Tutorials for Children by Children: Design and Evaluation of a Child-Centric Tutorial Authoring Tool for Digital Art

by

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Abstract

Digital art tools allow children to express themselves and to connect with other child art enthusiasts online. While the learnability of these powerful tools is an age-old problem, most existing research and available learning resources are geared towards adult users. In this thesis, we investigate a child-centric approach, through a tutorial authoring design concept that helps children author digital art tutorials to support peer-based learning. Through participatory design sessions, prototyping, and evaluations, we explore children's and parents' attitudes towards the creation and sharing of digital art tutorials online, children's perceived incentives to author such tutorials, and their reactions towards our specific design decisions. Our findings suggest important considerations for designing tools to motivate and support children's creation of digital art tutorials.

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Chapter 1

Introduction

Children are increasingly spending more time online. Recent surveys have shown that kids even as young as five-years old regularly spend 2-3 hours online each day [42,53]. During this time, many children are not only consuming content, but are also participating in child-centric communities. For example, there are YouTube channels dedicated to kids [9], online programming communities like Scratch where children produce interactive digital content [46], and storytelling environments for kids to create their own stories [3,22]. Safe online spaces such as these, allow children to express themselves and to connect with other like-minded peers [3,4,46].

One common way for kids to express themselves is through art. Encouraging art and creativity at an early age can promote children's social, emotional, motor, and cognitive development [2,63], can provide a sense of accomplishment, and can boost self–esteem [34]. Digital art tools open up new ways for children to express themselves, with a number of digital-art platforms providing child-centric sharing areas [65,66]. In

comparison to physical art, a challenge in moving to digital tools, however, is that many of the tools are feature-rich, which can impact their discoverability and learnability [24,32]. While there are numerous resources for adults to explore a digital art tool's potential (e.g., tutorials, Q&As, blogs), these resources tend to be designed by adults for other adults. Prior work suggests that children can find comprehending adult-oriented online help for complex software difficult [29].

In this thesis, we investigate the idea of children authoring digital drawing tutorials for other children. Whereas prior research on tutorial systems and authoring tools has focused primarily on adults [11,18,20,23,35], we propose and study a child-centric tutorial authoring system, that helps a child craft a drawing tutorial by capturing their workflow while they are creating a digital drawing. Peer-based learning, including creating tutorials for other children, is a powerful educational approach [1,15,40]. In addition to the pedagogical benefits, creating tutorials for peers helps children learn to think from others' perspectives, and also fosters self-acceptance, and a sense of self-identity [1].

1.1. Research Questions

In exploring child-centric tutorial authoring, we investigate:

1) How do children feel about the idea of sharing both their digital art and their workflows online?

2) What type of tutorial authoring interface might be appropriate for a child?

3) What are the perceived benefits or incentives for the children who are generating the tutorials?

1.2. Methodology and Approach

To address our research questions, we went through the following steps: 1) we developed a low-fidelity prototype that represents our idea of children's authoring and sharing of workflows, 2) we conducted a formative study with children to elicit reactions to our system concept and feedback on our design elements, 3) we developed a higher-fidelity prototype based on the feedback collected from the formative study, 4) we conducted another study with children to evaluate the higher-fidelity prototype and to further explore our concept.

1.2.1. Developing a Low-Fidelity Prototype

We initiated our investigation through an extensive literature survey and reviewing child-oriented online platforms to explore the design space. Motivated by previous literature [21,38,47,52,55] showing that low-fidelity (lo-fi) prototyping can be an effective way to facilitate the design process of child-centric applications, we developed a lo-fi prototype of our tutorial authoring system through iterative brainstorming and sketching. The lo-fi prototype was designed to provide children with a clear understanding of how we visualized our concept of children's authoring and sharing of tutorials (Chapter 3).

1.2.2. Formative Study

To address our research question regarding how children would feel about sharing digital art along with their workflows online, we conducted a formative study with eight child participants (ages 6-11), where we used our low-fidelity paper prototype to elicit reactions on our general approach. In this phase of our research, it was essential for us to get useful feedback from children to guide our design decisions. Inspired by previous literature [14],

we involved children in the design process by conducting participatory design sessions with them. We also interviewed their parents about any concerns they might have with this type of sharing activity. This study enabled us to get some initial insights into how children and parents approached our idea of creating and sharing digital art workflows online (Chapter 4).

1.2.3. Developing a Higher-Fidelity Prototype

We used the feedback received from the formative study to create a higher-fidelity digital prototype. The goal of the higher-fidelity prototyping was to provide children with a more interactive experience and use the prototype as a means of inquiry to evaluate our design decisions (Chapter 5).

1.2.4. Further Concept Exploration and Prototype Evaluation

To evaluate our higher-fidelity prototype and to investigate our third research question related to children's perceived incentives for generating tutorials, we conducted a second study with 16 child participants (ages 7-11). Due to the COVID-19 pandemic, the study was held remotely, where children interacted with our prototype online. We collected qualitative data by conducting semi-structured interviews, which we analyzed by affinity diagramming [7]. Additionally, we used a survey questionnaire to collect quantitative data (Chapter 6).

1.3. Contributions

The first contribution of this thesis is our approach to designing a child-centric tutorial authoring system for generating digital art tutorials, which we developed through an iterative process. Our other contribution is the findings from our two studies. Our findings

suggest that the children and their parents had positive attitudes regarding the idea of children creating tutorials for other children. Further, our findings provide interesting insights into children's perceived incentives to create tutorials, which ranged from altruism, to showcasing drawing skills, to wanting to document their workflows for their own recollection later. Finally, our findings highlight considerations for future work in this space, such as the importance of balancing tutorial creation with drawing, and providing scaffolding to help children annotate their tutorials.

The remainder of this thesis has the following six chapters: in Chapter 2, we review and summarize previous literature related to our research. Chapter 3 presents our general approach to children's authoring and sharing of workflows and also includes the design process of our low-fidelity prototype. Chapter 4 presents our formative study. Chapter 5 discusses the development of our higher-fidelity prototype. In Chapter 6, we describe our remote study. Finally, in Chapter 7, we conclude the thesis and discuss ideas for future work.

Chapter 2

Related Work

In this chapter, at first, we discuss research related to children's creation and sharing of different kinds of online digital content. We then turn to research on designing tutorial systems and tutorial authoring tools. We end this chapter by reviewing the literature on child-centric design techniques, which informs and motivates our research methodology.

2.1. Children's Creation and Sharing of Online Digital Content

There are many different online platforms designed to enable children to become contributors by generating creative digital content. To increase children's participation as content producers, online programming environments like Scratch [46] provide children with the opportunity to create their own interactive digital content, share ideas, collaborate, and communicate with like-minded peers [8,13,48]. Online interactive digital storytelling platforms also allow children to practice creativity by generating imaginative stories and collaborating with others [3,6,22,27]. Research in this direction has further investigated the design of collaborative storytelling authoring tools [49,59] as they can improve children's communication skills and writing abilities [49]. In another vein, online user-generated video sharing communities like YouTube are becoming increasingly popular among children as a stage to perform [62], engage actively with their audience [37], and even to establish their identities as kid influencers [56]. Findings from these studies suggest that appropriately designed tools to create digital content can provide children with the opportunity to express themselves [4,37,62], showcase their innovativeness [3,8,13,46], and also inspire others to participate and collaborate [6,22,27,48].

Motivated by these studies, this thesis explores how children feel about creating and sharing their digital art workflows. In comparison to the research discussed above, investigating ways to engage children in sharing digital art has not received much attention. Some research has focused on children's cooperative drawing approach [50] and proposed tools to support collaboration among peers [5,19]. However, to our knowledge, none has investigated what type of information children might want to share when it comes to digital

art and why. In this thesis, we investigate children's attitudes towards a tutorial authoring system that allows children to be creators of drawing tutorials while working on digital art.

2.2. Tutorial Systems and Tutorial Authoring Tools

Digital art is often created using complex software. There are numerous examples in the literature of research on designing tutorials and other help systems to support the learnability of complex software applications [33]. For example, several studies have concentrated on generating image-based tutorials by capturing and visualizing users' operation history of using an application [23,28,39]. There are also systems that automatically generate tutorials containing both the workflow histories and videos of the operations [11,25]. Our work is informed by these prior authoring systems; however, whereas the above work has focused on adults, we specifically focus on a system to help children create tutorials.

Also relevant to our work, there are systems that assist users with digital drawing [18,20,30,35]. These systems typically provide guidance to help users attain certain effects or drawings. Rather than guiding users towards a particular outcome, our objective in helping children create tutorials is to allow them to share ideas with other children, but without constraining another child's creativity.

We are not aware of any prior work examining how to design a tutorial authoring tool for children to create their own drawing tutorials. There are, however, a few online platforms for sharing digital art and tutorials that have some degree of child focus. For example, DragoArt [67] and DrawingNow [68] both list some drawing tutorials targeted at kids, but the vast majority are created by adults or staff illustrators. DrawingNow also

includes a tutorial system that video-captures the drawing process and allows users to create steps from the video after completing the drawing. Our approach differs by letting children create steps while drawing. We also allow children to explain their process in hopes of providing them with a sense of accomplishment.

2.3. Designing for Children, with Children

To design appropriate technology for children, significant importance has been given to involving children in the design process [17]. To confirm the success of any technology, first, we need to understand our target audience, their needs, and their perceptions [3]. Hence, prior work has designed appropriate technology for children by using and extending cooperative design [14,26,31], contextual inquiry [7,14,26], and participatory design [14,26,51] methods. To include children as partners throughout the whole research experience, Druin developed a research approach called Cooperative Inquiry [14], which is comprised of both participatory design and contextual inquiry. This work was extended to create a new technique called Mixing Ideas [26], to foster design collaboration with younger children through brainstorming process. Insights from these current practices suggest great potential of involving children in the research process to help ensure that the technologies are catering to children's needs. We have used this body of research to inform our study methods.

2.4. Summary

In this chapter, we discussed the current research trend related to how children generate and share different kinds of online digital content to point out children's capability to become online content creators. However, to our knowledge, no research has concentrated

on children's creation and sharing of digital art online, which is the focus of our thesis. In this chapter, we also talked about the existing research related to designing tutorial systems and tutorial authoring systems. We found that most such systems are adult-oriented, which motivated us to explore the design of a child-centric tutorial authoring system for generating digital art tutorials. We concluded this chapter by discussing commonly used design methodologies in the field of child-computer interaction, the knowledge from which we apply in our study designs.

Chapter 3

Authoring and Sharing Workflows: General Approach and Developing a Low-Fidelity Prototype

In this thesis, we followed a 'research through design' approach [64], where we used prototyping and evaluations to generate insights into how children respond to the idea of documenting and sharing their workflows. We started with low fidelity (lo-fi) prototyping to elicit initial reactions to the concept of sharing workflows and to refine our general design direction with a formative study. In this chapter, at first, we present our general approach, followed by how we developed our lo-fi prototype.

3.1. General Approach

Our general design direction for a child-centric authoring tool for digital art tutorials is to allow children to capture information on their workflows as they are drawing. Based on prior work showing that most tutorials follow a step-based nature [23,36], we wanted to assist the child in recording and documenting individual steps of their drawing. In our approach, the child decides when they are ready to save a step, with the prototype capturing the image and the tools used during that step. We let children control step capture to investigate how they conceptualize a step. We did not include video information in our tutorial system based on previous research [23,39] indicating that navigating video or animations can be complex and time-consuming. Further, we wanted to let children provide comments or tips associated with their steps, to communicate information about their drawing to others. Instructions that include both image and textual information are also said to be more useful to the users than only images or text [23]. Additionally, we wanted to include a review component, where the child could potentially modify their tutorial before saving it and/or sharing it.

3.1.1. Target Audience

Our initial target audience was children who are 6-11 years old. We targeted this range to cover children who can think logically and make independent decisions (ages 6-10) [16] and who can reason inductively and think from other's perspectives (ages 7-11) [44].

