivations of new media artists working at the contemporary frontier of computing education.

2.2 Broadening Participation In Computing Through Education

Our work's relevance to computing education is via broadening participation, whose challenges have been studied extensively in the past few decades [13, 59]. To address this perennial issue, there is a growing interest in computing education research for importing creative coding tools into existing CS curricula. Preliminary studies here were on intro computer science courses as a part of an undergraduate CS program [20, 65], a MOOC [44], and other STEM curriculum [12, 19]. In parallel, the HCI community started designing new creative coding IDEs [41]. These modern lines of work can be traced back to earlier works on *media computation*, an approach to introducing computer science concepts using media manipulation as the context for broadening participation [23, 55, 64], which has some shared values with creative coding in new media arts. However, the above research primarily focused on evaluating the effectiveness of programming curricula for achieving learning outcomes as specified by the values of computing educators. In our experience, this line of work may be disconnected from the conditions, practices, and motivations of new media artists who teach computing, a gap that inspired our study. Our interviews ended up discovering a mismatch between the goals and values of new media artists who teach and those implied by these existing studies' design and findings.

An emerging direction that could better align computing education research with creative coding is *culturally relevant computing* (CRC) education [14, 34, 38]. CRC proposes a community-based intervention framework that aims to increase student motivation and engagement and to build education-based social movements. Previous studies in CRC were often implemented at the content level, for example, merging indigenous knowledge and heritage practice with computing concepts [14]. In a recent study by Lachney, CRC is further framed as a "broker strategy" to create a "symbiosis" between culturally responsive education and community development [34]. This framing highlights how political dimensions may play a central role in teaching [34], a theme that emerged throughout our interviews as well.

2.3 Situated Learning versus Simulated Learning For Computing Education

Many of the pedagogical practices in art studio classes or workshops (such as those we studied) overlap with Lave and Wenger's theories of situated learning and communities of practice (CoP) [35, 52], along with cognitive apprenticeship [11], all of which have been applied to computing education. But long before formal educational systems, many communities throughout human history relied on apprenticeship to train newcomers into their communities [6, 35]. Here, Lave and Wenger's description of apprenticeship has been particularly relevant to art education [52], where it is not limited to "transmission and assimilation" but encompasses *full sociocultural practices of a community*, in order to bring in "[relations], activities, identities, artifacts, and communities of knowledge and practice" to learning [35].

This apprenticeship metaphor has spread and been applied to fields as diverse as literary to math education [7]. A line of research influenced by situated learning and CoP is the cognitive apprenticeship (CA) framework [11], which aims to unify apprenticeship with schooling, revealing the "cognitive and metacognitive processes" of practitioners to students [6]. These practitioner strategies include modeling, coaching, reflection, articulation, and exploration, which significantly overlap with some of the strategies used by the new media artists we interviewed when teaching their workshops. However, unlike what our interviewees reported, the CA framework seems to 1) separate the teacher's and learner's roles and 2) prioritize unidirectional cultural learning or be agnostic to the sociocultural contexts of learning.

In addition, despite CA in computing education having been studied since the 1990s, a recent literature review found that many studies focused on classroom applications of CA, thus missing opportunities to test and further develop theory in more authentic situated contexts [53]. This may have resulted from how classes are ultimately "simulated" versions of expert practice and thus situated outside of real-world computing community contexts [3]. Consequentially, many prior studies focused on evaluation based on result-oriented metrics such as course pass rates, exam performance, and enrollment growth. In contrast, our study's interviewees emphasized authentic contexts for their workshop teaching rather than being constrained by metrics of the formal education system.

3 METHODS

For this study we interviewed 18 *new media artists* [63] who both produce artwork using various electronic media and who teach computing workshops in a variety of settings. Each interview was 1–2 hours long and conducted via Zoom. Interviews were semi-structured and focused on the background of these artist-educators, the structure of the workshops they teach, and their purposes for and perspectives on teaching. Here are our guiding questions:

- Please describe your path to your current position.
- Please share a syllabus or a prompt from your teaching practice that you wish to discuss.
- How do you design your workshop activities (e.g., goals, intentions, or values)?
- How do you organize discussions and other group activities in your workshops?
- What kind of perspectives might be developed or influenced by these activities?

The lead author recorded and translated notes and quotations from recordings of each interview. For analysis, we followed the *abductive analysis framework* [58]: The interviews were each first coded through open coding with a team of two (both authors), and identified codes were categorized into major themes via multiple rounds of iteration between data analysis and collection, to identify "anomalous and surprising empirical findings" [58] against theories of immaterial labor (Section 2.1) and pedagogy (Section 2.3). After

Table 1: We interviewed 18 artist-educators to learn their motivations and practices behind artist-led technology workshops. The 'Years' column denotes years of teaching experience. '-' denotes that the participant wanted this data to remain anonymous.

