Fragmented Innovation: Anime and the Limits of Computer Science R&D

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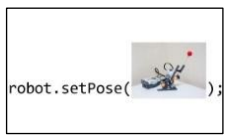
- **The University of Tokyo** Igarashi Lab '09 BSc, '11 MSc, '14 PhD
- **Microsoft Research** Asia '12/1-4 Research Intern / **Microsoft Research** '12/6-9 Research Intern
- **Adobe** Creative Technologies Lab, Seattle '13/8-11 Research Intern
- **National Institute of Advanced Industrial Science and Technology (AIST)** '14/4- Researcher, '18/10- Senior Researcher
- **Arch Inc.** '18/7- Technical Advisor (PI at R&D unit Arch Research)
- **Universite Paris-Saclay** '24/4-'25/3 Visiting Scientist

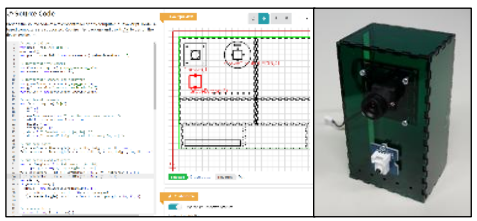
DejaVu
[ACM UIST'12]



Picode
[ACM CHI'13]

TouchDevelop
[ACM PLDI'13]


TextAlive **[ACM CHI'15]**


f3.js **[ACM DIS'17]**


Lyric App Framework **[ACM CHI'23]**


Griffith **[ACM CHI'24]**

Human-Computer Interaction researcher **studying creative activities** e.g., programming, video authoring, storyboarding through **building and deploying creativity support tools**

Jun Kato, Kenta Hara, and Nao Hirasawa. 2024. Griffith: A Storyboarding Tool Designed with Japanese Animation Professionals. In Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems (CHI '24). Association for Computing Machinery, New York, NY, USA, Article 233, 1–14.
https://doi.org/10.1145/3613904.3642121

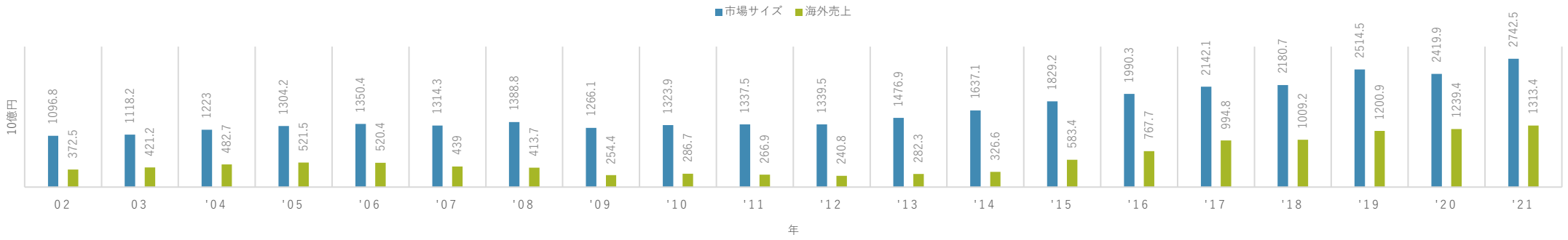
Fragmented Innovation:

Anime and the Limits of Computer Science R&D

- **Industrial fragmentation**
- Academic reward system for formalization
- Institutional (and sometimes linguistic) filters

Anime is attracting both global and local attention

- A remarkable cultural accumulation since the **1950s**
- A growth industry: market size **doubled in 10 years**, and **overseas expanded fivefold** [AJA, 2025]
- Growing attention from **industry and government**, including the new Cool Japan strategy [Cabinet Office, 2024] and Entertainment Contents ∞ 2024 [Keidanren, 2024]



Research on anime production has been “undone”

- Massive data production: about **six cardboard boxes** per 30-minute episode in paper terms, and **hundreds of TB** of intermediate materials per day in full-digital workflows
- Complex production pipelines involving **hundreds of people**

聖剣伝説 Legend of Mana -The Teardrop Crystal-
©SQUARE ENIX ／ サボテン君観察組合

***An example materials from anime production pipeline; produced by Arch Inc.**

Research on two-dimensional animation authoring has remained challenging … for a long time

> Why are computer graphics tools so difficult to apply to 2D animation? **It is not enough to simply solve technical problems.** The studio must also be convinced. Today's creation process is essentially a production line, in which a studio of 50 to 300 people work together to produce tens of thousands of drawings for a single feature film or television episode. Everyone has a specified role and follows detailed procedures to move from one stage to the next. Any attempt to computerize the traditional set of tasks must take into account **overhead costs** in both time and quality.