3.1 Low-Fidelity Prototype

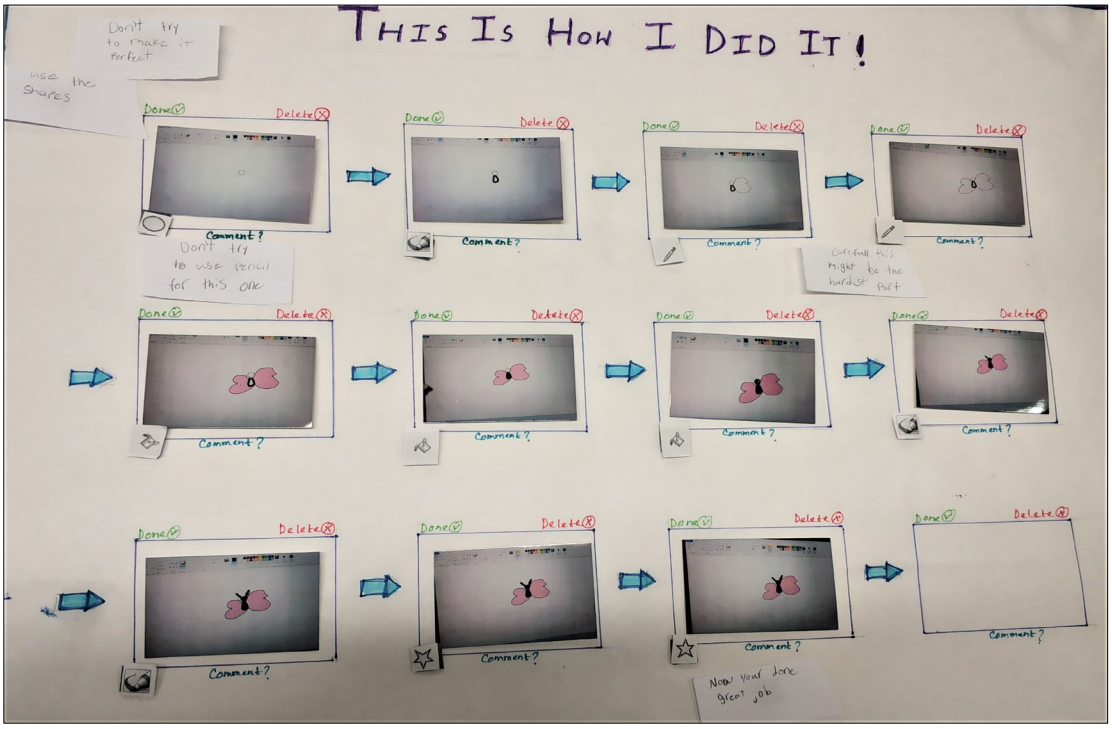

Figure 1: Low-fidelity Prototype. The workflow was generated by a 9-yr-old girl participant in our formative study

Based on previous research [21,38,47,52,55] showing the value of low-fidelity prototyping in designing child-oriented applications, we initially developed a paper prototype. Figure 1 illustrates an example of a complete workflow created with our prototype. The prototype has slots for each step in the tutorial, where each step includes a printed photo of the current state of the drawing as well as sticky notes for the tools used and any comments the child provides. We used this grid-based layout because research suggests users prefer a sequence of steps that include images and descriptions [23].

A challenge that we faced while paper prototyping was simulating the tools (e.g., color effects, undo/redo, copy and paste) of a digital drawing application on paper in a way that would be engaging for kids. So, instead of drawing on paper, we decided to let children

draw using Microsoft Paint, which meant that we needed a way to transfer different states of their drawing to the paper prototype. We initially tried taking screenshots of the drawing application, however, we found that processing and printing them required too much time than for a participatory design session. We instead used a camera and a Polaroid printer to capture the image on the screen and quickly print a photo to attach to the paper prototype. This enabled a child to work with the compelling drawing tools, while still retaining the advantages of paper prototyping for eliciting design feedback.

3.2 Summary

In this chapter, we presented our general approach to children's authoring and sharing of workflows. Additionally, we demonstrated our low-fidelity prototype along with our design goals and the process of developing the prototype. Informed by the previous literature, we decided to generate step-based tutorials with our paper prototype, which include both text and images. In the next chapter, we describe how we conducted participatory design sessions with children using this prototype, to explore potential design alternatives and elicit feedback from the children.

Chapter 4

Formative Study

In this chapter, we discuss how we used our paper prototype in a formative study to investigate children's reactions to the idea of sharing digital art along with how they make it and concerns that parents might have. Through this study, we involved children in the design process as has been advocated in prior work on designing technologies for children [14]. To this end, we used our lo-fi prototype for participatory design sessions with children to refine our system concept. In this chapter, we present our study design and discuss the findings from our formative study.

4.1 Participants

We recruited 8 participants (5 girls, 3 boys) who were 6-11 years old through snowball sampling and by placing advertisements throughout our university campus (See Table 1 for a detailed breakdown). In appreciation of their time and participation, the children received a small toy of their choice and the parents received $15 in cash. The study was approved by our research ethics board (Appendix A.1).

P#	Age	Gender
P1	6	Boy
P2	10	Girl
P3	7	Girl
P4	10	Boy
P5	6	Girl
P6	9	Girl
P7	11	Boy
P8	9	Girl

Table 1: Demographics of the participants in the formative study

4.2 Study Tasks and Procedure

To help the children understand the context of the use of our prototype, we started the study by demonstrating a storyboard prototype (Figure 2), which depicted a child sharing her digital art with her friend and introduced the idea of sharing a workflow. We next asked the child a few interview questions on their thoughts on sharing their drawings and workflows, seeing other's drawings, and following other's workflows. We then showed the child a PowerPoint prototype (See Appendix A.2) to demonstrate what capturing steps of their drawing might look like, before asking the child to draw using Microsoft Paint.

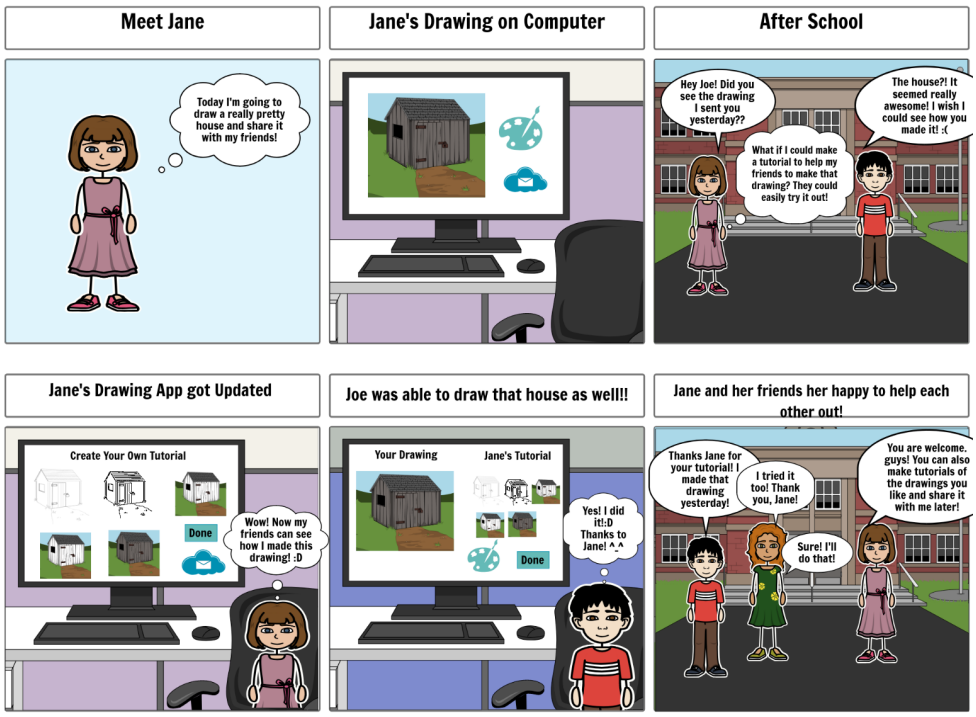

Figure 2: Storyboard Prototype

While they were drawing, we encouraged them to tell us when they were ready to create a step, at which point we took a picture of their screen with our camera.

After the child was done with the drawing, we printed the captured photos. Then, the child and the researcher started pasting the photos on the prototype (See Figure 1 in Chapter 3). We had a set of little sticky notes with icons of different drawing tools that the child could attach under each step. They could also write tips and comments on pieces of paper and attach those to the steps. During this process, we asked the children about what they liked and did not like about the prototype, what they would want to change, and what other information they thought might be useful for another child wanting to follow their tutorial.

We concluded our study session by interviewing the child's parent about any concerns they might have regarding children's sharing of digital art and workflows. The study sessions took place in a research laboratory, with each session lasting approximately one hour.

4.3 Data Collection

We primarily collected qualitative data from the semi-structured interviews with the children and their parents. We also video-recorded the participatory design sessions and audio-recorded the interview sessions, which we transcribed and analyzed for common themes.

4.4 Findings

We present observations on the appropriateness of our target age range and how the children responded to the system concept. We also highlight the feedback they provided on the prototype. Finally, we briefly share parents' perspectives about children's online sharing of digital art and workflows.

Appropriateness of the Target Age Range

In our participatory design sessions, the two 6-year old participants appeared to have difficulty grasping the idea of capturing workflows of their digital art. The remaining six older children seemed to understand the concept and were therefore in a better position to provide useful feedback, suggesting that 7-11 might be a better target age range. In the sections that follow, we report only on findings from the 7-11 years old kids.

Feedback from the Children

Upon asking whether they would like to share their drawings with others, most of the participants (5/6) expressed enthusiasm for the idea of sharing drawings and workflows to showcase their drawing skills and also to help others attempt to recreate their drawings.

P3: Then someone can do that too and then they'll be happy too. – 7-yr girl

Only one participant was hesitant to share his drawing as he felt that it was not good enough, suggesting a lack of confidence.

P4: Sometimes my drawings are bad. If it is good, I will show them. – 11-yr boy

All our participants were interested to see other children's drawings. They found this concept entertaining and thought it would help them generate ideas. All children also expressed interest in seeing the workflows behind these drawings. They felt it would help them to recreate a particular drawing they liked.

P6: Once my friend Danny, she drew a really cool thing like a girl, and I was like how did you do that?! I would like to try that. – 9-yr girl

From our participatory design sessions, we observed that all of the 7-11 years old children understood what steps are in a workflow. All liked the sequential way of displaying the steps as showed in Figure 1. They also found the icons of the tools associated with each step helpful. They believed the display of the workflows was simple and intuitive for other kids to understand the drawing process.

P3: I like this because if you are reading a book, you'll go like this. – 7-yr girl

All participants created steps for the changes they applied to their drawings. Once they understood the concept of creating steps, they did not hesitate to let us know to capture a photo of the drawing to make it a step. However, some of the kids (3/6) were so focused

on the drawing that sometimes they forgot to capture the steps. To tackle this, one participant suggested showing reminders to the user. Nevertheless, they did not want the system to capture steps without their permission – they wanted to remain in control.

Children were able to provide tips and comments about their steps. Though most of them were reluctant to write comments at the beginning, everyone attached at least one comment. Examples included: "Don't try to use pencil for this one", "Careful, this might be the hardest part!", "Now you're done. Great job!". One participant mentioned that having the option to write comments while saving the steps would be more beneficial as they might think of a comment while drawing a particular step and forget about it later.

Feedback from Parents

In general, parents were not concerned about children sharing their drawings online.

> *Not much different than showing her sketchbook to her friends.*

Their main concern was what kids would see and how that could be controlled. To ensure children's safety while sharing their drawings, parents wanted parental control to supervise what kids are sharing and whom they are sharing with.

> *I'm more concerned about what they can see. Because all it takes is one person to put up something disturbing… So, my concern is not privacy-related, but more controlling who creates a content that they can see.*

> *I mean the difficulty is, is it the child who is really sharing it?*

A few parents thought it may affect kids' creativity negatively if they always try to follow others' instructions. It might be helpful for children who just have started to learn, while for others, it may constraint their imagination.

> *In some sense, I think if we guide kids to follow a series of steps and maybe there are some constraints for them to imagine. They don't feel free.*

However, overall, parents felt that the opportunity to learn to draw from other children would have a positive effect on children's creativity.

> *Sometimes learning to do something somebody else's way can kind of encourage you and give you ideas for how to do something your way. I don't think it'll stifle her creativity as long as she has time and space to do her own things too.*

4.5 Discussion

To summarize the findings, our formative study participants were generally positive about sharing their workflows with others, and all participants seemed to enjoy generating a tutorial that showed their workflow. We did see some hesitance that might be attributed to lower confidence, however, warranting further study with a larger sample. Parents responded positively to the idea of their child sharing their drawings with others, provided proper parental controls were in place.

4.6 Summary

In this chapter, we presented our formative study design and the findings from the study. Findings from this formative study motivated us to develop a higher-fidelity prototype and conduct further investigation in this direction. In the next chapter, we describe the development of our higher-fidelity prototype.

Chapter 5

Developing a Higher-Fidelity Prototype

The low-fidelity paper prototype strengthened our understanding of what our target audience may want in a tutorial authoring system. Based on the feedback received on the lo-fi prototype from our formative study, we developed a higher-fidelity prototype to use as a means of inquiry [58] in a second study. We wanted to use this prototype to gain more detailed insights into how children might respond to our tutorial authoring approach. To facilitate our prototype development, we used a mix of automated capture and Wizard-of-Oz techniques, as we describe in this chapter.