AE#	Name	Gender	Age	Location	Race/Ethnicity	Years	Affiliation	Path
AE1	Kate Hollenbach	F	35-44	USA	White	6	University	CS to Art
AE2	Qianqian Ye	-	-	-	-	-	University	Art/Design to Tech
AE3	Seungbum Kim	M	35-44	Korea	East Asian	15	Art School	Education to Art
AE4	Youjin Jeon	F	35-44	Korea	East Asian	15	Non-Profit	CS to Art
AE5	-	-	-	-	-	-	University	Interdisciplinary
AE6	-	M	45-54	-	-	14	Independent	Education to Art
AE7	Kenneth Lim	M	25-34	UK	-	5	University	Interdisciplinary
AE8	Nick Briz	M	35-44	USA	Latino	13	University, Art School	Art/Design to Tech
AE9	Min Guhong	M	-	Korea	East Asian	10	For Profit	Humanities to Tech
AE10*	Binna Choi	F	45-54	Korea	East Asian	10	Independent	Education to Art
AE11*	Sooyon Song	F	45-54	Korea	East Asian	10	Independent	Activism to Art
AE12	Lauren Lee McCarthy	F	35-44	USA	Mixed	10	University	CS to Art
AE13	Roopa Vasudevan	F	35-44	USA	South Asian	10	University	CS to Art
AE14	Sam Lavigne	-	35-44	USA	-	8	University	Humanities to Tech
AE15	Nahee Kim	F,NB	25-34	USA	East Asian	2	For Profit	Humanities to Tech
AE16	Tiriree Kananuruk	F	25-34	USA	Southeast Asian	5	University, Art School	Art/Design to Tech
AE17	Nhan Phan	M	25-34	Vietnam	Southeast Asian	4	Independent	Data Science to Art
AE18	-	NB	35-44	UK	East Asian	10	University	Info Science to Art

*AE10 and AE11 create artworks and teach together as a collective, Unmake Lab.

all interviews were completed, the lead author again conducted focused qualitative coding on the full dataset to identify index cases and build variations to find overarching dimensions.

3.1 Interview Participant Backgrounds

Table 1 summarizes the backgrounds of the 18 artist-educators we interviewed. We recruited participants in-person at new media art conferences, online through emails, and via snowball sampling. We sought artists who taught computing workshops not only limited to creative coding but that also included adjacent subjects such as procedural design, physical computation, digital fabrication, digital writing, digital literacy, and speculative design, in order to more comprehensively capture a diverse range of teaching settings.

Table 1 shows years of teaching experience ranging from 2 to 15 (mean=9 years). This broad range helps account for fast-shifting trends in the field, how most artist-educators taught multiple subjects throughout the years, and how those who teach creative coding and other adjacent subjects share similar learning spaces. We also aimed for diversity across multiple dimensions as gender (2 Non-binary, 8 Female, 6 Male, 2 anon), as well as institutional affiliations (Art school, For-profit organization, Non-profit organization, Independent artist, University). Albeit falling far short of being a comprehensive representation of international artist-educators, participants were from multiple geographical locations (East Asia-Korea, Europe-UK, North America-USA, Southeast Asia-Vietnam) and ethnic groups (East Asian, Latino, Mixed, South Asian, Southeast Asian, White). Their academic backgrounds and career paths to their current teaching position were similarly diverse (e.g., trained in Art/Design and later getting involved in Tech [Art/Design to Tech], trained in Humanities and then later in Tech [Humanities to Tech], Interdisciplinary training, trained in Education to Art,

Activism to Art, trained in Data science/information science to Art, trained in Computer Science to Art).

3.2 Pedagogical Contexts: Types of Computing Workshops Taught by New Media Artists

The format of new media computing workshops extended beyond the common 'coding for artists' classes or bootcamps. Here are some of our interviewees' workshop formats:

- **Guided tour**: Workshop participants orient to situate – facilitators help newcomers navigate an unfamiliar place and grasp a context where the making of technology happens. (Figure 1-a)
- **Themed seminar**: Participants discuss to interpret – to examine the discourse of technology and connect to larger historical, social, and cultural contexts.
- **Hacking exercises**: Participants tinker to experiment with code and hardware – to understand mechanisms behind computing through manipulation with creative strategies and processes developed by other artists. (Figure 1-c)
- **Speculative nonfiction**: Participants imagine to prototype new interpretations – to ignite conversation and art creation through metaphors. (Figure 1-d)
- **Performance studio**: Participants perform with their bodies and props to sense-make – to experiment with the embodied experience of interaction. (Figure 1-e)

In addition to variations in format, according to the objectives of each workshop, there was variation across how close the workshop activities were connected to real-world practices of new media artists. This dimension spans a spectrum from simulated to highly-situated:

- **Structured Programming/Tinkering Exercises**: designed to simulate an art-making and problem-solving context, providing a foundational experience that emulates the initial stages of a new media artist's workflow.
- **Prototyping Speculative Design**: allowed participants to explore and experiment at a conceptual level, which may be developed into or become a part of their future art practice.
- **Creating Artwork for a Group Exhibition**: allowed participants to experience the entire process of conceptualizing, budgeting, producing, and presenting art in a professional context, thus closely aligning with the practices of new media artists who produce work for public display.
- **Full-Immersion Apprenticeship in Community Art Projects**: Participants took part in apprenticeships working on existing community art projects. This experience provided an entry to real-world collaborative and communal production processes.

3.3 Study Scope and Limitations

While we aimed to interview artist-educators from various demographics and backgrounds, our personal recruitment and snowball sampling methods led to some limitations: In our sample of interviewees, the racial and geographical composition was not proportionally representative of the broader population, as most of our participants self-reported as Asian (East Asian, South Asian, and Southeast Asian) and located in three northern continents. Most of our participants were in the age group 35-44, and nobody was 55 or older, which could be attributed to the relatively short history of the new media art field. Additionally, there is a broad diversity of values and aesthetic focuses within the field of new media art that our study does not address, as we scoped our research to focus on communities engaged in activism around computing technology. For example, our analysis did not capture the opinions of artists who primarily work with sound or those in the film, animation, or video game industries.