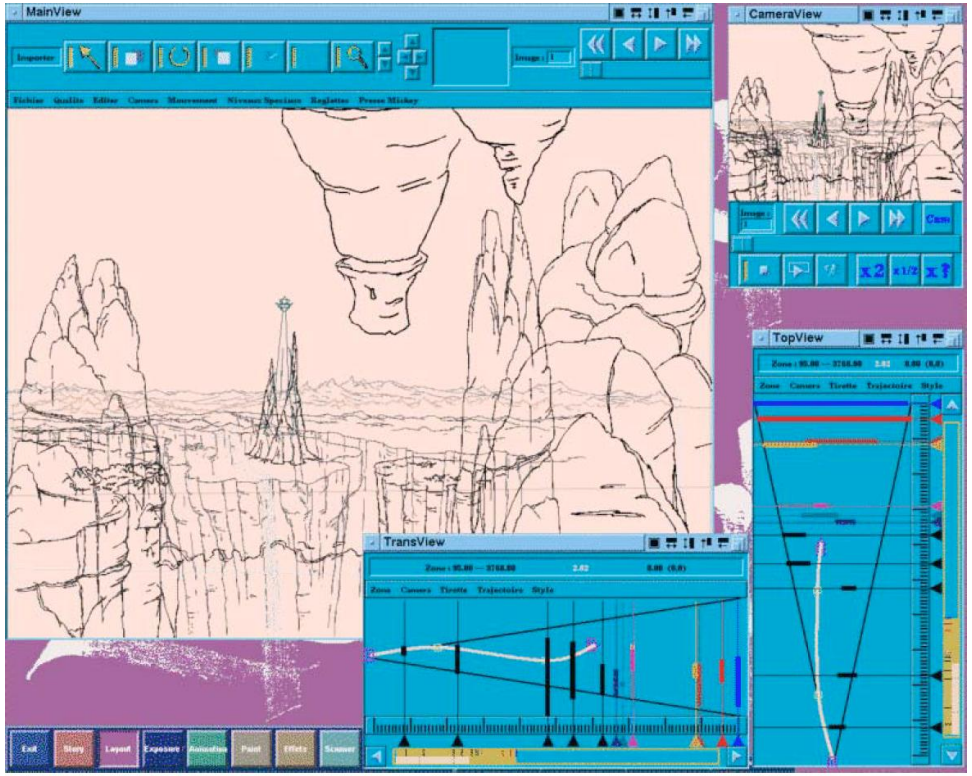
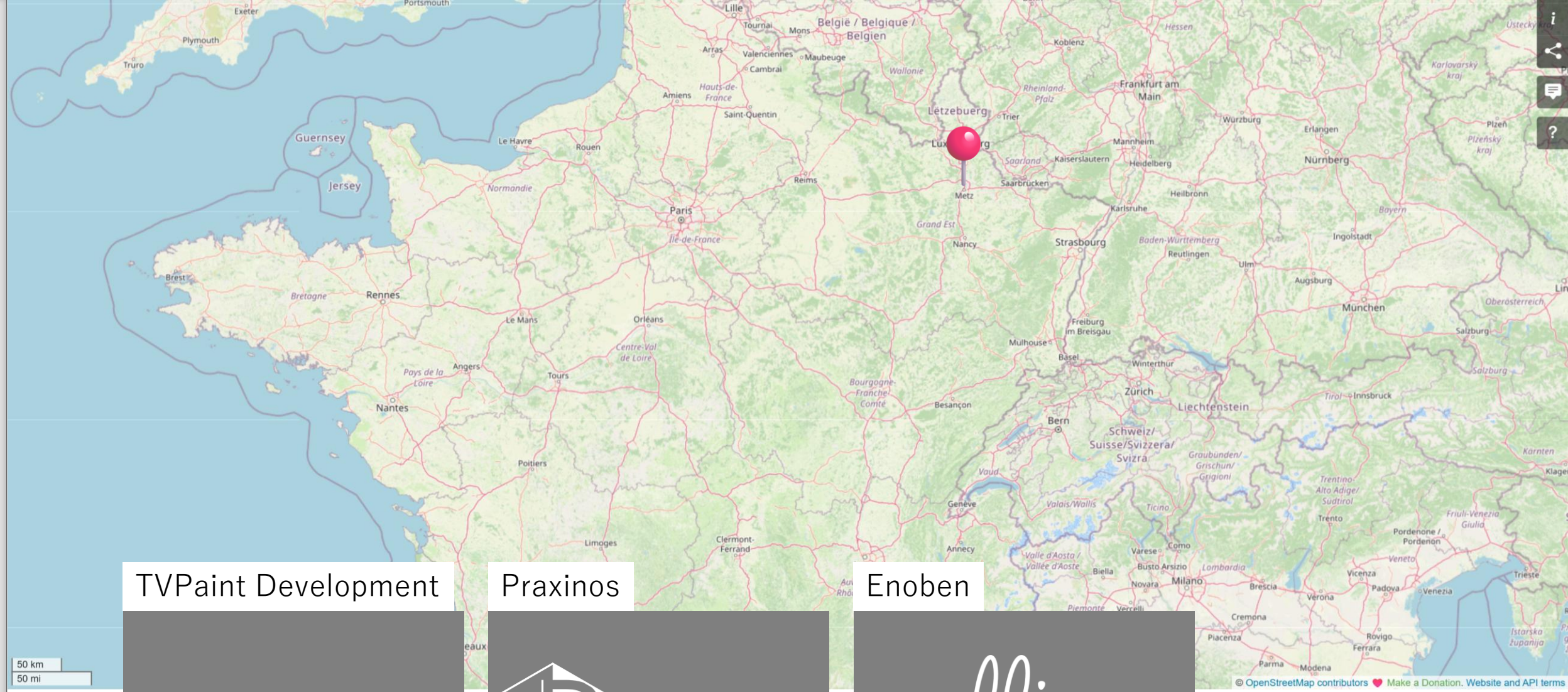


Figure 8: The Layout module showing a front view, top view and side view of a scene.