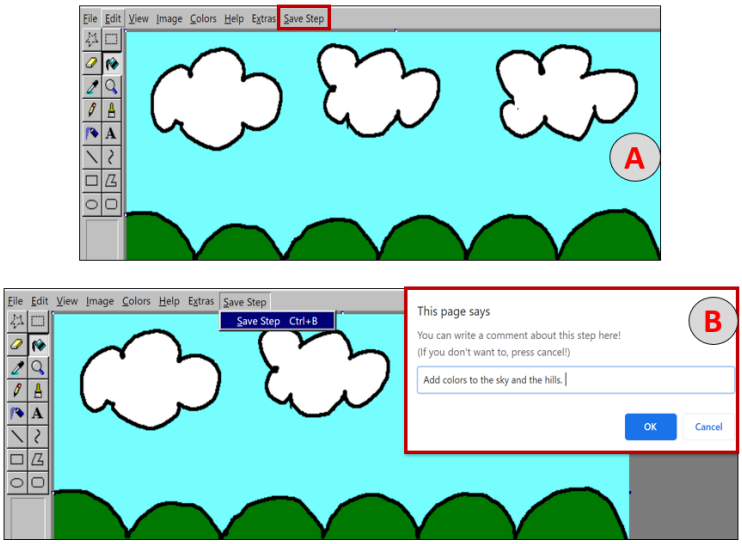

Figure 3: Higher-Fidelity Prototype: A "Save Step" feature has been added to JS Paint. When clicked, the prototype captures the progress of the drawing along with tools used for that step (A); The child can optionally choose to provide a comment with the step (B)

5.1 Prototype Functionalities

Our higher-fidelity prototype (Figure 3) allows a child to generate a tutorial while drawing digital art. Our prototype currently works with JS Paint [41] (Figure 3A), an open-source drawing program. When the child chooses to capture a step by clicking the "Save Step" feature (Figure 3A), the prototype automatically records the current state of the drawing as well as the tools used as part of that step. The prototype also allows the child to add a comment when saving a step (Figure 3B). This design decision was based on the feedback from our formative study that some children preferred to write comments while working on the drawing to avoid forgetting them. During our formative study, we also observed that when concentrating on their drawing, kids sometimes forgot to save steps, which they later

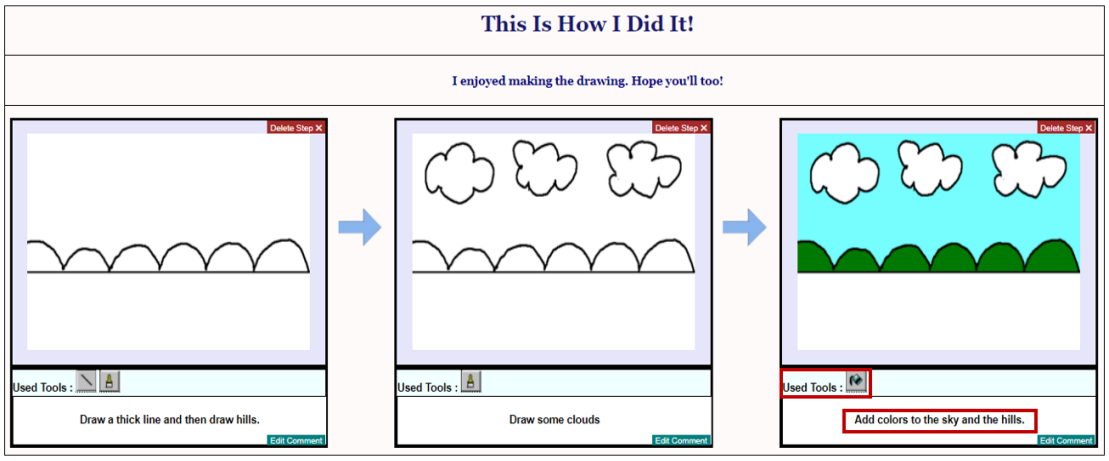

Figure 4: Upon completion of the drawing, the prototype displays the captured steps sequentially along with the associated comments and used tools

regretted. Our prototype, therefore, prompts the child to save a step at regular intervals. These prompts are currently controlled via a wizarding interface. With this wizarding interface, a facilitator would remotely press a button to show a prompt on the participant's screen when the participant forgets to capture steps. From the participant's end, the display of the prompt would seem automatic.

After the child has completed their drawing, the prototype displays an automatically generated step-based tutorial, as shown in Figure 4. The sequence of steps captured by the child includes information on the tools used and any comments that the child provided while drawing. Children can edit comments (Figure 5A), delete unnecessary tool information (Figure 5B), and delete steps (Figure 5C). After they finish editing the tutorial, the prototype displays the final version of the tutorial, which could eventually be shared with friends.

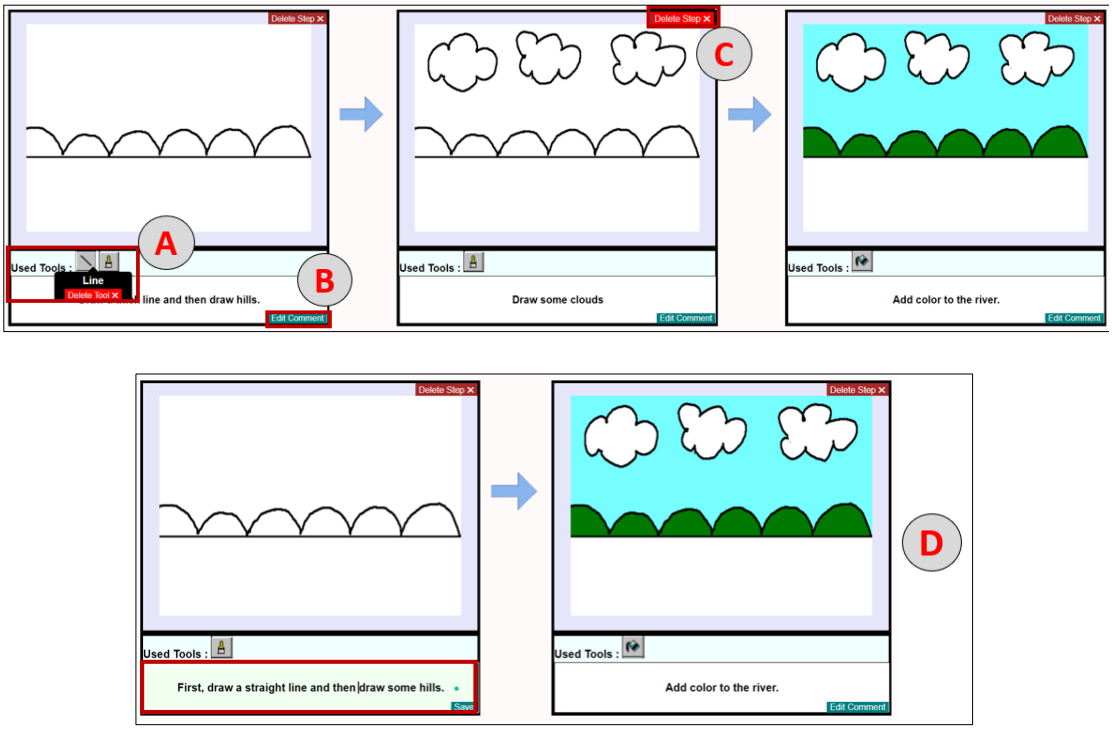

Figure 5: Children can delete unnecessary tool information (A), edit comments (B), and delete steps (C). Changes in the workflow are reflected immediately (D)

5.2 Summary

In this section, we demonstrated our higher-fidelity prototype and described our design decisions regarding the development of the prototype which was informed by the feedback we received from our participatory design sessions with children. In the next phase of our research, we used this higher-fidelity prototype to conduct a more detailed evaluation.

Chapter 6

Further Concept Exploration and Prototype Evaluation

Our formative study provided some initial indications that children seemed open to the idea of generating tutorials for other children. In a second study, we use our higher-fidelity prototype to investigate the question of what incentives children might have to generate a tutorial for others, including how they might balance tutorial generation with focusing on their own art. We were also interested in how they would use our tutorial authoring interface, including how they would decompose their drawings into steps, what type of comments they would leave for other children, and whether they would be interested in making post-hoc modifications to their tutorials.

Like our formative study, we had planned to conduct individual sessions with children in a laboratory setting. However, due to the COVID-19 pandemic, we transitioned to an online study, where we interacted with participants using video conferencing software.

In this chapter, we present the study design of this online study and analyze and discuss the findings from this study.

6.1 Participants

We recruited 16 participants for our study (8 girls, 8 boys), who were 7-11 years old (mean: 9.5; see Table 2 for a detailed breakdown). We conducted the study in May and June 2020, when several COVID-related restrictions were in place in our city. As such, we were unable to recruit by placing advertisements in our community and instead relied on snowball sampling. As the study was conducted online, we were able to recruit internationally.

P#	Age	Gender	Country
P1	11	Girl	Bangladesh
P2	9	Boy	Canada
P3	10	Boy	Canada
P4	7	Boy	Canada
P5	10	Girl	Canada
P6	11	Boy	Canada
P7	9	Boy	United States
P8	8	Girl	United States
P9	10	Girl	Canada
P10	10	Boy	Canada
P11	8	Boy	United States
P12	11	Boy	United States
P13	11	Girl	Canada
P14	11	Girl	United States
P15	10	Girl	United States
P16	7	Girl	Canada

Table 2: Demographics of the participants in the online study

In appreciation for their time, the family was provided with $20 in cash or as a gift card. The study was approved by our research ethics board (Appendix B.1).

6.2 Study Tasks and Procedure

To conduct the study remotely, we used video conferencing software with the parent's supervision. To enable the facilitator to act as the prototype "wizard", we used TeamViewer, which allowed the participants to access to the facilitator's computer screen directly. This also meant that participants did not have to install any other software to run our prototype. Each study session was approximately 60 minutes long.

Similar to our initial formative study, we began by showing the child a storyboard (Figure 2 in Chapter 4) to introduce them to the idea of sharing their art. We then asked a few interview questions to investigate whether they understood the concept of steps and tutorials, how they feel about sharing their drawings and/or workflows, and using another child's tutorial. After that, the facilitator demonstrated the prototype by creating a simple drawing and generating a short tutorial.

Next, we asked participants to perform the following three tasks: 1) We asked the participant to draw something. We asked them to capture their steps while drawing and told them that they could provide comments with each step if they wanted to. 2) After the child completed their drawing, we asked them to review the generated tutorial and make any desired modifications. 3) We asked the child to view a tutorial of a simple drawing (See Appendix B.2) that was created by one of the researchers to have a style similar to those generated in our formative study. We had originally planned to ask the child to use the tutorial to create a drawing. However, in our pilot study sessions, we observed that

children were becoming tired, with the online nature of the study likely adding additional mental load. Therefore, to shorten the study session, we compromised by showing them a tutorial and eliciting their feedback on whether they would like to use a tutorial generated by another child.

After completing each task, we asked a few open-ended questions about their experience of using the prototype. We intermixed the interviews and tasks to create a more conversational atmosphere with the child as well as to provide a break from using the prototype. In piloting, we found these breaks to be particularly important with the study being online. We also asked them survey questions by adapting the Fun toolkit survey technique [45], which has been used in previous studies with kids to evaluate interface usability.

Specifically, we asked 10 questions covering: i) how they felt about using the features of our prototype (Smilyeometer shown in Figure 6); ii) which task they liked most (Fun sorter shown in Figure 7), and iii) whether they would like to do each task again (Again-Again Table shown in Figure 8). Children completed the Smilyeometers after the drawing task and after viewing the other tutorial. Other survey questions were asked at the end of the study. Participants completed the surveys on the facilitator's computer (using TeamViewer). The facilitator explained the survey questions if the child had any questions.