We scoped our study to focus solely on workshop instructors since they are the main agents of the tech education framework who not only design and deliver these workshops but who also theorize, advocate, and self-critique them as a part of their art practices. However, this means our study does not include the important viewpoints of students or how the motivations of these instructors play out live in actual workshops. Past critiques caution against relying too heavily on educators' interpretations alone [27]. Paulo Freire of critical pedagogy urges that "an educational practice in which there is no coherent relationship between what educators say and what they do is a disaster [16]," so the relationship between professed beliefs and actual practice should be investigated further. For a more comprehensive understanding of new media arts education, additional studies will be needed to capture student experiences and perform direct observations of these workshops. Our current interview study provides a first glimpse into instructor perspectives in these pedagogical settings, and our findings can hopefully form the basis for future investigations.

4 CONDITIONS PERCEIVED BY NEW MEDIA ARTISTS TEACHING COMPUTING

We divided our study findings into three sections. In this first section we cover the conditions underlying the teaching practices of new media artists as described by the 18 artist-educators we interviewed. We grouped their responses into three themes: precarious work, time-and-place limits, and unrealistic student expectations. These accounts in turn shape their individual goals and practices of teaching, which we will discuss in Sections 5 and 6.

4.1 Precarious Work

Career opportunities for new media artists are limited, unpredictable, and thus precarious. One interviewee described the artist's experience after art school as "surviving in the wild" while emphasizing how artist communities are crucial for sustaining art practices [AE6][1]. Many indicated that when they started their careers, teaching was one of the limited options available to earn income [AE4,9,10+11,14,15]. Despite how common it was to enter the adjuncting path – taking multiple part-time teaching positions on a contractual basis after getting a degree (e.g., an MFA), some interviewees expressed how it is unsustainable to support themselves by juggling part-time positions offered by art schools [AE14]. Some were able to teach full-time as adjunct instructors but were required to relocate (often internationally), and the position was still contract-based [AE13,14]. Outside of higher education teaching positions, teaching opportunities were organized seasonally or as one-time events depending on the availability of funding [AE4, 10+11].

Even when new media artists build a technical career within the tech industry and communities, their paths are disconnected from a conventional full-time career. For example, AE8 and AE14 worked as web developers. However, their past projects did not transition into a long-term project that could financially sustain their art practice. And while AE3 was deeply involved in open-source communities and created independent projects, they also found it hard to support their art practice through such activities.

> **Takeaway:** Teaching is one of the limited ways to generate income for artists whose career options are precarious. Even those who obtained teaching and technical positions are not necessarily full-time.

4.2 Time-and-Place Limits

Artist-educators in our study reported how they work without sufficient time or a safe place for their work to belong, describing the roles of the tech industry, the art world, academia, and education in relation to their pedagogical practice.

4.2.1 No Time: Inhuman Scale and Hype Cycle of Tech. Today's tech stack and infrastructure have a tendency to grow increasingly complex, making them less approachable to newcomers. For example, interviewees described how web development frameworks

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[1]Note that we use AE1, AE2, etc. to refer to the Artist-Educators whom we interviewed for this study, instead of the more traditional P1, P2, etc. Instead, we use the term 'participant' in this paper to refer to those who participated in the classes and workshops that these artist-educators taught.

have grown more intricate and convoluted over the past decade [AE4,14,18], which made teaching and learning harder.

In addition, new media artists are constantly under pressure to stay up-to-date. As described in prior research on cultural workers [1, 18, 24, 43, 56], artwork is often evaluated in terms of novelty. This pressure is especially prominent in new media art, as the history of this field has often been presented in relation to the novelty of the computational medium. AE5 mentioned the dilemma that with the accelerated pace of development of computing technology, the novelty of this medium will quickly diminish by the time it becomes part of any official curriculum. More generally, interviewees felt the pace of technological advancement is accelerating and leaving little room for thoughtful reflection and contemplation [AE4,6,12,14,16-18]. A representative sentiment here came from AE4:

> In this kind of field, they don't have the pace that lets you use technology with poise, carefully taking time. There is no consideration for others who move at different speeds. People reprimand you for [not staying up-to-date]. Even for intro courses, professors are in a rush. [...] Everyone was already onboard, and the focus of the class was on how to quickly produce results.

On top of this, some countries may inadvertently create hype cycles in art and technology education, which then motivates new media artists to switch their practices within a short time frame. For example, AE10+11 (who teach together) described how tech education trends in their country drastically changed within only a few years:

> Around 2012-2017, there were few self-organized DIY communities and other maker spaces. [...] Around 2018, the South Korean government started a campaign, "Training 100,000 makers" [...]. This hype drove us to move away from the maker movement and into art. [Before the 2020s,] [new] media art was always marginalized in the art scene. Then, once government funding for new media art became available, there came a trend or pressure to learn computing technology, especially among young artists.

> **Takeaway:** New media art pedagogy and practices may be interrupted by the speed of hype cycles, which was more prominent in regions geographically and culturally further from the centers of the tech industry.

4.2.2 No Place: Legitimacy Issues and Alienation from Conventional Platforms. As a field, new media art shares its roots in computing media and some history with computer science, but interviewees felt that their methods were marginalized by mainstream computing practitioners. Even those with an established research practice still experience this legitimacy issue within the academic community. AE18 reported their experience at multiple research institutions:

> [...] from my experience [doing research], and being in higher education, it is not always legitimized. People do not see the value of arts; they see people doing art as a funny thing [...], and they do not see art practice as a

> method or even artistic research as a methodology, as a site of thinking [and knowledge production].

Furthermore, artist-run spaces and workshops are mostly supported by seasonal public funding [AE4,10+11]. Even with funding, depending on the local culture, it may be hard to organize and conduct cultural education workshops as independent artists without the backing of institutions [AE10+11]. Gaining legitimacy in the public eye is challenging unless there is "trust established through reputable institutions, such as art museums" [AE10+11]. This legitimacy issue gets worse for artist-educators based in countries without advanced technological infrastructure since there is a "huge gap in communicating" new forms of knowledge production and pedagogy [AE17].