Jean-Daniel Fekete, Érick Bizouarn, Éric Cournarie, Thierry Galas, and Frédéric Taillefer. 1995. TicTacToon: a paperless system for professional 2D animation. In Proceedings of the 22nd annual conference on Computer graphics and interactive techniques (SIGGRAPH '95). Association for Computing Machinery, New York, NY, USA, 79–90. https://doi.org/10.1145/218380.218417

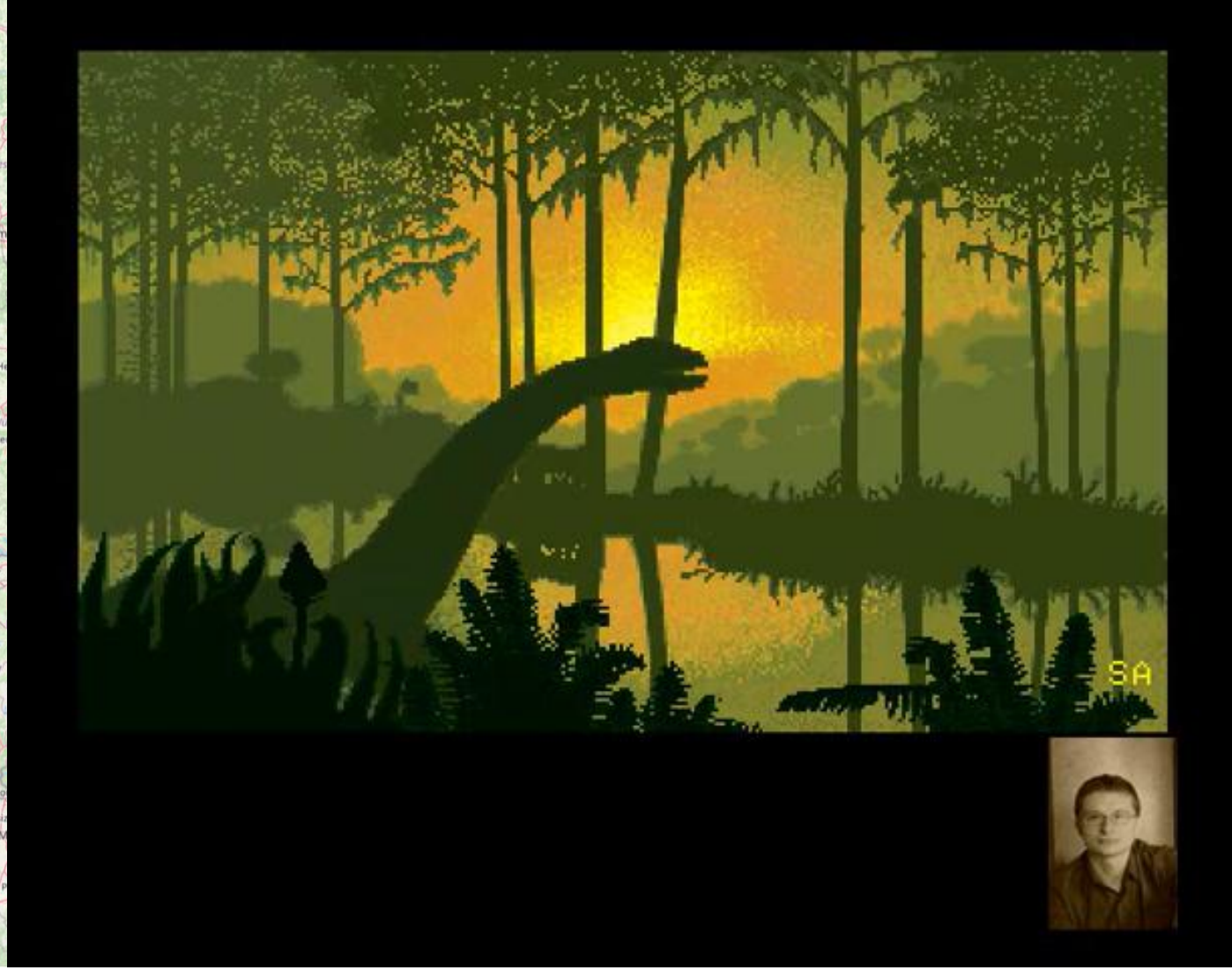


TVPaint Development

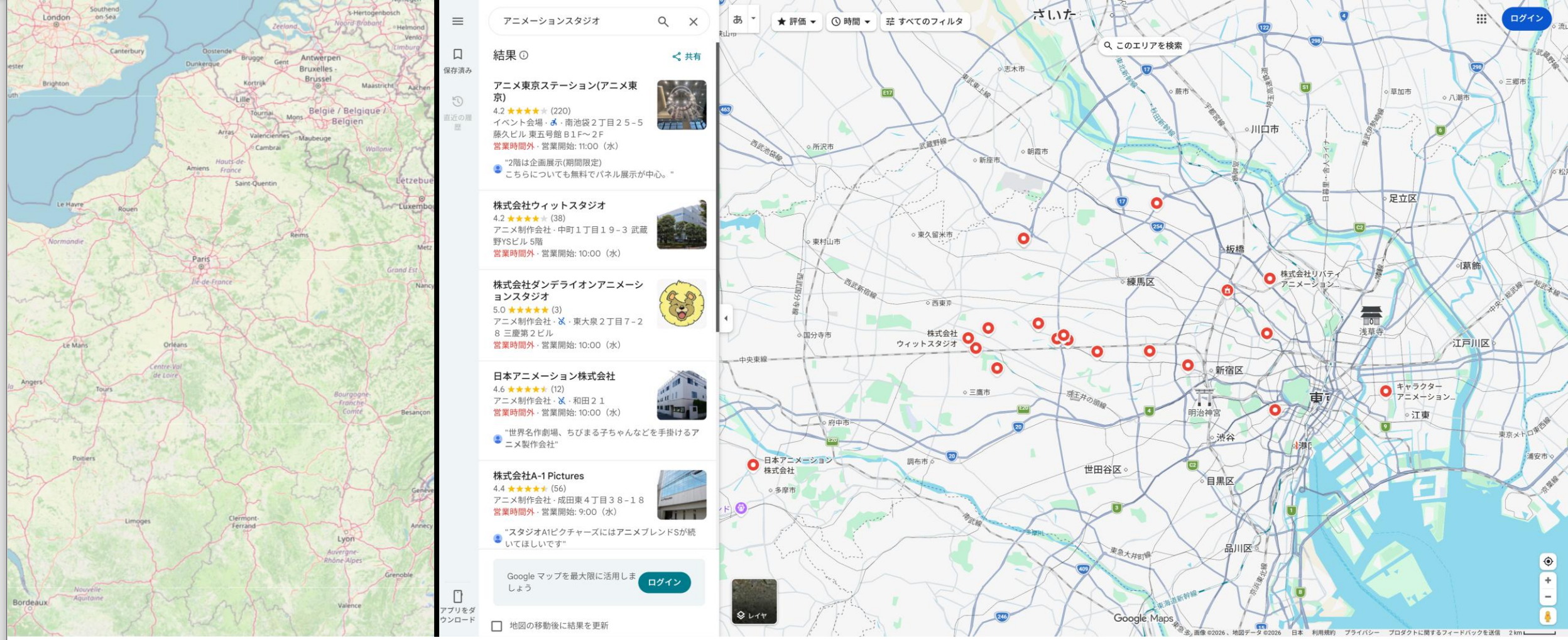
Praxinos

Enoben

Praxinos