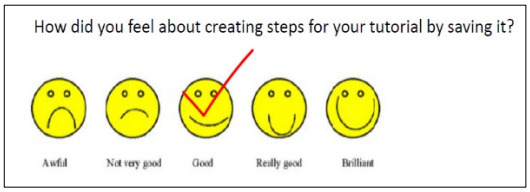

Figure 6: Smilyeometer from the Fun toolkit was used to elicit feedback on the Features (e.g., creating steps, writing comments) and Tasks (viewing and using others' tutorials)

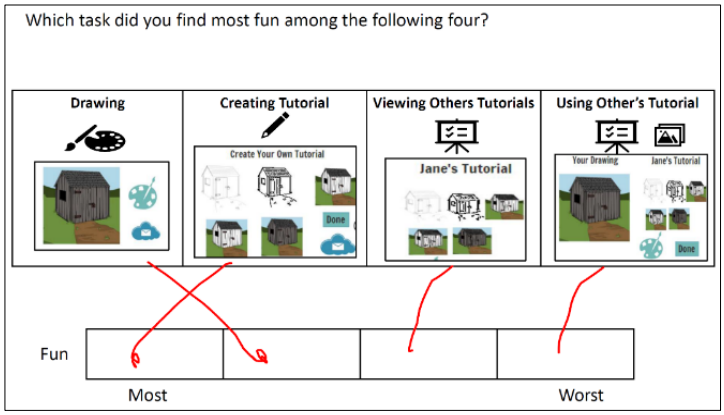

Figure 7: Fun sorter from the Fun toolkit was used to rank the tasks based on the Fun aspect

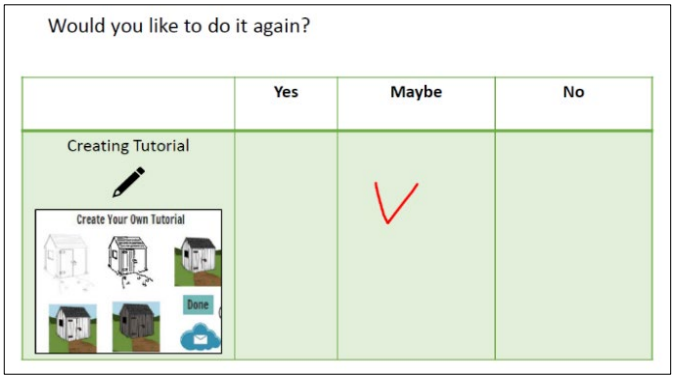

Figure 8: Again-Again Table from the Fun toolkit was used to ask the participants whether they would like to do a task (e.g., drawing, creating a tutorial, etc.) again

6.3 Data Collection

Our main source of data was the qualitative data from the semi-structured interviews conducted throughout the study. We recorded the entire study sessions using a screen recorder to capture the interactions with the prototype. Finally, we used the surveys to elicit structured data on children's experiences with the prototype.

6.4 Findings

The majority of our participants (12/16) were familiar with the concept of a tutorial. All successfully generated a step-based tutorial using the prototype. The girl participants drew flowers, unicorns, or nature scenery, whereas the boys created drawings of a rocket, ship, or their favorite Lego characters. See Figure 9 and Figure 10 for example tutorials created by our participants.

On average, participants generated 7 steps per tutorial (min: 4; max: 10; SD: 1.68). For most participants, each new element added to the drawing constituted a step. As the formation of a step was conceptual and related to elements of a child's drawing, this indicates that implementing automated step capture would be challenging. For example, simply creating a step for each tool used would have resulted in tutorials with much lower granularity than those created by our participants.

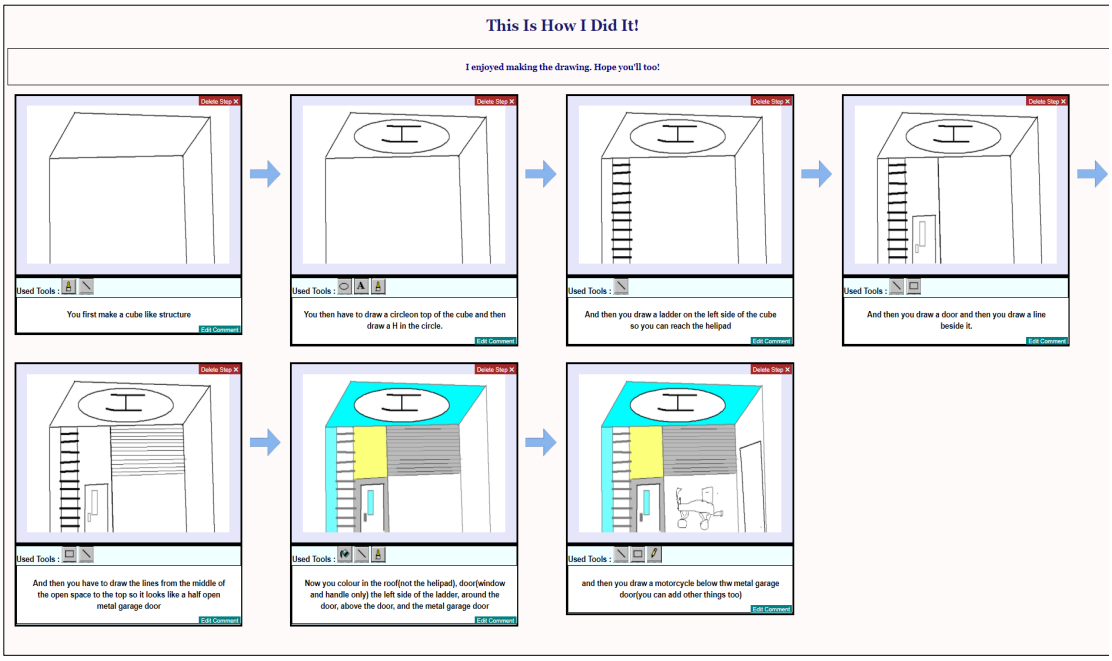

Figure 9: Tutorial authored by an 11-year-old boy (P6)

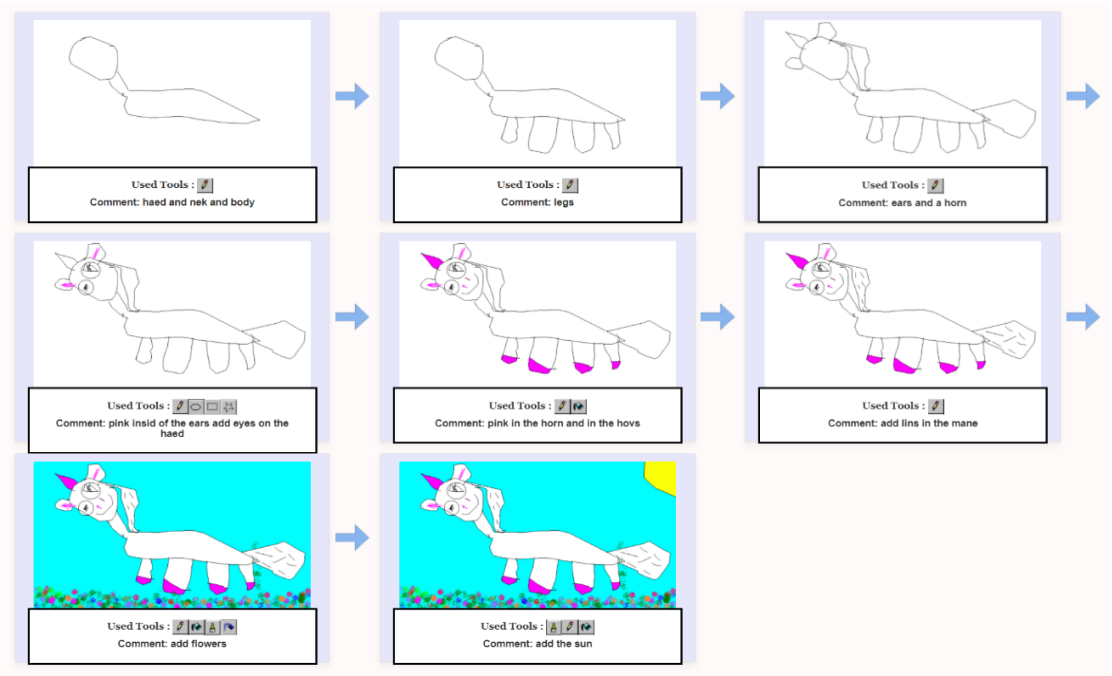

Figure 10: Tutorial authored by a 7-year-old girl (P16)

Almost all participants (15/16) provided comments with their steps. The average number of comments per tutorial was 6 (SD = 2.38). 14 participants provided comments with each step. Comments often described the drawing element in the step, e.g., "the ocean", "Lego arms", "moon", etc. Some participants provided more detailed or specific instructions with their comments, e.g., "You first make a cube like structure", "Make a hill and color on top", "Add texture to the grass", "Add any of your imaginary details you like", etc. We did not observe any age differences manifest themselves in the commenting style or informativeness.

6.4.1 Survey Findings

The survey indicated that all 16 participants felt positive about creating steps and viewing others' tutorials (Figure 11). 14/16 participants also felt positive about writing comments. Additionally, we found that 10/16 participants wanted to create a tutorial again; the remaining 6/16 indicated that they might be interested in doing so (Figure 12). Responses were positive for viewing and using others' tutorials: only one participant did not want to view or use others' tutorials in the future.

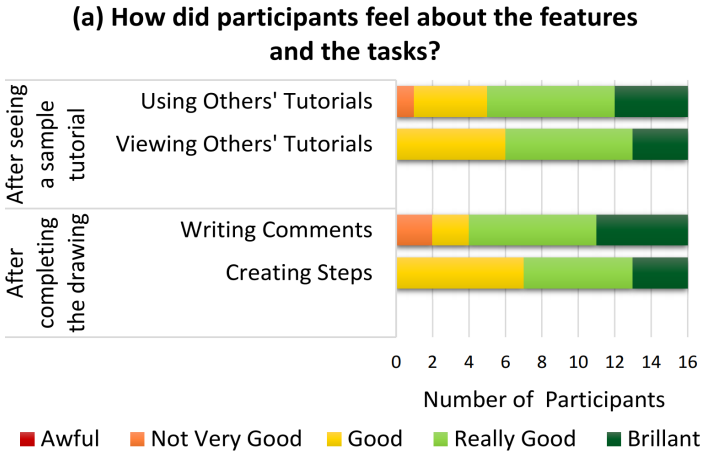

Figure 11: Participants' ratings on the tasks and the features of our prototype

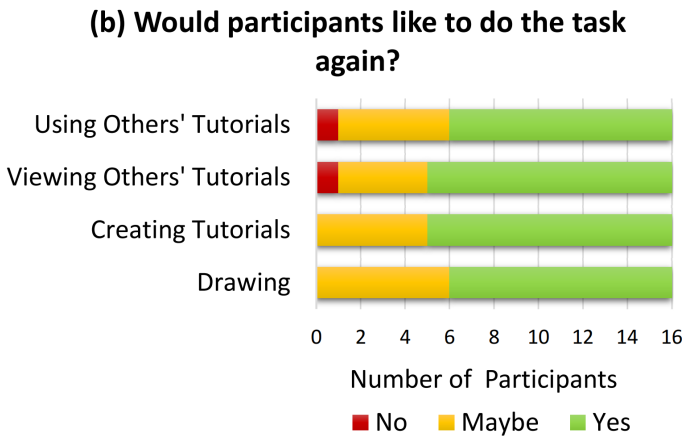

Figure 12: Whether participants would like to do a task again

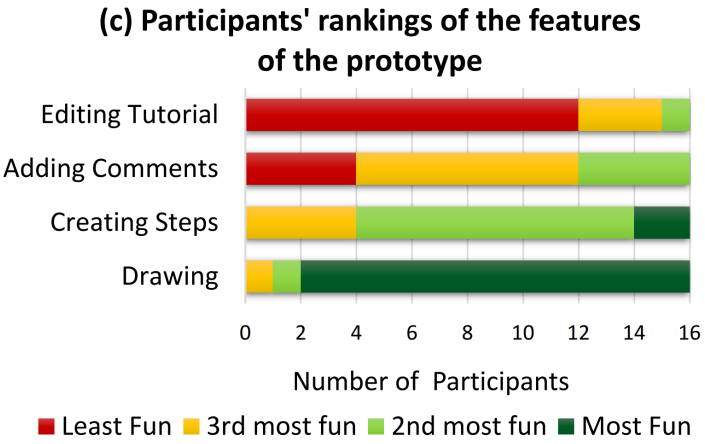

Figure 13: Participants' rankings of the features of the prototype based on the fun aspect

Among the four features - drawing, creating steps, adding comments, and editing tutorials, 14/16 participants found drawing as the most fun and the remaining two participants chose creating steps as the most fun feature (Figure 13). 10/16 rated creating steps as the second most fun feature. 12/16 of the participants found editing tutorials to be the least fun among all the four features, which they confirmed in the interviews. This

potentially supports our idea of capturing and generating the steps while creating the drawing.

6.4.2 Interview Findings

We transcribed the interview data and then analyzed it by using a bottom-up inductive approach and creating affinity diagrams [7] to identify themes in the data, as shown in Figure 14. While creating the affinity diagrams, I initially applied open coding [12] to the quotes and then used the affinity diagramming to refine the initial set of codes. Next, I clustered related quotes and performed axial coding [54] to identify themes. Along with another researcher, I collaboratively iterated on the raw data, clusters, and codes until clear themes emerged.

Figure 14: A segment of our Affinity Diagrams created from the Interview Data

From our analysis, themes emerged related to incentives for creating and sharing, and attitudes towards child-authored tutorials, which we present below. The qualitative data also contained insight regarding how different features of our prototype might support tutorial creation. To contextualize the quotes, we provide each participant's age and gender.

Incentives to create and share tutorials from the children's perspective

Table 3 summarizes the reasons children provided for and against the idea of creating and sharing tutorials. As the counts show, some participants provided multiple reasons. All the 16 children provided reasons in favor, however, 5 expressed mixed views. We elaborate on their reasons below.