AE3, 4, and 10+11 raised concerns around the lack of dedicated spaces or long-term educational programs for artists to learn technology beyond simple digital literacy classes. AE10+11 pointed out "how most workshops seldom delve into the details or deeper aspects of technology reaching the mechanism level." They also mentioned how the unpredictability of funding, combined with limited resources, made it hard to develop a continuous curriculum to learn advanced topics, despite the clear needs of local artists.

In addition, interviewees talked about how conventional art platforms fail to provide a space for community-engaging or public-friendly art practices, which include the educational workshops that they taught. For example, AE8 mentioned how traditional art gallery settings would not support the types of audience engagement they desire:

> When you walk into a friend's dinner party, you have a different mindset than when you walk into a gallery. Sometimes when you walk into an art gallery, you are on edge, you are reserved, you are closed off, and you feel like 'the art is judging you' as much as you are judging the art and that's not the [mindset] I need to be in when I'm engaging with the ideas that I want to engage with.

Some interviewees recalled having no place for critical training in new media art education [AE13,14]. AE14 described their past training program as:

> [...] really focused on production. And you're forced to just like make a bunch of stuff really quickly all the time but it was not really strong conceptually or theoretically. So I used to joke about it as a sort of bring-your-own theory program. Bring-your-own politics, bring-your-own theory.

> **Takeaway:** New media art practices focused on education are alienated from existing art, education, and technology platforms. Artists are under pressure to argue for their legitimacy and to secure their place.

4.3 Unrealistic Student Expectations

In addition to the precarious nature of their careers and lack of platforms that legitimize their art and teaching practices, artist-educators sometimes face unrealistic expectations from their students. One of the most frequently reported themes here was how

computing classes were *expected to deliver fast and marketable results to students*, which may be at odds with instructors' pedagogical goals.

This view is also frequent in undergraduate art and design classes, where students with unreasonable expectations may suffer from the mismatch between technical skills and ambition, as AE1 recounts:

> [...] it's easier for [artists] to have a vision of what am I doing, why am I making something. But it's harder to make their technical skills match their ambitions. [...] it takes a long time to get to that point where you're not just like copying the examples and like tweaking the numbers, but you're actually recombining things that you know in a new and interesting way. And that is something that students need a lot of time for and they have to actually want to do to get there.

Especially for those who teach undergraduates, there was a unique tension between students prioritizing skill acquisition for job training and instructors trying to promote intellectual exploration of "creative, aesthetic or conceptual ideas" [AE13]. Students prematurely optimized for a specific, narrow scope with the hope of getting immediate outputs that they can use to demonstrate their marketability for future jobs. For instance, AE3 described how their students avoid going out of their comfort zone in team projects:

> [...] while I encourage collaboration, this trend worries me. They are only in their second year, and they say, "you only work on programming, you only work with fabrication, you only work on conceptual parts, you only work on graphics." [...] So in my opinion, it feels like an extension of the old-fashioned vocational school system, where you need to become specialized in one thing quickly and get a job.

This premature specialization could self-disqualify students from opportunities to experiment with technology outside of the paths defined solely by industry standards. The immediate outputs in such cases may entail different media, such as demo reels, VR projects [AE3], or building an app [AE9] that is ready to be shared via online platforms with the goal of "getting hired" as soon as one finishes the educational program [AE1-3,9,13,17,18].

> **Takeaway:** When new media artists teach, they may face unrealistic expectations from students to deliver fast and marketable results, which conflicts with their pedagogical goals.

5 MOTIVATIONS FOR NEW MEDIA ARTISTS TO TEACH COMPUTING

In this section we report the main motivations for artist-educators to teach their computing workshops, which often stem from the unique conditions that they work within (described in the prior section).

5.1 To Fill Gaps

Many artists described the purpose of their workshops as filling gaps left by other forms of computing education. For example, AE9

described how online resources failed for their workshop participants and how their workshop served these people's needs by focusing on learning together and sharing know-how from the instructor's own experience:

> These people tried to self-learn coding using resources on YouTube or other online learning platforms and found that they had a hard time understanding and following them. 'I can't motivate myself to learn coding [when studying alone].' [...] So instead of simply saying, 'It's better for artists to be taught by artists,' I think a class would be more useful for students when taught by a person who went through a similar path that they are about to take. As a person who went through similar failure points and questions that they are about to experience, I can share know-hows [and concrete examples from my experiences].

AE18 mentioned how computing education conventions might alienate learners and how their teaching aims to bridge literature, text, and programming to invite women, non-binary, and queer communities to compute:

> When we teach programming in a more traditional sense [...] a lot of my students feel alienated. But I try to shift it around, [...] relating [programming] to literature and text, then it [...] opens up a new genre. People can tell stories, people can think about content, people can relate more. I see the benefit of bridging these three together and trying to see whether this approach can also attract more women, non-binary, and queer people as well.

> **Takeaway:** Recognizing gaps in the conventional education system, new media artists were motivated to work with learners, especially starting from their closest community to bridge computing with the arts.

5.2 To Reveal

Artist-educators were also motivated to teach in order to reveal how our minds and world operated around computational media. Through presenting the behind-the-scenes of computing, they wanted to encourage students to develop agency and perspective. For example, AE1 described one of the important goals of their class as showing details of steps behind image-making via coding, thus revealing how to think like a creative coder:

> [...] I think what a lot of them tend to think when they're getting started, it's like, oh, I want to draw the shape perfectly. But, you know, [...], how would you make a moon shape? [...] There is no function that draws a crescent moon. But what if you draw a white circle, and then you draw another circle that's the same color as the background over top, but just partially over top of the white circle, then you have a crescent moon shape.