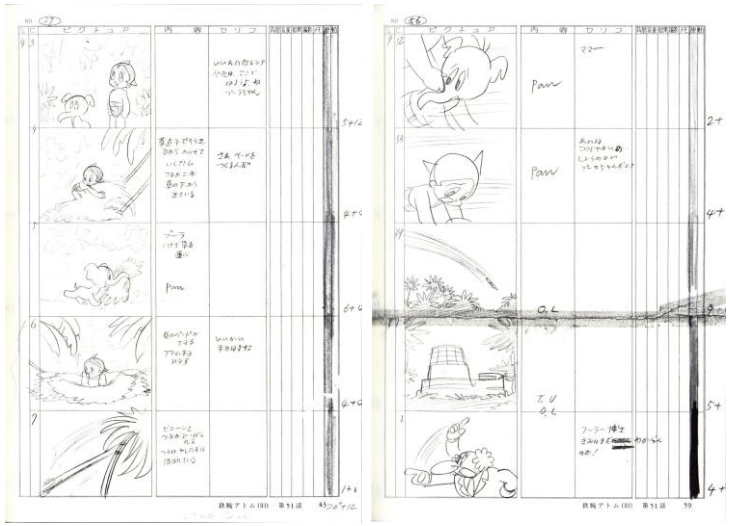
https://www.youtube.com/watch?v=p-bGsZuFZfw



- Anime studios are **highly concentrated** in western Tokyo
- There has been less pressure to digitize, as materials could be **delivered physically** by bike or car

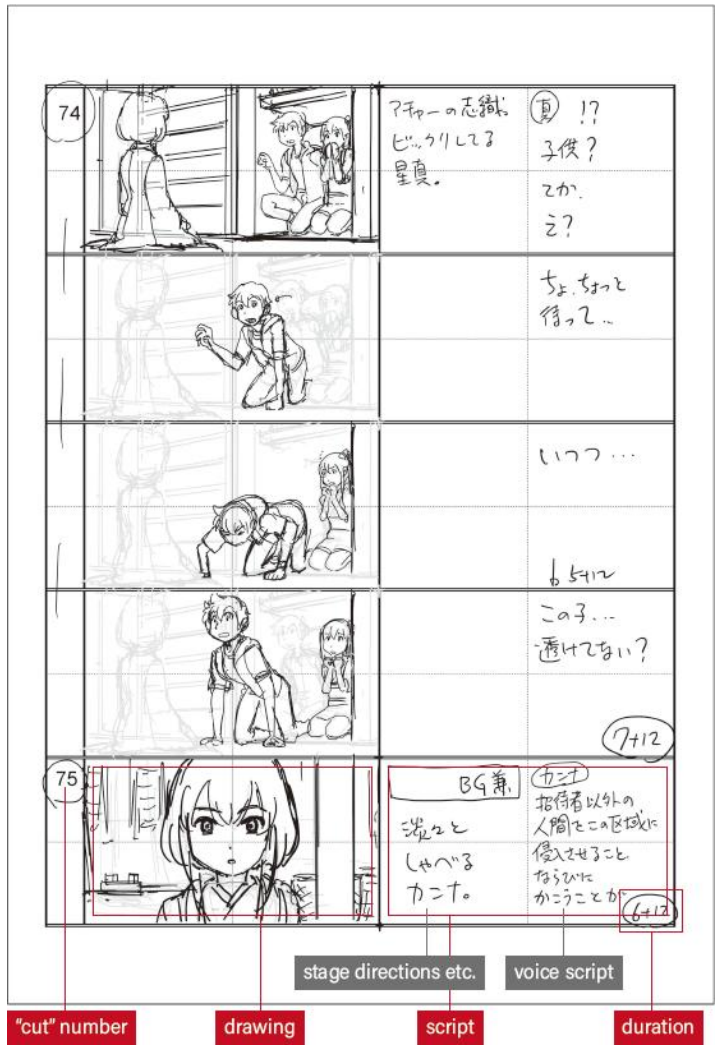
Highly collaborative nature resulted in “standards”

[Image] NHK, https://www3.nhk.or.jp/news/special/sci_cul/2019/10/news/news_191026/



[Images] Astro Boy E-Conte – Tezuka Osamu, “Tezuka Osamu E-Conte Taizen (1) Tetsuwan Atom,” p.43 and p.59