Reasons for creating and sharing Tutorials	
Altruism	14 participants
Assessing Own Tutorials and Seeking Validation	12 participants
Showcase Drawing Skills	6 participants
To Keep a Record of Their Own Drawing	5 participants
Reasons for hesitating to share Tutorials	
Lack of Confidence	5 participants

Table 3: Reasons for and against creating and sharing tutorials along with the number of participants who felt this way

Altruism

The main incentive to create and share tutorials for most of the participants (14/16) was altruism. There were some nuances, however, in how children expressed their desire to create tutorials as a way of helping others. For example, some of the kids (4/16) wanted to

help people in general by sharing their tutorials, whereas others specifically wanted to help their friends. In terms of why they wanted to share, participants were particularly motivated to give other kids new ideas for drawing, seeing their tutorials as a way to ensure that the kids could create the drawings easily:

> *P2: I'd like to show my friends so that they can get an idea of what to do next when they draw again and also, I can show them a few steps about how they can make it. ...I'd like it because it'd feel good. Like I'm helping people without even seeing them. – 9-yr boy*

Other children (4/16) liked the idea of showing kids how they might draw something differently. For these participants, it seemed to be less about showcasing the final product and more about illustrating their process.

> *P15: It's fun and lets other people learn how to draw something in another way. – 10-yr girl*

A few participants (3/16) wanted to share their tutorial only if their friends specifically asked for it. They were not confident in their drawing skills and were shy to share their drawings with others unless someone needs it.

> *P1: If my friends want to know that and want to see a tutorial then, of course, I'll show it. – 11-yr girl*

Assessing Own Tutorials and Seeking Validation

Some participants (7/16) wanted to share workflows with others to assess their own skills. If others could reproduce or make a better version of their drawings by following their tutorials, they felt that it implied that their tutorial was understandable and useful.

> *P12: I'd just wanna see how good the steps were that I made, and if they ended up making it look more realistic. – 11-yr boy*

Others (9/16) thought they would feel validated even just by having another child try their tutorial, since this would mean they produced something interesting. Knowing that others were going to view and use their tutorials to create a drawing gave them the satisfaction that their art is appreciated by others and their effort is valued.

> *P15: I'd like it because some kids like to draw, and I'd like it if they do this thing. I'd be happy too, to see that they used my tutorial. – 10-yr girl*

Showcase Drawing Skills

Some of the children who seemed particularly confident in their art and drawing skills, wanted to share their tutorials to showcase their skills (6/16). For these children, it seemed less about receiving validation and more about having an outlet to share their creativity with others.

> *P14: If I'm proud of the artwork then I'd wanna show it to other people. So that they have an opportunity to try doing art and learn. – 11-yr girl*

To Keep a Record of Their Own Drawing

Finally, some participants (5/16) wanted to create tutorials to keep a record for themselves so that they could review it later to recreate the drawing. It indicates that even if a child is not comfortable sharing their tutorials with others, they can still create tutorials for themselves.

> *P6: If I ever went back and reviewed it, it kinda leaves like a bookmark… Next time you can follow the steps again. – 11-yr boy*

Lack of Confidence a Deterrent to Sharing

Some participants (5/16) were not as eager to share their art and their tutorials with others due to a lack of confidence. They were hesitant to create and share tutorials because they believed their drawing skills are not adequate to create tutorials, even though their drawings were not noticeably worse than the other participants. They were not confident that others would like their tutorials.

> *P14: Some of them are better at drawing and I'm scared that they're gonna judge me. – 11-yr girl*

P14 mentioned earlier in the interview that she wanted to showcase her drawing skills by sharing the artwork she is proud of. However, at the same time, she had some reservations about sharing due to her lack of confidence. This indicates that some children might be in conflict about whether to share their tutorial.

Opinions about the features of the tutorial authoring system

During our interviews, children provided feedback on the features of our prototype and our general design approach, as well as ideas for future improvements.

Capturing steps was intuitive but can divert attention

Participants generally found saving steps while creating the drawing to be simple and intuitive. One participant mentioned that she got so accustomed to saving steps that she did it without even thinking about it.

> *P14: At one point I kinda forgot that to save step (that she's using the feature of saving steps subconsciously). I kinda got used to saving the steps. – 11-yr girl*

On the other hand, some participants (6/15) felt that saving steps distracted them from their drawing. When they were focused on their drawing, remembering to save the steps, and pausing their drawing to do so was sometimes a hassle. They worried that it might ruin their flow and they might forget what they wanted to do.

> *P16: I was kinda in a mood. I like focusing on what I'm doing instead of stopping and doing something else. – 7-yr girl*

Incorporating an optional automated step capture feature might be well received by children who want to generate a tutorial but find saving steps distracting. However, such a feature would have to consider that children's natural formation of the steps was based on the elements of their drawings rather than tool use.

Mixed reaction towards writing comments

Though all but one participant provided comments with their steps, only half of those participants (7/16) explicitly discussed the value that they saw in providing comments. They believed that comments could assist others to go through the steps and could also help them remember what the steps meant if they wanted to review their own tutorials.

> *P14: Writing comments is a good way to explain it because sometimes just looking at pictures doesn't make sense. – 11-yr girl*

Some of the participants who were not as enthusiastic about commenting (4/16) found it difficult to come up with appropriate comments. They indicated that it was sometimes hard to explain the steps the way they wanted.

> *P15: Sometimes you have another way to say it in your head and it's complicated to put it in comments. – 10-yr girl*

Thus, overall, we observed mixed reactions towards commenting: some were enthusiastic about writing comments; for others, it seemed to be a source of pressure. At a minimum, this supports our decision to make commenting optional. Future versions could explore ways to assist the children who want to provide comments but struggle to verbalize their thoughts.

Tool Information is not always sufficient

The tool information provided with each of the steps was seen as useful by most participants as they felt it gave a clear idea of which tools were needed to achieve a certain effect. However, a few participants wanted to provide more information regarding the tools that they used. For example, in addition to the tool name and the icon, some tools could have more details, such as brush size, the color of the paint, etc. Future versions could explore designs that can include additional information for certain tools.

Attitudes towards following other children's tutorials

In addition to getting insights into children's incentives to generate tutorials, we hoped to gain initial insight into how the children felt about being consumers of kid-generated tutorials. As a reminder, due to time constraints, we showed participants a sample tutorial to elicit their opinions, but they did not actually have to follow a tutorial.

The main reason for wanting to see others' tutorials was to gain new ideas and inspiration from others' drawings (11/16). Participants mentioned that they are sometimes unsure about what to draw, how to start, and were interested in seeing other ways to draw something. Participants also (7/16) mentioned how they can learn from others who are better at drawing by viewing their tutorials and by comparing their drawings to find

potential ways to improve. One child mentioned that she wanted to make the authors feel happy that someone has tried out their tutorial. Below are some quotes that represent participants' attitudes towards following other's tutorials:

> *P15: So that I can also get an idea because I'm always questioned about what I can draw... I like art and I'd like to draw something in another person's way. – 10-yr girl*

> *P6: I wanna see how they think and what I'm missing in my drawing so that next time I can make my drawing better ... Someone who drew this before may have more experience than me and so I can use their steps and then I'll be experienced too. – 11-yr boy*

> *P16: Using their own tutorials would probably make them feel happy. It'd make me feel happy to make others' feel happy. – 7-yr girl*

Three participants were not enthusiastic about the idea of following others' tutorials. They indicated that they did not like following instructions or wanted to draw something in their own way, with their own creativity.

> *P9: I'd probably draw it myself because I like drawing on my own. To be like less step by step by someone else's. – 10-yr girl*

Opinions about Adults' vs Kids' Tutorials

After showing children our sample tutorial, we asked them whether they would prefer it if the tutorial was created by an adult. For example, prior studies have found that preschoolers prefer child informants over adult informants for some kinds of information (e.g., toys) [57]. Half of our participants (8/16) believed that an adult's tutorial would be more detailed and informative than a child's tutorial. Some of the kids expressed interest in seeing

tutorials from established artists. A couple of participants (2/16) believed that kids' tutorials would be better than adults' tutorials because kids' tutorials are more fun and creative. They also felt that adults' tutorials could be too difficult. The other participants (6/16) said that the age of the author does not matter to them, that it would depend on the skill level of the author, and how informative the tutorial is. Some also mentioned that they would like to try out both the adults' and the kids' tutorials. The quotes below illustrate this range of opinion:

> *P15: I think adults make a little more sense … If it was an adult's, they'd explain it a little more – 10-yr girl*

> *P8: The little kids' drawings are sillier and more like fun and joyful. Adults are like perfecting everything. And kids are like they go crazy and I like that. – 8-yr girl*

> *P6: Sometimes adults don't have more experience than the children because they never really draw a butterfly. And sometimes children always draw butterflies. I guess depending on their skills, not age. – 11-yr boy*

These findings indicated openness and potential advantages to tutorials from both children and adults, warranting further investigation.

6.5 Discussion

Our findings suggest that most children in our study were interested in and capable of authoring drawing tutorials. Their incentives to author and ultimately share their tutorials included helping their peers and other social incentives (e.g., seeking validation and showcasing skills). Some also wanted to maintain a record for their own purposes. We were surprised by the extent that their motivations mirrored those found in prior work on adult populations. For example, altruism is an intrinsic motivator for adults who share their

knowledge online [60]. Similar to the incentive of 'showcase drawing skills', adults also author tutorials to showcase the workflows they find interesting [43]. Self-efficacy is another important consideration [61]. In our studies, we noticed that children's level of confidence in their drawing abilities seemed to affect their attitudes towards sharing. While building a child-centric sharing platform is beyond the scope of this work, this overlap in motivations suggest opportunities to learn from prior adult-centric research on how to motivate sharing online. For example, positive voting and textual comments have been shown to encourage adults to contribute [10]. Future work can explore the extent to which these prior approaches could also encourage a range of children to share their digital art workflows online, or conversely if new child-centric approaches are needed.

Our findings indicate that children can be interested in following another child's tutorial and have provided some preliminary insights on their opinions of adult- vs. child-authored tutorials. As a preliminary investigation, we informally compared the tutorials authored by our participants with some of the adult-generated tutorials dedicated to kids available in two online communities: DrawingNow [68] and DragoArt [67]. We observed similarities in step formation and commenting style, however, as some children in our study suggested, the adult-authored comments were more detailed. The more striking difference, however, was that the adult-authored tutorials mostly followed a structured way of drawing, starting with a workable frame to make the drawing process easier. Our participants took a less structured approach, allowing their drawings to move in creative directions. The potential for this difference was expressed by two children in our study, who felt that child-authored tutorials might be more "crazy" and "joyful", whereas adults' tutorials might focus more on technique and drawing success. Further study is needed to

understand the relative advantages and disadvantages of child- vs. adult-authored tutorials for this type of creative activity. For example, adults' tutorials might be better for teaching drawing skills, whereas children's tutorials might be more relatable and inspire creativity.

We had to conduct this study online due to the COVID-19 pandemic, which had some drawbacks. For example, participants were sometimes distracted by siblings and some experienced internet issues that introduced a lag when they were using the prototype on the facilitator's computer. Some parents had difficulties setting up the study, which made the kids impatient. On the other hand, we also saw advantages to the online setting that we had not anticipated. For example, we were able to recruit internationally, and parents did not have to find the time to bring the kids into the lab. Our biggest fear was that the lack of physical presence might result in lower participant engagement and affect data quality. We were pleasantly surprised, however, that participants were as or even more engaged in the interviews than they were in our initial lab-based study. We suspect that being in the familiar environment of their home helped make the children comfortable in expressing their thoughts. Nonetheless, future work should explore the generalizability of our findings to a larger sample.

Our findings suggest important considerations for child-centric authoring systems for an activity like digital drawing. Most children responded positively to the idea of creating a tutorial while they were drawing. They further indicated that they found the post-hoc modifications to be the least fun activity of the study session. This suggests that interleaving tutorial generation with the principal activity is a promising design direction. At the same time, we saw that children wanted to control the granularity of their steps, but sometimes became so engrossed in the drawing activity that they forgot to do so. Future

work could consider adaptive prompts or automated step capture that take into account the characteristics and tendencies of the child artist. Our findings also suggest that children appreciated the ability to annotate their steps, however, some found it difficult to craft good comments. Future work could therefore consider ways to scaffold this process, for example, through sample comments or comment templates. There is also the potential to explore alternative uses of this type of drawing capture approach. For example, one child in our study proposed the idea of using the system to create an illustrated story with her friends.

6.6 Summary

In this chapter, we presented our remote study, where we evaluated our higher-fidelity prototype and shared the findings from our interview and survey data. Along with indicating that the children were interested in and capable of authoring tutorials with our prototype, the findings also uncovered important insights into what motivates the participants to generate drawing tutorials in general, and why they find it interesting to follow others' tutorials. Further, we received feedback on the features of our prototype and our general design approach. Additionally, this study provided some initial insights into children's preferences about adult- vs. kid-generated tutorials. Findings from this study also provide implications and recommendations for future research in this direction.