AE3 emphasized how they wanted students to be aware that learning to code means engaging with a transformation in their thinking process:

> *It's impossible to entirely map our intention into a piece of code. Coding is a process that requires us to transform our thoughts in a way that fits them into the computing process, which is different from how human naturally thinks. [...] I want students to be aware of this. For example, you can draw something elaborate with just a simple line function. Then students will meet the point of transformation, like when you learn OOP [Object-Oriented Programming], and their thinking process will be transformed.*

Another frequent motivation of workshops was to reveal the possibilities of a computational medium [AE 7,8,9,10+11, 13]. As an example, AE9 described one of the motivations of their web development workshop was to remind participants about the history of the web and its untapped current potential:

> *"Originally stemmed from an academic project, the web has since evolved into diverse forms. The current dominant web experience represents only a small part of what the medium can offer. So through my class [...] I wanted to introduce many possibilities inherent in this medium."*

Furthermore, many classes were designed to reveal how technology is part of our environment. For example, AE8 described how their class aims to reveal the relationship between us and technology and further encourage students to learn computing to develop agency to leverage technology: "either you are going to use it, or be used by it." [AE8]

> **Takeaway:** Artist-educators were motivated to reveal and demystify the process of working with computational media, encouraging students to develop critical understanding and agency in computing.

5.3   To Produce Artwork

For many of the artists we interviewed, teaching has grown to be a necessary part of their art-making practice. While the majority of them started teaching just to financially support their art, they tended to realize along the way the connection between teaching and art-making. For example, AE4 described their experience in combining the two:

> *Teaching was how I made my livelihood since my artworks are not in forms that can be sold. [...] I began to realize the connection between my teaching and my art practice, and second, the urge that I ought to combine these two. [...] I no longer teach isolated from my art practice.*

Another practical reason to teach was to learn about new technology they could use in their art. For example, AE5 described how they sometimes need to teach a technique that they are not yet familiar with:

> *[I am] not an expert or don't have a lot of experience [with the new technique], but I still get into it [...] teaching the class, I learned projection mapping together with students. [...] I also learn from my students often too.*

> *They have fresh perspectives [and some have extensive experience with particular tools].*

Furthermore, teaching offers new opportunities for artists to engage with participants outside of what traditional art platforms can offer. Their workshops abandon hierarchical structures in order "to meet each other more honestly and sincerely" [AE4] and to be open to uncertainty [AE12], which overlap with some interviewees' aesthetic goals [AE4,9,12,14,16,17]. This theme was motivated by some mentioning how traditional art spaces (i.e., art exhibitions, art galleries) fail to support their intended engagement with audiences, and how teaching can provide an alternative space for it [AE4,8,13]:

> *If you think about how artwork operates, there is an extra layer, the aura of art exhibition, you need to overcome to meet the [message]. I feel there is something already not honest about it. So maybe teaching has become more 'artistic' than fine art - AE4*

> **Takeaway:** For some artist-educators teaching has progressed from a means of financial support into a critical part of their artistic process.

5.4   To Cultivate New Cultures

Lastly, new media artists were motivated by the idea that teaching can be a place to encourage new cultures in computing. All of our interviewees' art practices were based on the assumption that engagement with computational media provides fertile ground to apply artistic strategy and discover new ways of computing.

In this context, teaching was in part motivated by creating a space to encourage students to take risks and open up to uncertainty, as described by AE12:

> *And I do feel like [the space or the opportunity to take risk] is a really important part of the class. That's why I think it's valuable even if people aren't specifically really interested in performance. It's [..] about that risk-taking and that opening yourself up to something where you don't quite know how it's going to end up. And I think that's useful for people even if their practice tends to be [all on the computer].*

This emphasis on cultivation is evident in how artists valued training students to engage with tech issues. AE6 talked about annual gatherings with their workshop alumni:

> *[...] even though they ended up in non-technical fields, their engagement in tech-related issues remains quite high. So, even if you didn't pursue a career in computing, you've developed a disposition to participate in the discussion of technology. I'm proud of how they keep one ear open to technology.*

Some were also motivated to rewrite the narrative of technology in their community, which consists of members who are historically excluded from participating in the production of computing technology. For example, AE4 contrasted what they teach in their workshops to a viewpoint that is prevalent in their country:

> *"[I teach participants that a] programming language is something that is designed by someone, that you may*

find a part that you want to improve one day. [...] In contrast, the following narrative is prevalent in Korea: computer code is something elegant and amazing. It is something that American elites and world geniuses developed over many decades."

> **Takeaway:** New media artists view teaching as a means to promote greater diversity in computing cultures, emphasizing education's role in broadening participation and challenging traditional narratives.

6 PRACTICES OF PERPETUAL TEACHING

We discovered that artist-educators engage in what we call *perpetual teaching*, an extension of Deleuze's concept of perpetual training [10, 61, 62] in which new media artists feel pressured to continually keep their skills up-to-date. For our interview participants, perpetual teaching involves merging teaching with learning and encouraging their workshop participants to build self-reliant skills to learn further on their own. Specifically, shaped by the conditions and motivations covered in Sections 4 and 5, respectively, the following strategic practices of perpetual teaching in media art workshops emerged from our interviews: 1) self-reflective practices for generating new identity, 2) critical practices for generating new discourses, and 3) situated practices for generating new communities.