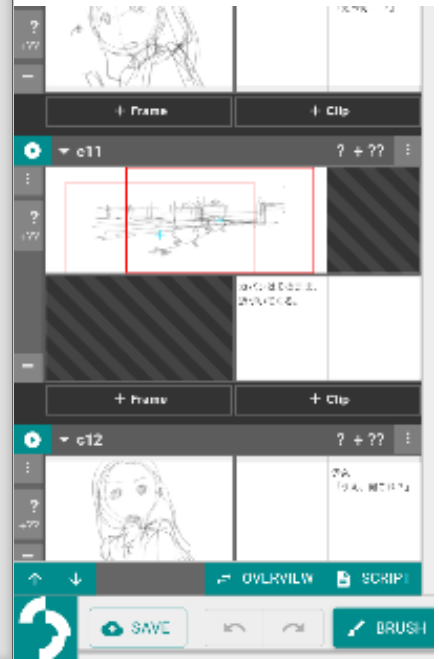
- “**E**” (illustration) + “**conte**” (continuity)
- “**Storyboard**” in English

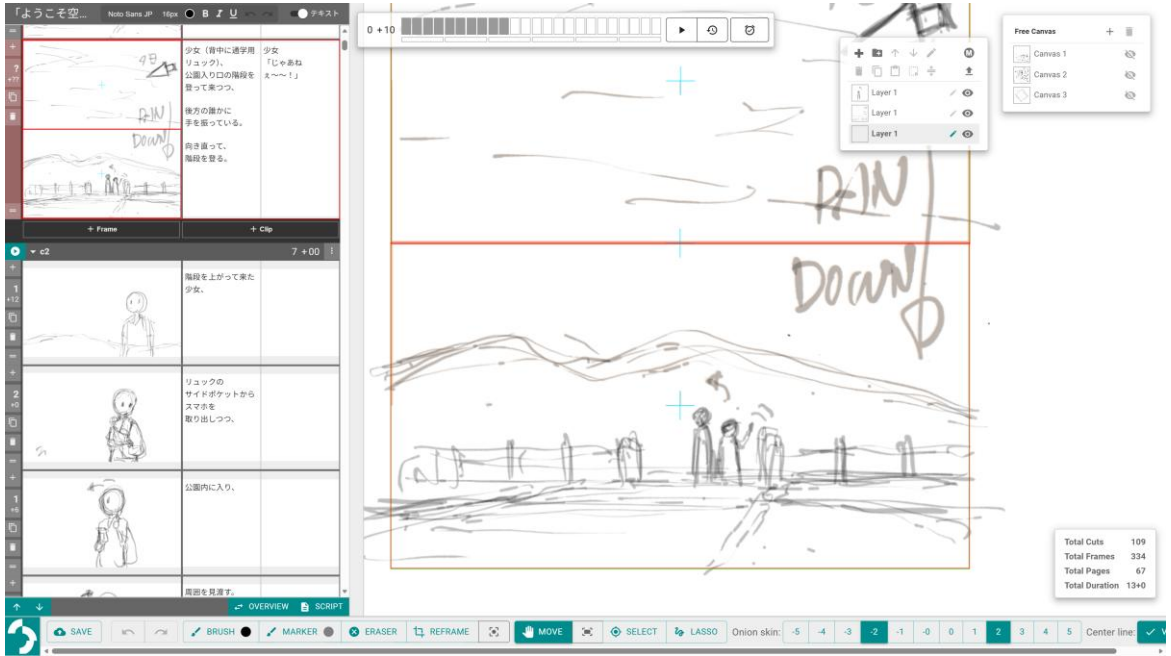


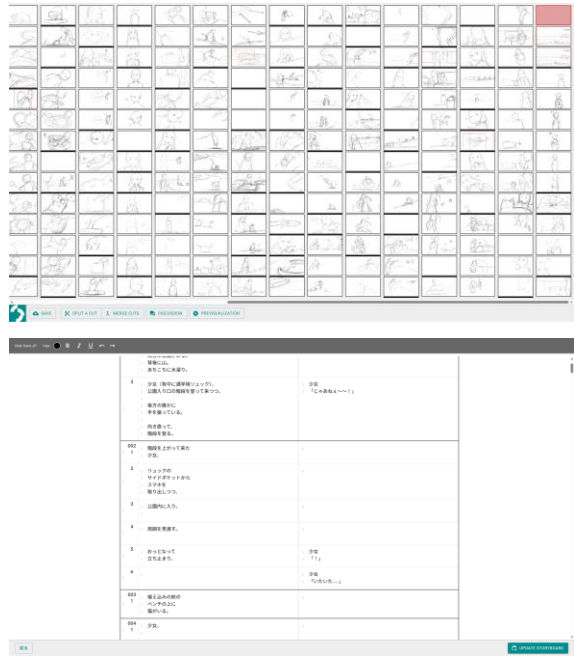
This storyboard is from “Animation Technology 2019 Spring” p.2, drawn by Kazuya Murata for XFLAGS ANIME “Starlight Promises.”

Why E-conte tools have remained underdeveloped

- The user base is extremely small, giving tool vendors **little incentive to invest**
- Simply replicating the paper-based format is not enough, requiring **even more costly engineering**







Fragmented Innovation:

Anime and the Limits of Computer Science R&D

- Industrial fragmentation
- **Academic reward system for formalization**
- Institutional (and sometimes linguistic) filters

Image created by the artists of NYIT Computer Graphics Lab and provided courtesy of Great Big TV LLC. Original name: "time.warp", an image composition directed by Alvy Ray Smith, using efforts of Jim Blinn (saucer), David DiFrancesco (colorized Stonehenge), Paul Xander (clouds), Alvy (grass and Paint3 used for the clouds and grass), Ephraim Cohen (wrote the fn program used), and Lance Williams (chrome texture). One of many images created at NYIT CGL at various times in the 1970s (1975–79).

https://blog.siggraph.org/2020/08/pioneering-pixels-the-nyit-computer-graphics-lab-then-and-now.html/

Ed Catmull:

> My belief was, and still is, that we show all our work and that we publish. It is an illusion to think that we get ahead by holding on to secrets. The real issue is: How do you attract the best people? **You do this by encouraging publishing and open communication in a community.** I have lifelong friends in the SIGGRAPH community.

https://blog.siggraph.org/2020/08/pioneering-pixels-the-nyit-computer-graphics-lab-then-and-now.html/

Anime heavily relies on analog practices

Analog sketches are simply more difficult to be formulated as mathematical problems

NYIT CGL's initial focus was on 2D CG animation
Example outcome: Tween (Ed Catmull), Paint (Alvy Ray Smith), and SoftCel (Garland Stern)

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How WEIRD is CHI?