Chapter 7

Conclusion

In this thesis, we present the participatory design and evaluation of a child-oriented tutorial authoring system for digital art. Results from our studies indicated that children in our studies actively engaged with our prototype, producing a range of step-based tutorials geared towards other children. These findings suggest that our child-centric approach to tutorial authoring was well-received by the children. In the following subsections, we conclude by discussing the research contributions and the potential future research direction of this thesis.

7.1 Contributions

This thesis presents a child-centric approach to design and evaluate a tutorial authoring system that assists children with generating digital drawing tutorials. We initiated our investigation by developing a low-fidelity prototype through iterative brainstorming and informing our design decisions by an extensive literature survey. We used this lo-fi prototype to conduct a formative study with children where we elicit reactions to our system concept and feedback on our design elements. We also interviewed the parents about any concerns they might have with this type of sharing activity. Our findings suggest that the children and their parents had positive attitudes towards the idea of children creating tutorials for other children.

We used the feedback from the formative study to create a higher-fidelity digital prototype, which we evaluated in an online study. The results of our second study unveil children's incentives to author tutorials, which ranged from helping their peers, to demonstrating drawing skills, to wanting to document their workflows for their own recollection later.

To summarize, our research makes the following contributions:

- We presented our concept and the design of a child-centric tutorial authoring system for digital art that we developed in cooperation with children.

- We presented findings from a formative study that illustrate parents' and children's attitudes towards sharing children's digital art workflows.

- We presented findings from a remote study which provide insights into children's perceived incentives to author and share tutorials.

7.2 Limitations and Future Research Directions

Conducting our study online during the height of COVID-19 restrictions in our city introduced a few limitations. For example, we could not use community advertising, which likely reduced the diversity of our pool (e.g., in terms of socioeconomic status). Further, we had originally intended to have children try a previously created tutorial to elicit grounded data on their perceptions, however, the COVID-19 pandemic required us to move to an online setting and shorten our sessions to avoid video conferencing fatigue. A future study can consider including a task of reproducing a drawing by using a previously generated tutorial in the study design. This might provide us with a more concrete understanding of what aspects of a tutorial the children would like to adopt, to which extent they like to follow a tutorial, etc.

In our interviews, participants expressed interest in sharing their tutorials with others and following others' tutorials. In future work, our tutorial authoring system can be incorporated into an online digital art-sharing platform where children can share their art along with self-authored tutorials. It would be interesting to explore whether interaction with such a platform can provide children with a sense of self-accomplishment while supporting self-based learning. While promoting altruism, such a platform might also have the potential to grow a community of child art-enthusiasts. In the future, a longitudinal study with our tutorial authoring system incorporated into an art-sharing platform can

uncover insights into the long-term effects of using such a platform on children's sharing of art tutorials.

Our findings illustrate the potential for children to be engaged and motivated by this form of peer-based help and knowledge sharing, with potential applications to other domains (e.g., helping children create programming tutorials). Our approach is also but one way to provide children with tools to share aspects of their creative process with others. Future work should further explore new ways for children to communicate their digital art ideas and skills with their peers and connect with other children in positive online communities. Future work should also study the role of such communities in fostering important social skills. Finally, it would be interesting to explore the generalizability of our approach to other creative activities that involve complex software, such as 3D modelling for child-oriented makerspaces.

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Appendix A

Formative Study Additional Materials

A.1 Research Ethics Board Approval

UNIVERSITY OF MANITOBA | Research Ethics and Compliance

Human Ethics
208-194 Dafoe Road
Winnipeg, MB
Canada R3T 2N2

PROTOCOL APPROVAL

TO: **Andrea Bunt**
Principal Investigator

FROM: **Julia Witt, Chair**
Joint-Faculty Research Ethics Board (JFREB)

Re: **Protocol J2019:062 (HS23128)**
"Designing an Online Platform for Children for Sharing Digital Art"

Effective: August 28, 2019 **Expiry:** August 28, 2020

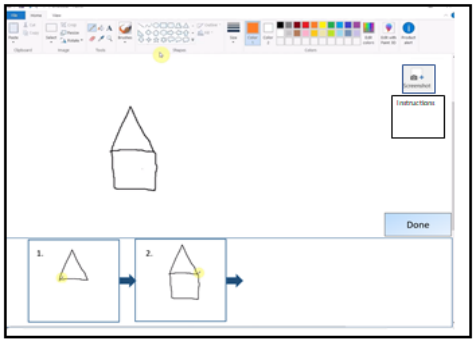
Joint-Faculty Research Ethics Board (JFREB) has reviewed and approved the above research. JFREB is constituted and operates in accordance with the current *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans.*

This approval is subject to the following conditions:

1. Approval is granted for the research and purposes described in the application only.
2. Any modification to the research or research materials must be submitted to JFREB for approval before implementation.
3. Any deviations to the research or adverse events must be submitted to JFREB as soon as possible.
4. This approval is valid for one year only and a Renewal Request must be submitted and approved by the above expiry date.
5. A Study Closure form must be submitted to JFREB when the research is complete or terminated.
6. The University of Manitoba may request to review research documentation from this project to demonstrate compliance with this approved protocol and the University of Manitoba *Ethics of Research Involving Humans*.

Funded Protocols:
- **Please e-mail a copy of this Approval, identifying the related UM Project Number, to the Research Grants Officer**

A.2 Sample PowerPoint Prototype



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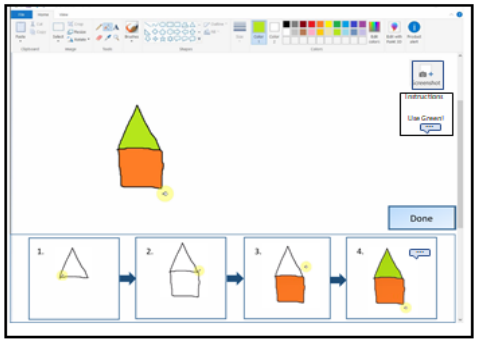

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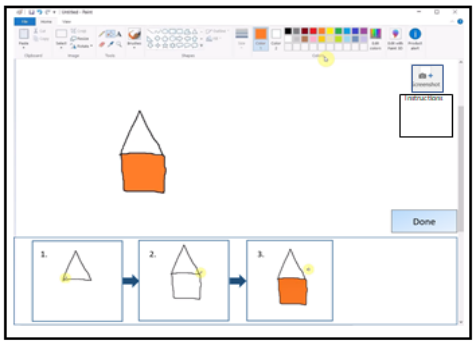

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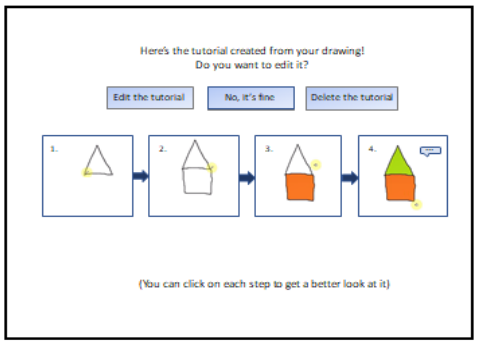

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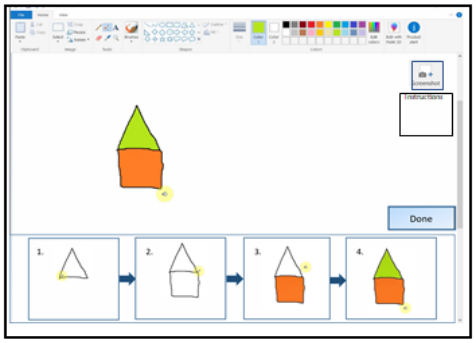

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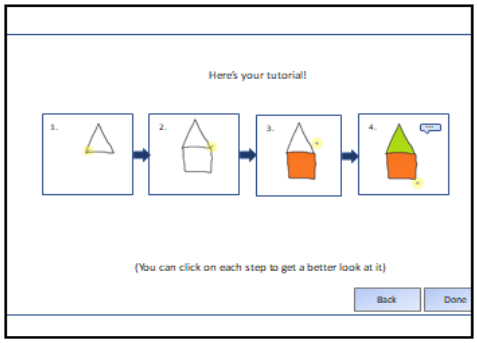


6

A.3 Sample Semi-structured Interview Questions

A.3.1. Sample Semi-structured Interview Questions for the Child

1. Have you ever wanted to show your friends the drawing you made on the computer? (Like Jane did?)
2. What do you think about showing your friends how you did it?
3. Would you be interested in seeing other kids' drawings?
4. Have you ever seen a drawing somebody else has made and wondered how they made it? (Like Joe?)
5. If you wanted to make a drawing like somebody else and if you could see how they made it would you try to follow their steps to make it?

A.3.2. Sample Semi-structured Interview Questions for the Parent

1. How frequently does your child create drawing on computer?
2. Which computer program does s/he use?
3. Did s/he learn using this computer program all by him/herself?
4. Does s/he struggle to use any of the program's different features?
5. Does he/she (or has s/he ever wanted to) share his/her drawing with his/her friends or siblings?
6. If yes, how does s/he do so?
7. How would you feel if your child is provided with an online platform to share his/her art with his/her friends?
8. What kind of privacy concerns do you have in this regard?

9. If your child could see how another child made a particular drawing, what impact would it have on your child's learning process? Do you think it might help him/her? Or would it affect his/her creativity?

A.4. Poster for Recruiting Participants

A.5. Informed Consent Form

UNIVERSITY OF MANITOBA

DEPARTMENT OF COMPUTER SCIENCE

Winnipeg, Manitoba
Canada R3T 2N2

Research Project Title: Designing an Online Platform for Children for Sharing Digital Art

Researchers:

Dr. Andrea Bunt, Associate Professor, Department of Computer Science, University of Manitoba,

Ananta Chowdhury, Graduate Research Assistant, Department of Computer Science, University of Manitoba

Please take the time to read this carefully and to ensure you understand all the information.

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Your child is invited to participate in a research study on the topic of designing an online digital art-sharing platform where they can share their digital art along with how they created it. The goal is to find out how children respond to the idea of sharing digital art with their workflow histories and how we can design such a platform for them appropriately. Your child's participation in this research study includes participating in the design of the platform with the researcher by drawing, observing, listening to, and talking to the researcher. If you have any questions or concerns, please feel free to contact the researcher at the above email address.

The benefit of participating in this research is that the participants may gain a greater appreciation for the steps that are required to design technology. The knowledge they have contributed to in this study will be used to design an online art-sharing platform for children like them. The risk to this study is no greater than in everyday life.

As part of this project, we will ask you to participate in a semi-structured interview about your child's drawing practice and your concerns regarding their online sharing of art, if any. The interview will take about 10-15 minutes.

Participation in this study is voluntary and will take approximately one hour of your child's time. You will receive a $15 compensation, and your child will be given the opportunity to pick a small toy from a box of toys we will have during the study.

We wish to record our discussions with you and your child by using a standard digital voice recorder and videotape the study session with a handheld video camera. The audio and video will assist our data analysis by allowing us to review the discussion and the study session in detail. The video of the study session and any information you choose to contribute in our discussion is

completely confidential and will be used for anonymized research analysis. We will assign you and your child a unique number for the study and we will not associate your name to the data in any way to ensure anonymity while analyzing it later. We may use anonymized quotes for purposes of dissemination; your child's name will not be included or in any other way associated with the data presented in the results of this study. The video of your child will only be used for internal data analysis purposes. Only the researchers of the study will have access to the video recordings. We will not use any video footage of the study in any publication. By signing this consent form, you agree that you understand this and that we may use the recorded audio and video for data analysis purposes only.

Data collected during this study will be retained for a period of maximum three years in a locked cabinet or in a password-protected computer in a locked office or laboratory in the University of Manitoba, to which only researchers associated with this project (Andrea Bunt, Ananta Chowdhury) have access. The data will be destroyed by December, 2022. In addition, the University of Manitoba may look at research records to see that the research is being done in a safe and proper way. We intend to present results as academic publications and a thesis which will be published in MSpace. Once published, results of the study will be made available to the public for free at http://hci.cs.umanitoba.ca/. Again, no personal information about you or your child's involvement will be included.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research interview and agree for your child to participate in this study. By doing this you also confirm that you are of the age of majority in Canada (18 years or more) and the legal guardian of the child in question. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the interview anytime and/or refrain from answering any question you prefer to omit. Even by withdrawing, you will keep your compensation. You are free to withdraw your child from the study at any time, and if your child wishes to withdraw from the study he/she is free to do so at any time throughout the study and you will still receive your full compensation of $15 and a small toy. You can also withdraw your data even after the study until December 2019 (Withdrawal Date: 12/19).

This research has been approved by the University of Manitoba Joint Faculty Research Ethics Board. If you have any concerns or complaints about this project, please contact Dr. Andrea Bunt , or the Human Ethics Coordinator . A copy of this consent form has been given to you to keep for your records and reference.