6.1 Self-Reflective Practices: for generating new identity

We first cover artist-educators' practices for teaching computing at the personal level, which entails self-discovery in relation to technology and building self-efficacy in coding artwork.

6.1.1 Reshape relationship with technology. Several interviewees mentioned that their workshop aims to demystify computing practices [AE1,2,4,7,8,9,13]. For instance, some implemented personalized pedagogy to help participants "unlearn" barriers and reshape their relationships with technology. Most notably, mental barriers to learning computing, which manifest as individual anxieties about failing to use technology in the "correct" or expected manner, were frequently observed in new media art communities [AE4,10-13,15,16]. For example, AE3's students in Korea experience a language barrier: In their creative coding classes, students found the programming language reference guide "scary" because it was written in technical English. Thus, AE3 introduced a special tutorial that guided students to observe the structure of technical documentation. After going over the documentation part by part together in class, "they started to realize, this is not *English*, but structurally organized information." [AE3]

In some cases, a more involved form of guidance was implemented to make the learning experience more welcoming for outgroup learners. As part of a physical computing workshop, AE4 provides a guided tour of Eulji-ro [45], a historically male-dominated industrial district in Seoul famous for specialized electronics and hardware (see Figure 1-a). AE4 pointed out how the location could possess "map fog with horrors of unknown place" for many of

Figure 3: Examples of teaching materials developed by our participants: a) Interactive coding playground. TwoLang is a playground where codes written in two different languages (including Korean-based programming languages) are compiled in real-time and compared side-by-side (Section 6.1.1) (Credit: Seungbum Kim) [28]. b) Art assignment. The first assignment about mistake (Section 6.2.3) from the "Making Mistakes" class at School for Poetic Computation (Credit: Tiriree Kananuruk) [26]. c) Performance. A lecture performance demonstrates the misusage of computer vision technology (Section 6.2.3) before discussing the topic (Credit: Unmake Lab) [33]. d) School as a medium. A small school that teaches coding as practical and conceptual writing has been forked multiple times by former students to create new schools (Section 6.3.1) (Credit: Min Guhong) [22].

their diverse workshop participants. A guided group tour, a "walk-through of something trivial but can't be done by yourself," was implemented as the first part of the workshop program to help all participants get comfortable within a possibly unfamiliar and unwelcoming space.

Lastly, some workshops were entirely devoted to reshaping one's relationship to computing through self-reflection. AE9 described how their web development workshop is designed around revisiting "self-introduction" – starting from participants introducing their mundane past experiences of the web, the curriculum walked participants through the basic process of coding a personal website as part of their self-discovery for personal taste in web development:

> *In order to introduce yourself, you need to put together things about yourself, [...] reveal, emphasize, or hide some aspects about yourself. While you are engaged with these [self-reflecting] processes, you will learn more about yourself [...] Once you begin developing your own web development practice, you will need to know your likes and dislikes and what messages you want to convey.*

6.1.2 Develop metacognitive skills. It was common for new media artists to incorporate activities in their workshops for developing various habits and frameworks related to metacognitive skills [46], such as self-reflection, planning, and setting up a self-motivating framework for sustaining creative practice. One common example

was journaling and writing self-reflections, which is a long-time part of the artistic tradition [AE3].

Some were attentive to how starting to code requires metacognitive training as well [AE1,2,3,18]. Similar to those teaching other computing courses, new media artists walk students through the coding process presented from the metacognitive level but tailored to interactive media and visual design contexts.

Lastly, several included in their curricula discussions on the impacts of new media art and computing as a crucial part of their teaching in the context of impacts on specific communities [AE4,7], the wider social imagination [AE1,9,13,15,18], and planet-scale ecology [AE17,18]. Specifically, they felt new media artists and designers should develop habits of self-reflecting on one's responsibility to society. For instance, AE13 emphasized self-awareness of the influence of one's work and the importance of discussing responsibility in new media art curricula:

> artists [claim] that we are influencing the culture, at the societal level, to a certain degree. [...] we're kind of controlling the imagination [...] so share the responsibility in some sense. [...] Even if we make critical or socially engaged artwork, we think of ourselves as existing outside of the structures that we're all embedded in. And that's fundamentally not true.

Takeaway: New media artists design their workshops to include self-reflective practices that guide students to reshape relationships with technology to overcome mental barriers. Also, the workshops include exercises to develop metacognitive skills, such as self-reflection, planning, and setting up a self-motivating framework.

6.2 Critical Practices: for generating new dialogues

We next cover practices that go beyond the personal dimension and enter into discussions around broader new media art communities. This encompasses artistic strategies to generate new dialogues about computing technology and society.

6.2.1 Cast technology into broader contexts. To encourage critical discussions on technology, new media artists bring technology into broader philosophical, social, cultural, and historical context in their classes [AE1-5,7,8,10+11,16,18]. Nearly all of our interviewees expressed that teaching computing should not be decontextualized from existing devices, systems, and sociocultural constraints. For instance, in AE8's class an artwork called <Log Jammer> by Allison Burtch [5] was presented as an example of contextualizing the Wi-Fi technology to ignite discussions on sociotechnical issues:

> [The work is] a log with an antenna coming out of it [...]. But it jams all the Wi-Fi signals in the area. [...] her artwork was not to hack into a network but to prevent anybody from getting on using the internet [...] and create a space outside of technology. Because their critique was, even in these natural spaces, how technology is everywhere and we don't get a break from our notifications.

This contextualization of technology is an essential component of new media art workshops, as "one of the roles of new media artists is to thread the context of technology" [AE6]. This leads to reframing computing skills that are merely seen as "skills to get hired" and encouraging students to use them as a starting point for wider artistic investigation.