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ABSTRACT

Computer technology is often designed in technology hubs in Western countries, invariably making it "WEIRD", because it is based on the intuition, knowledge, and values of people who are Western, Educated, Industrialized, Rich, and Democratic. Developing technology that is universally useful and engaging requires knowledge about members of WEIRD and non-WEIRD societies alike. In other words, it requires us, the CHI community, to generate this knowledge by studying representative participant samples. To find out to

1 INTRODUCTION

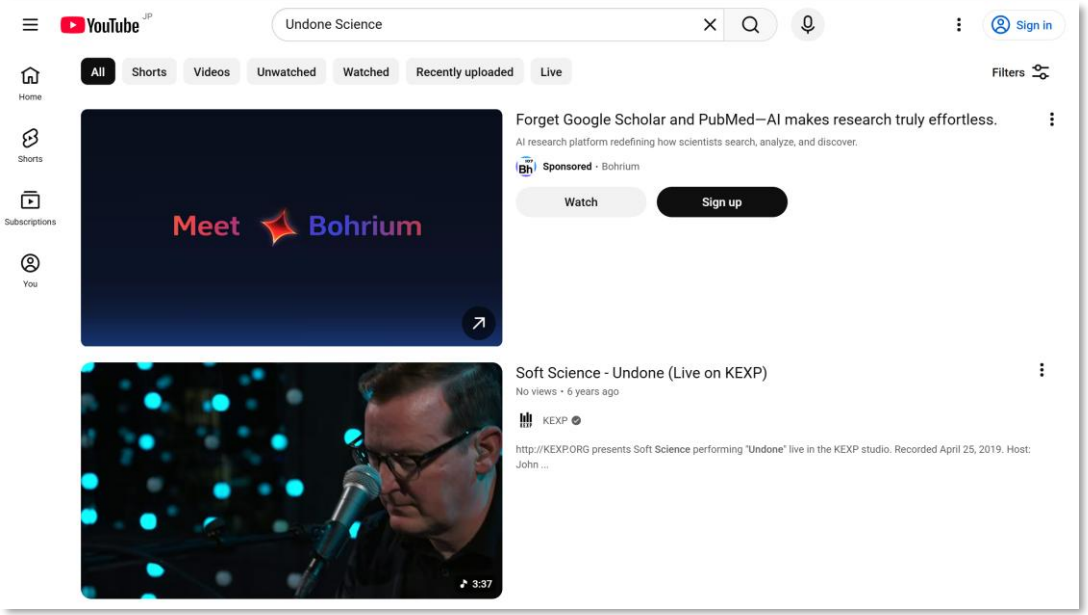
CHI is widely regarded as the premier venue for Human-Computer Interaction, often influencing technology innovations that were inspired by its publications on the design and use of computer technology. Such technology innovations are being used by increasingly large numbers of people from diverse countries around the world. Commonly, the research findings produced by the CHI community that are driving such innovations may be assumed to be universally applicable to the entire human population.

Sebastian Linxen, Christian Sturm, Florian Brühlmann, Vincent Cassau, Klaus Opwis, and Katharina Reinecke. 2021. How WEIRD is CHI? In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21). Association for Computing Machinery, New York, NY, USA, Article 143, 1–14.
https://doi.org/10.1145/3411764.3445488

based on Western participant samples, representing less than 12% of the world's population. Furthermore, we show that most participant samples at CHI tend to come from industrialized, rich

nizing that its members, including those who contribute research to CHI, are primarily from North America and Europe.

Growing HCI around the world will be especially needed given



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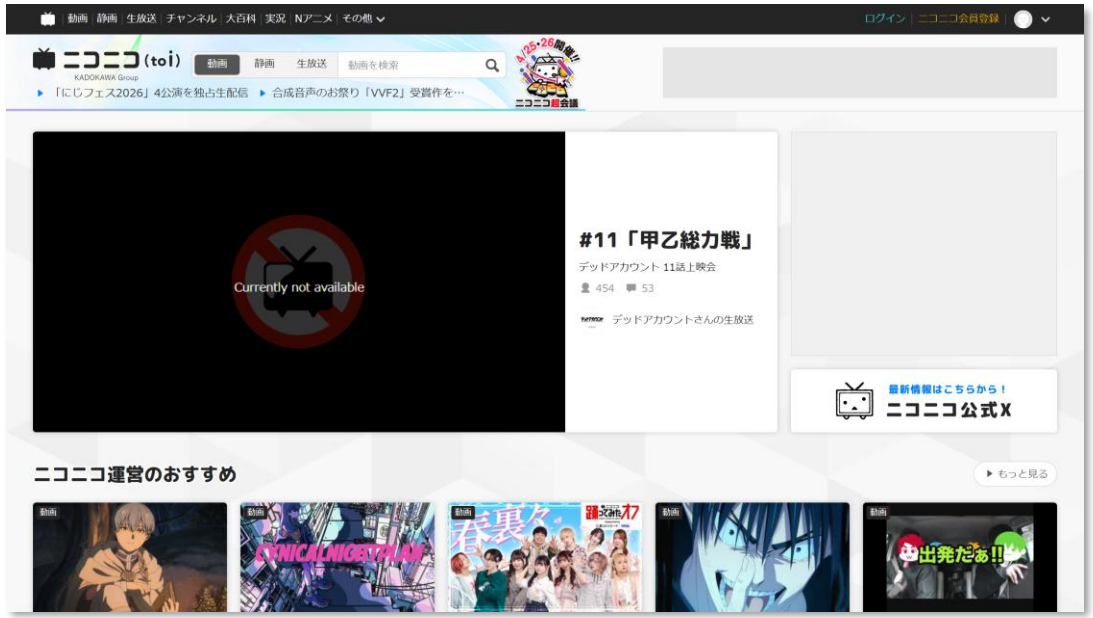