☐ I wish to receive a summary of the findings.

Please write your email address if you checked the box above:

Participant's email address: _____

Parent's Signature _____ Date _____

Researcher's Signature _____ Date _____

Appendix B

Remote Study Additional Materials

B.1. Research Ethics Board Amendment Approval

University of Manitoba | Research Ethics and Compliance

Human Ethics - Fort Garry
208-194 Dafoe Road
Winnipeg, MB R3T 2N2

AMENDMENT APPROVAL

May 6, 2020

To: **Andrea Bunt**
Principal Investigator

From: **Julia Witt, Chair**
Joint-Faculty Research Ethics Board (JFREB)

Re: **Protocol # J2019:062 (HS23128)**
Designing an Online Platform for Children for Sharing Digital Art

---

Joint-Faculty Research Ethics Board (JFREB) has reviewed and approved your Amendment Request received on **May 1, 2020** to the above-noted protocol. JFREB is constituted and operates in accordance with the current *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans.*

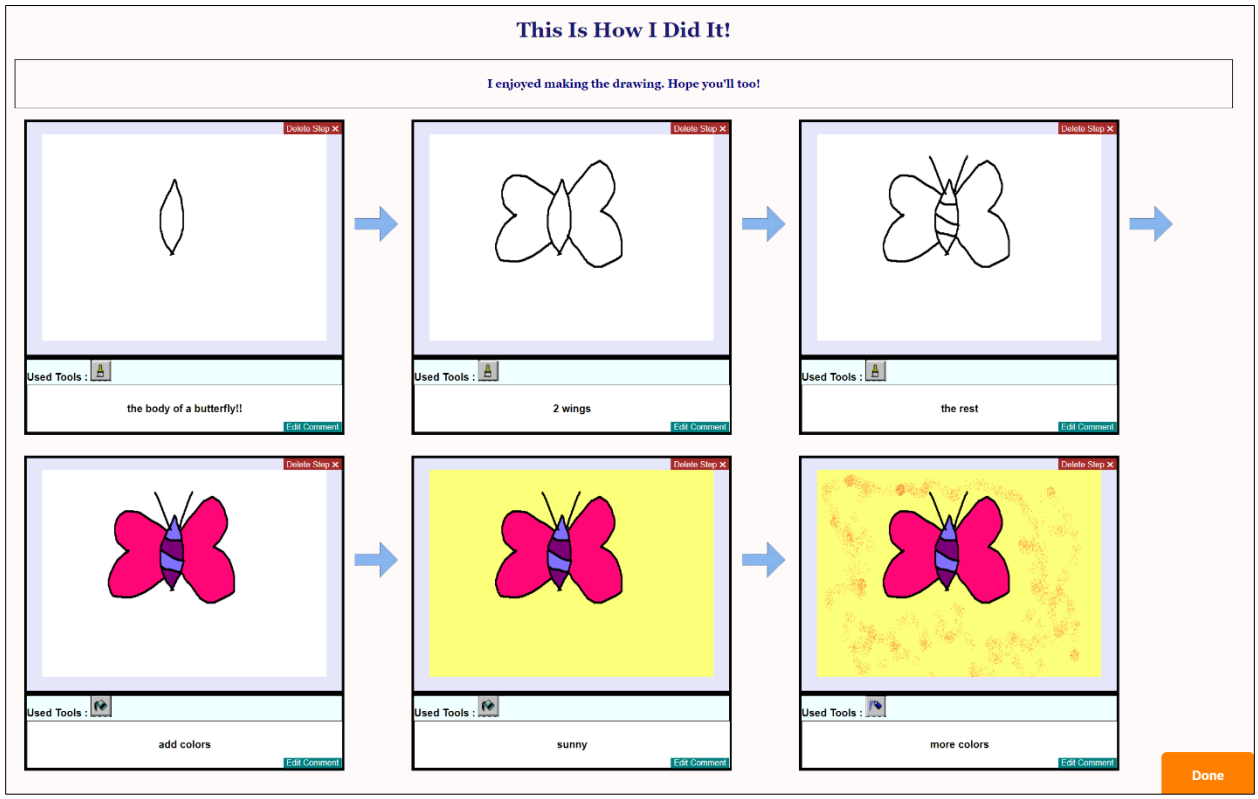
This approval is subject to the following conditions:

i. Approval is given for this amendment only. Any further changes to the protocol must be reported to the Human Ethics Coordinator in advance of implementation.

ii. Any deviations to the research or adverse events must be submitted to JFREB as soon as possible.

iii. Amendment Approvals do not change the protocol expiry date. Please refer to the original Protocol Approval or subsequent Renewal Approvals for the protocol expiry date.

B.2 Sample Digital Art Tutorial

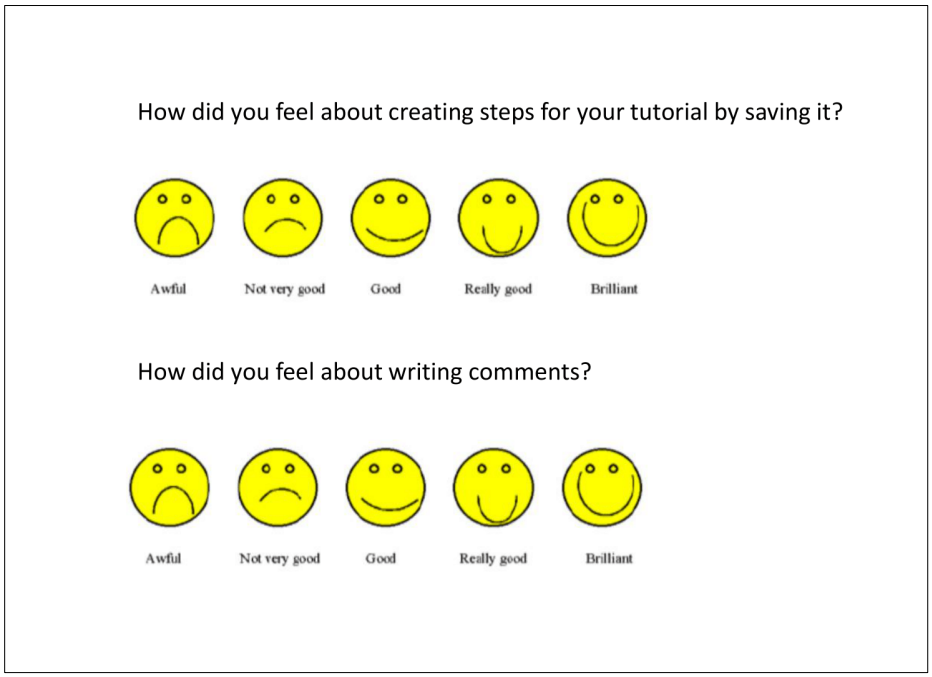


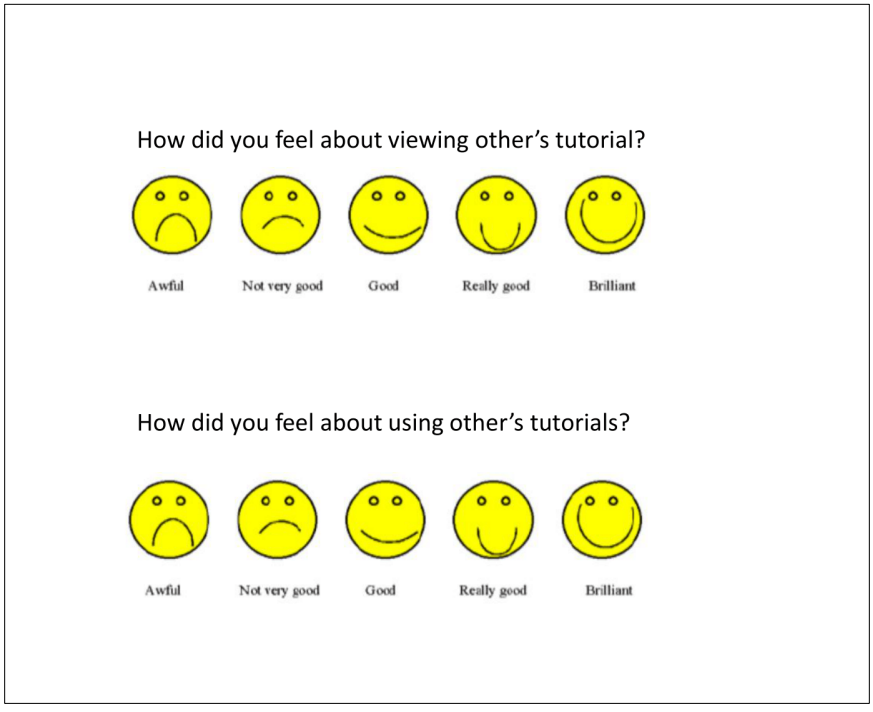
B.3 Sample Semi-structured Interview Questions

1. Have you ever wanted to show your friends the drawings you made on the computer? (Like Jane did?)
2. What do you think about showing your friends how you did it?
3. Would you be interested in seeing other kids' drawings? Why?
4. Have you ever seen a drawing somebody else has made and wondered how they made it? (Like Joe?)
5. (Jane created a tutorial of her drawing for Joe.) Do you know what a tutorial is? (Explain what tutorials and steps are in this context to the participant if s/he doesn't understand the concept of a tutorial.)

6. If you wanted to make a drawing like somebody else and if you could see how they made it would you try to follow their steps to make it?
7. Did you find saving steps annoying or distracting? Would you like to focus only on your drawing instead?
8. What did you like most about this tutorial?
9. Did you enjoy creating this tutorial? Why?
10. What do you don't like in your tutorial?
11. What else would you like to include in your tutorial? Why?
12. Would you like to change this tutorial any other way that can't be done here? (tough)
13. What do you think about the tool information that we have here? Do you think it's necessary? Why / why not?
14. Would you like to see if someone created a drawing using your tutorial? Why?
15. Did this tutorial help you? How?
16. What did you like or did not like about this tutorial?
17. What other information might have helped you better?
18. Would you like it better to create the drawing all by yourself?
19. Do you think you'd like a tutorial more if it was created by an adult person?
20. Would you like to create a tutorial too? What made you want to do it?

B.4. Sample Survey Questions





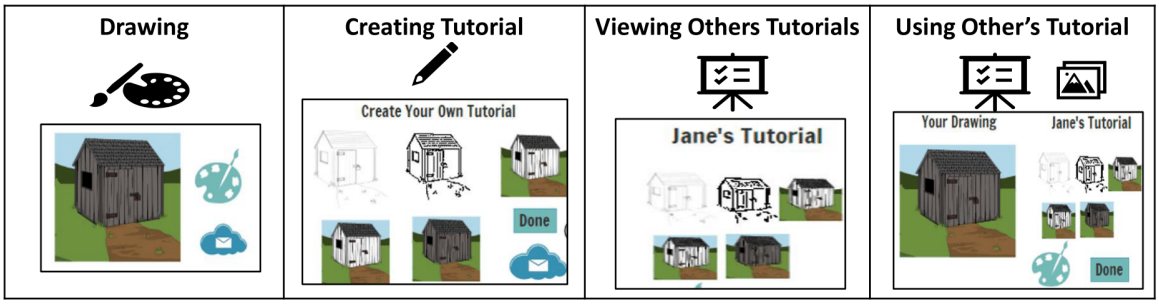
Which feature was most fun among the following?

Drawing | Creating steps | Adding Comments | Editing your tutorial

Fun

Most Worst

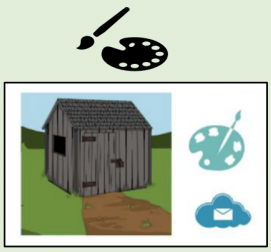
Which task did you find most fun among the following four?



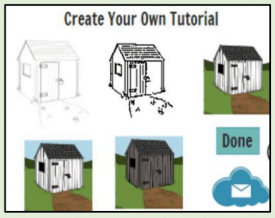
Fun

Most Worst

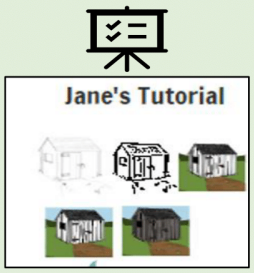
Would you like to do it again?

	Yes	Maybe	No
Drawing 			

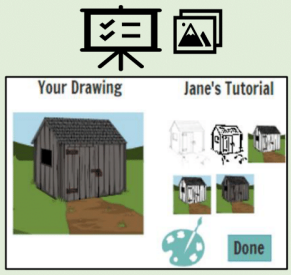
Would you like to do it again?

	Yes	Maybe	No
Creating Tutorial 			

Would you like to do it again?

	Yes	Maybe	No
Viewing Other's Tutorial 			

Would you like to do it again?