6.2.2 Reinterpret the dominant discourse of technology. Our interviewees also encouraged their students to reinterpret commonly-accepted technical terms: Unpacking words like "learning," "user," and "valid," new media artists critically examine the main discourse of the tech industry and reinterpret concepts from that discourse to find opportunities to cultivate new tech cultures. One representative example is AE12's undergraduate class that connects performance art and the concept of a user. The term "user" is widely-used in the tech industry to describe non-programming clients who only use (consume) software tools (the end product) but who do not directly partake in the development process. AE12 described their first class assignment about users, emphasizing purposeful *misinterpretation* of user instructions:

> the first assignment [...] is thinking about users in different contexts [...], called user instructions. The students are supposed to go find a few different examples of instructions for a user. [...] They collect some examples and we all look at them together and think about them. Then, they pick one of those sets of instructions, and they have to perform it while creatively misinterpreting the instructions in some way.

Furthermore, new media artists highlighted the importance of the value set we choose in shaping technology. Nearly half of interviewees mentioned *repurposing* as an artistic strategy to break away from the current dominant values [AE4,12,13,14,15,16,18]. For example, AE14 repurposed web scraping tools in their class for "artistic, poetic, and critical ends." Originally developed for business practice to automatically extract data on the web "to surveil us, exploit and financialize," this kind of tool can be flipped to "reveal or even intervene in power relations" [AE14]. For example, AE14 created an online gallery and art prints made from scraped data of commodities listed on alibaba.com under search terms like 'riot gear' and 'human labor' (see Figure 1-b).

6.2.3 Leave room for intentional misinterpretations. Related to reinterpretation, new media artists also embrace *intentional* misinterpretations or errors in their workshops. Similar to repurposing, misinterpretation through metaphors is a popular artistic strategy for creating room for discovery. Our interviewees intentionally misused computing [AE8,10+11,14] or used aspects of computing as metaphors to set a context for creating novel situations [AE12,15,16,18].

For example, AE10+11 created a metaphoric framework for performative misuse of computer vision technology. In one of these performances, the audience witnessed how a stone topped with ketchup was recognized by the algorithm as "a hot dog" [33]. After the performance, the artists invited their audience to a discussion on the use of computer vision in surveillance and military technology. Despite lacking technical background, the audience was able to

discuss issues of computer vision, referring directly to phenomena observed in that performance.

Often, metaphors are used to present the reflective relationship between technology and sociocultural conditions. For instance, two artist-educators described how concepts from technology and queer politics could bi-directionally enrich each other through metaphors [AE15,18]. Specifically, AE15 led a workshop about the programmability of sexuality and gender by utilizing technological concepts as a metaphor for "converting mechanisms of existing programming languages and network protocols into provocative interactions." They described how this could also be the beginning of reimagining technology and that "in order to contextualize [familiar] technology to something we can freely imagine, we need a special interface," and that art could offer the place to invent that special interface.

Furthermore, mistakes are simultaneously a tool and a subject of critical investigations. AE16 described how mistakes can be used for generating questions and how it helped them develop a workshop on speech technology:

> [...][consider a case where] you just go wrong [...] every time you perform. [..] So my question on this is how can mistakes generate new ideas for the artist? [...] That's how I realized I want to play with speech. I want to play with language because that's something I make mistakes [...] with my [English] accent all the time because I'm Thai. [...] Once I have that question [...] the aesthetic [questions arise]

Takeaway: Artists design their workshops to introduce critical and artistic strategies to generate new dialogues about computing technology. These strategies include recontextualizing computing into a broader sociocultural context, reinterpretation of existing narratives, and generous usage of metaphors and analogies.

6.3 Situated Practices: for generating new communities

Lastly, we describe practices that situate teaching outside of a single workshop, which involves using them as a platform to help participants get involved in existing new media art communities or form their own. When asked about the ideal organization and interactions of their workshops, all interviewees described it as a community of learners without a formal teacher as the authority figure. For example, AE14 described their ideal setup as:

> [...] a cohort where it is actually flat [...] there's a rotating facilitator, and we're coming together to skill-share or have a series of meetings around a particular topic [...] everyone could be in charge [for] one session. [...] I think that's the type of thing that would be really exciting for me. Having that community and cultivating it and someone can fork that to make their own community.

6.3.1 Forking new communities. Related to the quote above, *forking* – the process of creating a new independent community based on

the structure and conventions of an existing one – was a commonly-reported practice. Interviewees recounted that many artist collectives were born out of past workshops as a forked subgroup [AE4,6,9,15], with examples including their own collective [AE10+11]. Often larger-scale community projects such as self-organized schools operate as a hub for artist collaborations. Here AE16 described their observation of participants in their artist-run school:

> I think most of the people who apply to [this school] sort of know our core or our philosophy of the school. So most of them aim to collaborate [...]. That's why they join, [...] to get more connection or work together in the future. I still see some of them hang out or coming back to [the school] [...] either apply for another class or teaching or even work together.

6.3.2 Creating artist-led tech organizations. Sometimes brand-new artist-led organizations are created as a response to traditional movements in tech. For example, AE1, AE2, and AE12 are deeply involved in an open-source software organization related to technology around their art practice; AE12 created and led one of the largest open-source libraries for creating new media art [*anonymized*]. After the release of version 1.0 of the library, they subsequently refocused the project on accessibility and revised the project leadership structure to facilitate broader participation.