Niconico video

WEIRDness is just a tip of iceberg

- Double bind for anime research that needs to **go over language barriers twice**
- Institutional and linguistic filters shape what counts as legitimate and researchable knowledge
- These filters make some topics easy to circulate, while others remain difficult to justify, sustain, and reward

- Though, the answer is **not simply to invert the filter**

feature

On the Relationship Between HCI Researchers and Creators—or How I Became a Toolsmith

Research on creativity support tools in human-computer interaction often focuses on novel interaction design, but that is just the tip of the iceberg. Let's dive deeper and help creative activities "in the wild."

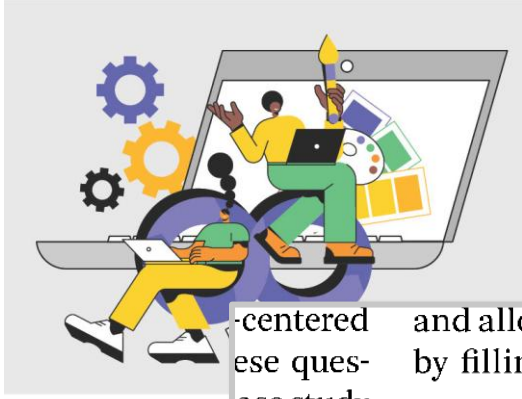
By Jun Kato

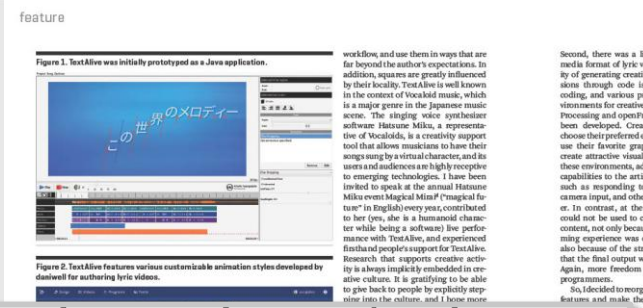
DOI: 10.1145/3596927

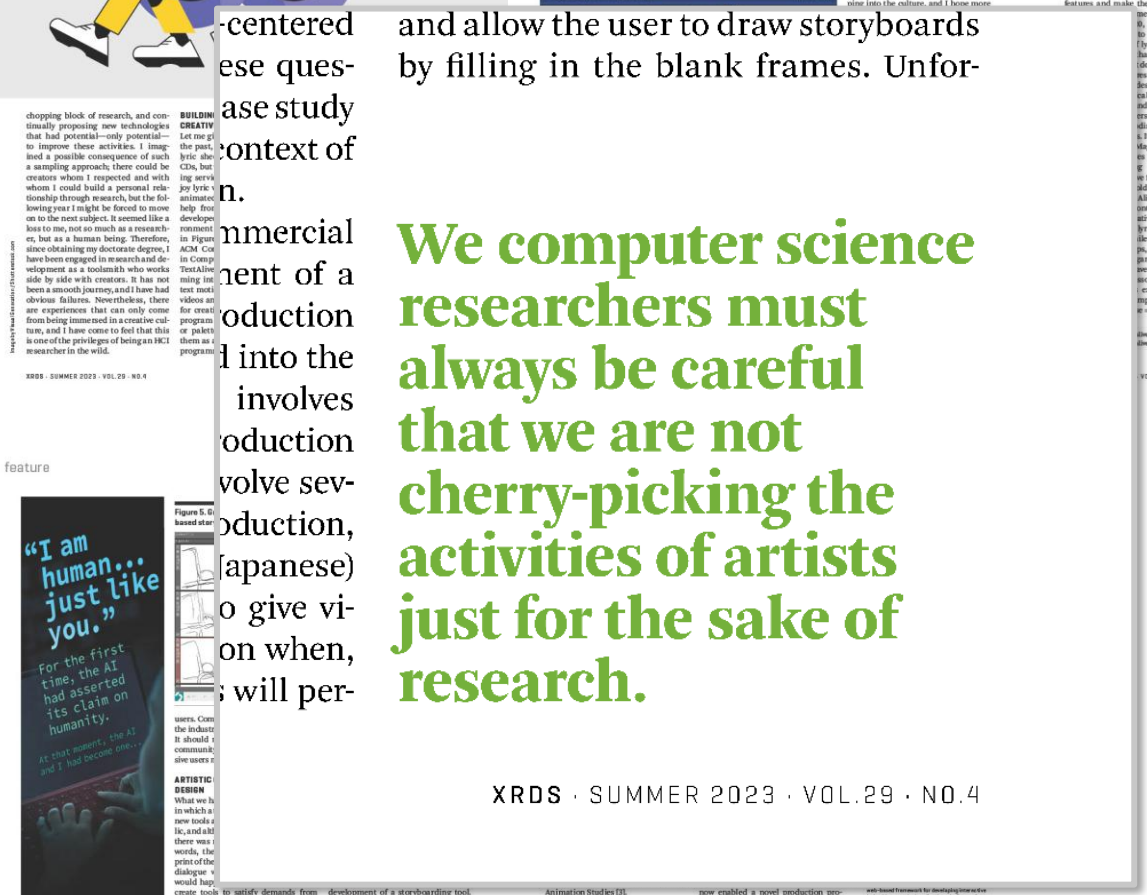
OPEN ACCESS

During my doctoral studies, I specialized in human-computer interaction (HCI), particularly interaction techniques that incorporate graphical representations to intuitively process real-world data that is difficult to handle in character-based programming environments. Paraphrasing this in the light of the issue theme, I researched creativity support tools to facilitate the creation of new media expressions. (Herein, I do not distinguish programming from art because I consider programming to be a kind of computer-aided art in itself.) I wrote papers for top-tier international conferences every year, basking in the intellectual excitement of coming up with interface design ideas that would enable new programming experiences. These ideas for new technologies would come to the attention of people creating production-ready programming environments (creativity support tools) and would gradually be incorporated into the environments used by ordinary programmers (creators).

I still do not doubt the value of the novel tech… this kind… short-tern… academic… things, which is an irreplaceable expe… rience. However, by the time I finished my doctoral studies, I had become frustrated with the lack of support for user creativity "in the wild." For example, I would conduct user studies before writing a paper, and I would find it very excruciating when people engineering