	Yes	Maybe	No
Using Other's Tutorial 			

B.5. Affinity Diagrams


Reasons for seeing others drawings
To Get more Ideas to draw
Curiosity
To learn & to improve
Try out other ways of drawing
Reasons for following a Tutorial
Tutorial is interesting & easy to follow
Miscellaneous (Reasons for following)
Like keeping my hand itchy
Like Drawing by themselves
To Get more Ideas
Curiosity see other's hard work
Claiming knowledge of other's Approval
To Improve
Quicker & Easier to try out
Challenges themselves
Follow tutorials while keeping originality
Originality
Curiosity
To learn
To Improve
Good Starting Point
Good drawing & easy tutorials
Rather create own tutorial
Curiosity
To learn a new way
For someone who didn't know how to draw it
Authority & more experience
Original & Follow others
Spark up interest to draw
Learning abt other's art
Easy to create
Would see to create their o
See others progress
Learn from experts
Like following instructions
Customize
Use others' ideas to make them happy/accomplished
Don't like to follow other steps
Use ideas, detail Area, other's drawing
Help to learn sth new + New Ideas
Get more ideas & share drawing
Learn & share newly learned skills
Following a tutorial is easier
Do their own & follow others if they like
Learn Art
Tutorials show a fun way / better & starting point
Tutorials show how they made it
Doesn't like the content
To learn
True sth new
First ideas
Good / Interesting
First learning themselves then try others
Help to learn sth new
To remember all the steps & learn to draw
Interesting / has following
Follow to do what I like
For harder drawings


Reasons for Coming to Jamm Steps
Reasons for not liking to draw
Easy to follow steps are fine + helping
Drawing Attention
Simple Feature
Saving steps are a feature
Not enough to draw much
Saving steps in Interface
To show progress visually
Not saving would give more time to focus on drawing.
Stressful
Reminders are when the main is creating tutorials
Drawing + saving steps are one to one relationship
Saving steps & Drawing are 2 different Tasks
Review Drawing
Bookmark
Helping others to understand what the steps mean
Help them to make better sense of the steps
To remind myself about the steps of the drawing
Helps to remember what the steps mean
Hard to follow
To show others how to help solve through steps.
Showcase writing skills
To inform others about the steps
Make a story with the comics
Helps to explain the drawing at the process
To help others understand the process
Little words can help a lot
Correct mistakes
Good way to explain
Boring
Time Consuming
Displaying all the steps/whole progress
Displaying the Tutorial
Displays the whole process
Displays the tutorial
Sequential
Breakdown the steps
Tool Info
Novelty
Enlarged view of a step
Hover Effect
Enlarged steps
Edit the steps
Feature to edit the drawing in a step
Rearrange the steps
Helpful tips
More detailed tool info
Info about colors
Breakdown of steps + colors
Breakdown of steps + easier
No missing steps
Being able to see the each steps to follow
Progression of steps
Simplicity
Easy to read
Simple for first attempt
Drawing
Colors
Scary for some non ready
Tutorial should let the creative
More Explanation
Detailed Comments
More details
Adult's tutorials are more informative
Expert Level
More detail + Expert view
Proper steps + Good outputs
Breakdown of bigger steps
Adult's tutorials easier
Adult's can draw different ways
Adult's can draw different ways
Breakdown of steps
Use of different tools
Use different tools
Accurate drawing
Precision
Kid's tutorials are joyful
Both are Equal
Adult's tutorials are more informative
Expert Level
Depends on skill level
Depends on skill level
Informative Tutorial is what counts
Depends on how detailed the tutorial is
How good the tutorial is
How beautiful a tutorial is
Improve tutorial

B.6. Recruitment Email

Hello,

The Human-Computer Interaction Lab at the University of Manitoba is looking for children aged 7 to 11 years, to participate in an online study about designing an online art-sharing platform where children can author tutorials for other children while generating digital art. The children should have some basic experience of using a computer-based drawing tool (e.g. Microsoft Paint) for participating in this study. Additional details about the study, which will be conducted online, are included below. If you are not interested in participating in this study, you do not have to reply to this email. Feel free to forward this email to anyone who might be interested in participating.

Study Details:

Your child's participation in this study includes drawing, observing, listening to, and talking to the researcher (University of Manitoba M.Sc. student Ananta Chowdhury) and using a piece of software that allows children to create their own drawing tutorials.

The study will take approximately 60-90 minutes and will be held online via video conferencing with the parent's supervision. You will need to install a software called TeamViewer for the study session. A simple step-by-step guideline will be provided. Also, the facilitator's contact number will be shared beforehand to provide support while setting up the software. For conducting this study, your computer should have a working webcam and microphone. To assist us with data analysis, we will record the facilitator's screen. This footage will be used for internal anonymized data analysis purposes only and will not be shared. Participation in this study is voluntary and participants can withdraw any time they want. This study will be facilitated by Ananta Chowdhury, a master's student at the Department of Computer Science at the University of Manitoba. Ananta is working in collaboration with Dr. Andrea Bunt. If you are the parent of a 7-11-year-old and you are interested in your child participating in our study, please contact Ananta Chowdhury .

If you have any questions regarding the study, feel free to ask for more information. Upon contact, you will be provided with an informed consent form with more detailed information about the study. If you agree to participate, the study session will be scheduled at a time of your convenience. As an appreciation of the participation, your family will receive a $20 digital gift card from either a toy store, a bookstore, or a food delivery service or $20 in cash. This research has been approved by the University of Manitoba Joint Faculty Research Ethics Board. The Research Ethics Board can be reached by phone

Thank you.

B.7. Informed Consent Form

UNIVERSITY OF MANITOBA

DEPARTMENT OF COMPUTER SCIENCE

Winnipeg, Manitoba
Canada R3T 2N2

Research Project Title: Designing an Online Platform for Children for Sharing Digital Art

Researchers:

Dr. Andrea Bunt, Professor, Department of Computer Science, University of Manitoba.

Ananta Chowdhury, Graduate Research Assistant, Department of Computer Science, University of Manitoba

Please take the time to read this carefully and to ensure you understand all the information.
This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Your child is invited to participate in a research study on the topic of designing an online platform for children for sharing digital art. Where our broad research goal is about sharing digital art online, in this study, we are specifically looking at how children feel about creating their own tutorials while drawing and the idea of sharing the tutorials with others. The goal is to find out how children respond to the idea of sharing digital art with their workflow histories and how we can appropriately design such a tool for them. Your child's participation in this research study includes drawing, observing, listening to and talking to the researcher and using our prototype of the tutorial authoring system for our online art-sharing platform. If you have any questions or concerns, please feel free to contact the researcher at the above email address.

The benefit of participating in this research is that the participants may gain a greater appreciation for the steps that are required to design technology. The knowledge they have contributed to in this study will be used to design an online art-sharing platform for children with a focus on designing a digital art tutorial authoring system. The risks to this study are no greater than in everyday life.

Participation in this study is voluntary and will take approximately 60-90 minutes of your child's time. Your child will receive a $20 gift card from either a toy store or a bookstore, or a restaurant delivery service, or $20 in cash.

The study will be held remotely via video conferencing with your supervision. You will need to install a software called TeamViewer for the study session (A simple step-by-step guideline will be provided. Also, the facilitator's contact number will be shared beforehand to provide support while setting up the software). The video conferencing will be done using a conferencing tool of your preference. You will be given access to the facilitator's computer by using the software, so that you can access everything needed to run the study without needing to install anything else. Your child will be asked to interact with the prototype running on that computer and this interaction will be captured using a

screen recorder. Throughout the study session we will ask questions and have discussions with your child about the prototype. We wish to record the video conference in order to record our discussions with your child by using the screen-recorder. The audio and video from the recorded video conference will assist our data analysis by allowing us to review the discussion and the study session in detail. The video of the study session and any information you choose to contribute in our discussion is completely confidential and will be used for anonymized research analysis. We will assign you and your child a unique number for the study and we will not associate your name to the data in any way to ensure anonymity while analyzing it later. We may use anonymized quotes for purposes of dissemination; your child's name will not be included or in any other way associated with the data presented in the results of this study. The video of your child will only be used for internal data analysis purposes. We will not use any video footage of the study in any publication. By signing this consent form, you agree that you understand this and that we may use the recorded audio and video for data analysis purposes only.

Data collected during this study will be retained for a period of maximum three years in a locked cabinet or in a password-protected computer in a locked office or laboratory in the _, University of Manitoba, to which only researchers associated with this project (Andrea Bunt, Ananta Chowdhury) have access. In addition, the University of Manitoba may look at research records to see that the research is being done in a safe and proper way. We intend to present results as academic publications and a thesis which will be published in MSpace. Once published, results of the study will be made available to the public for free at http://hci.cs.umanitoba.ca/. Again, no personal information about you or your child's involvement will be included.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research interview and agree for your child to participate in this study. By doing this you also confirm that you are of the age of majority in Canada (18 years or more) and the legal guardian of the child in question. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the interview anytime and/or refrain from answering any question you prefer to omit. Even by withdrawing, you will keep your compensation. You are free to withdraw your child from the study at any time, and if your child wishes to withdraw from the study he/she is free to do so at any time throughout the study and he/she will still receive the full compensation of a $20 digital gift card. You can also withdraw your data even after the study until July 2020 (Withdrawal Date: 08/20).

This research has been approved by the University of Manitoba Joint Faculty Research Ethics Board. If you have any concerns or complaints about this project, please contact Dr. Andrea Bunt or the Human Ethics Coordinator . A copy of this consent form has been given to you to keep for your records and reference.

☐ I wish to receive a summary of the findings.

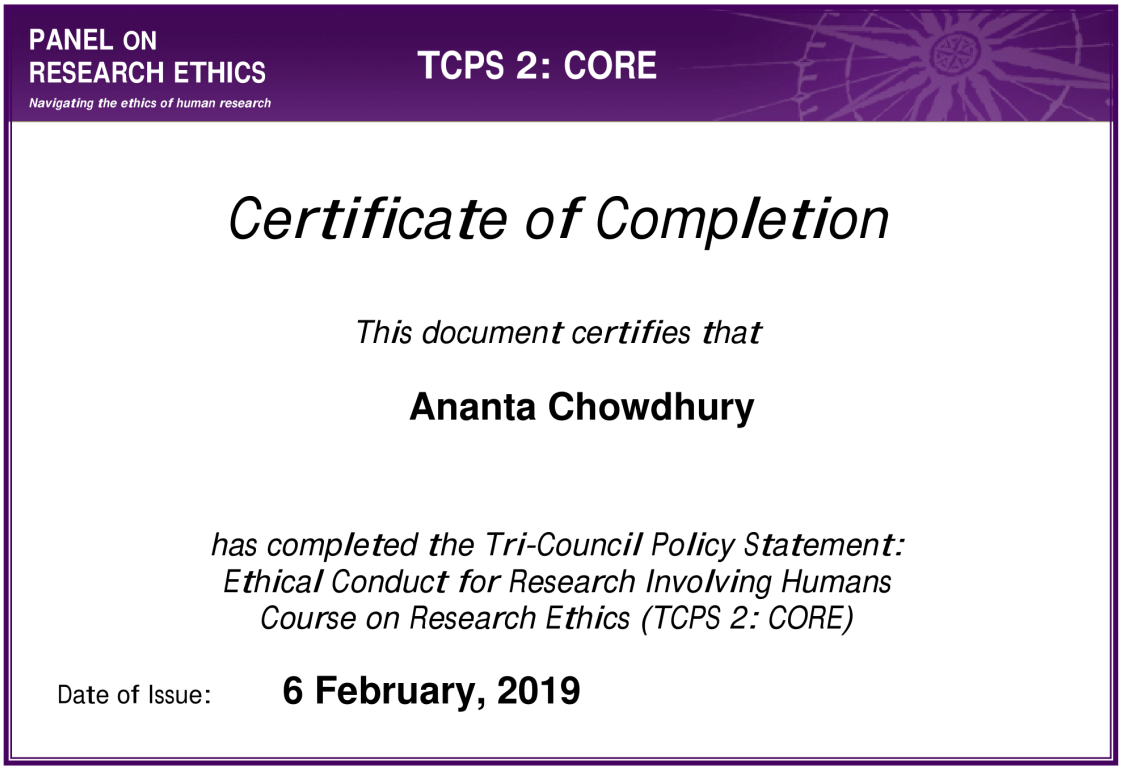
Please write your email address if you checked the box above:

Participant's email address: _____

Parent's Signature _____ Date _____

Researcher's Signature _____ Date _____

B.8. TCPS 2: CORE – Certificate of Completion



PANEL ON RESEARCH ETHICS
Navigating the ethics of human research

TCPS 2: CORE

Certificate of Completion

This document certifies that

Ananta Chowdhury

has completed the Tri-Council Policy Statement:
Ethical Conduct for Research Involving Humans
Course on Research Ethics (TCPS 2: CORE)

Date of Issue: **6 February, 2019**