Now this project organizes funded opportunities to support onboarding students into community participation. And the project lead role is assigned through an open-call procedure and rotated on a regular basis to ensure diverse leadership opportunities in order to keep the organization sustainable. AE2 is the current project lead for this open-source project, and their path to getting involved in this organization demonstrates how its structure prioritizes the inclusion of learners and outsiders. As an architect who had just begun to learn to code, they were first involved in the project through work submitted to an online "100 days of coding" event. The work ended up featured on the project's front page. AE2 recalled, "That was empowering. I thought, wow, this community is different. Because I was a beginner."

Takeaway: Artists fork off existing communities and create new ones that support each other's perpetual teaching by using workshops as a platform for inviting newcomers into ongoing projects.

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7 DISCUSSION AND CONCLUSION

Reflecting on our interviews we found that for new media artists the meaning of teaching computing was not limited to only pedagogy but also became an integrated part of their art practice. Under working conditions that make perpetual training a responsibility of individuals (Section 4), new media artists reframed these constraints to serve their core values by devising practices that we call *perpetual teaching*, which includes self-reflective, critical, and situated practices (Section 6). Guiding learners to nurture their own sets of values, positions, and self-efficacy while organizing as a community is closely integrated with new media art aesthetics, as

reflected in our interviewees' motivations to fill gaps, reveal, produce artwork, and cultivate new cultures via their teaching (Section 5).

Zooming out more broadly, how do these findings relate to some of the perennial issues discussed in computing education? In the remainder of this paper we touch upon two issues: 1) the relevancy and validity of applying situated learning theory to computing education and 2) the role of education in computing culture.

7.1 How should we approach situated learning for computing education?

Originally the concept of situated learning came from studying accounts of apprenticeship from midwives, tailors, quarter masters, butchers, and nondrinking alcoholics communities [35]. While apprenticeship and guided participation provide a textbook case model for craft and studio-based traditional art training [35, 52], does it apply just as well to computing education for artists? Based on our study we see a few limitations of applying the model as-is. First, new media art computing education is missing the technology expert at the *center* of a community of practice. Workshops present concepts, techniques, and knowledge originating from the field of computer science, but there is no proxy for an expert here since the artists leading these workshops are not involved in the computer science CoP. Additionally, the goal of new media art computing education is not about becoming a part of the existing field of computing.

Second, the priorities for learning differ from traditional accounts of situated learning. Under precarious working conditions (Section 4), perpetual teaching aims to maximize usage of the workshop's limited time for building momentum toward individual learners' goals: prioritize working on unbound, speculative questions that learners bring to the workshop. This is also seen in the emphasis on teaching skills that can sustain and widen a creative framework (artistic strategies, metacognitive skills, research skills, etc.), placing less priority on using the time to refine the precision or accuracy of the learner's technical skills. This differing prioritization draws a high contrast with craft production, one of the original contexts of situated learning.

Is such disconnect problematic for learning computing in this context? Coming back to the 'situated learning versus simulated learning' debate in computing education, Ben-Ari reminds us that legitimate peripheral participation can only be applied to learning a subset of technology but not necessarily to opaque "high-technology" such as computing [3]. In this context, Ben-Ari's proposed way to effectively bring insights over from situated learning was to focus on teaching "the nature of practice" and letting students work on *simulated problems* "based on considerations of motivation and pedagogy, rather than verisimilitude to the real world" [3]. New media art computing education takes the simulated dimension even further. Their practices highlight how learning can start from a learner's own interests and needs by working on *speculative problems* leading to personal experiments – experiments with new identities, new analogies, and new organizations.

7.2 Can computing education contribute to creating new tech cultures?

Recent close examinations on the norms and values of CS departments have revealed how factors such as value alignment (especially communal goals) [37], intersectionality (e.g., race and gender) [50], and prestige-oriented departmental norms [29] influence the decisions of undergraduate students. These decisions include their choice of declared major, their social experiences, and their sense of belonging within the department. Down the line, these factors extend to shaping their CS career choices and potentially impacting CS career practice norms in the future. These factors of institutional culture seem to act as a filter even for highly motivated individuals who have gained acceptance into the CS program. What analogous filtering mechanisms might exist for individuals (such as artists) who may have never considered learning about computing?

Throughout our study, we found that artist-educators were making efforts to address the variations of *discursive closure* [9] – discursive patterns that shut down alternative thinking – while guiding students through speculative problems. Discursive closure for computing education was previously analyzed in a case study of an art-based participatory workshops series [40]. Throughout this engagement, facilitators encountered four recurring patterns of discursive closure: technological determinism, trajectorism, "false dilemma," and disqualification [40]. Based on our interviews, disqualification is as well prevalent in new media computing education contexts, which artist-educators try to confront in their practices (Section 6.1.1). Further empirical investigations to identify the root-cause and underlying processes of these patterns will be crucial for the broadening of computing education research to these adjacent fields.

Our findings confirm the view that a school is a unique place to question beliefs and conventions [17, 57] that could provide a space for artists to develop their careers in teaching computing while also protecting their core values by engaging in cultural projects. New media artists proposed many directions (self-reflective, critical, and situated practices) to encourage individuals to circumvent these discursive closures and pursue speculative computing problems. Our discussions with artist-educators have prompted us to imagine education's potential to facilitate new identities, new networks, and new culture for learning and creating technology. More thorough investigations remain for its eventual role in the formation of the computing field's culture (e.g., how do the values and motivations of individual educators influence the learning experience of their students?), discrepancy between design motivations and actual effects, and the consequences of different ways to motivate new learners (e.g., what are the effects of motivating using the novelty of media or new affordances?). In sum, we call on the community to encourage future investigations into computing education's field-specific norms and conventions along with the processes behind the intergenerational transmission of such norms.

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