standpoint, and there are no inherent flaws in the interaction design we are proposing." As researchers, we can easily leave issues as future work and expect some of them to be addressed by technology transfer, where innovative technologies created through research are delivered to society… ators every year, putting them on the







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and allow the user to draw storyboards by filling in the blank frames. Unfor-

We computer science researchers must always be careful that we are not cherry-picking the activities of artists just for the sake of research.

XRDS · SUMMER 2023 · VOL.29 · NO.4

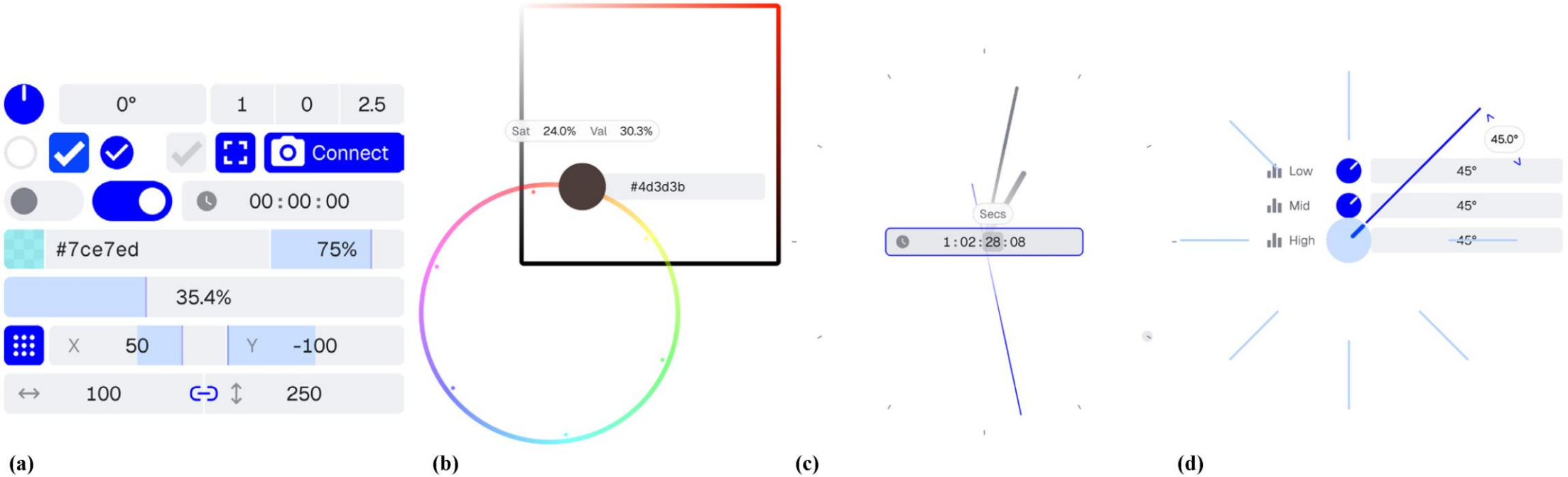
Jun Kato. 2023. On the Relationship between HCI Researchers and Creators---Or How I Became a Toolsmith. XRDS 29, 4 (Summer 2023), 26–31. https://doi.org/10.1145/3596927

Why looking at the past matters

- What **implicit assumptions** do we carry as a community?
- How can we make those assumptions visible?
- To understand present-day filters, we need to trace how they were historically formed – for instance, HCI is now more than forty years old
- Although still a relatively young field, it has already accumulated institutional habits and sedimented assumptions

Example: GUI research has never been "done"

We sampled such widgets from popular production software and analyzed their interaction design and implemented a set of GUI widgets



Baku Hashimoto and Jun Kato. 2025. Tweeq: Parameter-Tuning GUI Widgets by/for Creative Professionals. In Proceedings of the 38th Annual ACM Symposium on User Interface Software and Technology (UIST '25). Association for Computing Machinery, New York, NY, USA, Article 15, 1–16. https://doi.org/10.1145/3746059.3747723

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Fear of being "done" wrongly, and courage to carry it out properly

- Data-driven methods may lower the need for explicit formal models
- Growing concern with non-WEIRDness may make anime easier to legitimize as a research object
- Government attention may also accelerate investment

Anime may soon move from being undone to being done too much, and I want to run it as **"science in motion"**

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