Community 3D Printing at Libraries

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ABSTRACT

This initiative centers on democratizing 3D printing technology, particularly for individuals lacking technical expertise, by collaborating with public libraries. The objective is to bridge the accessibility gap, historically dominated by tech enthusiasts, by refining strategies through engagement with libraries offering 3D printing services. The investigation focuses on understanding user needs, challenges, and the extent of community involvement in the design phase. Motivated by a desire to make 3D printing inclusive, the project draws inspiration from related studies, emphasizing the importance of demystifying the technology for newcomers. The methodology involves surveys, interviews, and community workshops, revealing insights into user demographics, preferences, and challenges. Preliminary findings underscore the perceived complexity of 3D printing processes and highlight the potential of libraries as community hubs for 3D printing access. The workshop's positive response indicates a willingness to engage with 3D printing, emphasizing the need for user-friendly tools and educational content. The initiative aims to collaborate with libraries to make 3D printing more accessible, fostering a creative and inclusive community.

1.   INTRODUCTION

Our current initiative revolves around simplifying 3D printing technology, aiming to extend its accessibility to a broader audience, particularly individuals who may not possess a high level of technical expertise. Traditionally, 3D printing has been predominantly utilized by engineers and tech enthusiasts, creating a barrier to entry for those less familiar with the intricacies of the technology. Recognizing the growing trend of public libraries offering 3D printing services to their communities, we have identified an opportunity to bridge this gap and make 3D printing a more inclusive and user-friendly experience.

To refine our strategy and address the specific needs of the community, we are actively engaging with public libraries that currently offer 3D printing services. Through these interactions, we aim to gain insights into their existing workflows, community engagement practices, and areas where our innovation can enhance the overall experience. Collaborating with these institutions allows us to understand the challenges faced by users, identify pain points in the current 3D printing landscape, and pinpoint opportunities for improvement.

A crucial aspect of our investigation involves assessing the extent to which individuals utilizing public 3D printers are involved in the design phase of the process. We are keenly interested in understanding the factors that may discourage people from creating their own 3D models. If there is a prevailing trend of reliance on pre-existing designs or external sources, our goal is to uncover the underlying reasons for this behavior.

In summary, our mission is to change and greatly improve the 3D printing landscape by making it accessible and user-friendly, particularly for those who may not have a background in technology. Through collaboration with public libraries, we aim to empower individuals to harness the full potential of 3D printing technology, fostering a more inclusive and creative community.

2. MOTIVATION

Our motivation behind this project is to make 3D printing accessible to everyone. Currently, it's mostly tech-savvy people who use 3D printers, and we want to change that. Our team, comprising diverse backgrounds and ideas, explored various project possibilities related to diabetics, autism, and food, but our collective decision to focus on 3D printing was influenced by the potential to engage with a community. This inspired us to focus on helping regular people, not just tech experts, get into 3D printing. Personally, we see the potential to bridge the gap between 3D printing enthusiasts and the wider public, making 3D modeling simple for non-tech users. Witnessing one of our teammate's mother's interest in creative outlets coupled with the challenges she faces with technology, we envisioned our project making a meaningful impact by simplifying the 3D modeling process. As we progress, our research delves into understanding the needs of library communities, aiming to create an application that facilitates easy 3D printing education and design. Our ultimate goal is to empower individuals, regardless of technical expertise, to explore the creative possibilities of 3D printing using the familiar interface of their smartphones [1]. Among those who could significantly benefit are elderly individuals seeking avenues for creative expression, artists and crafters with a passion for art but limited technical backgrounds, educators and students aiming to integrate 3D printing into various subjects, small business owners and entrepreneurs in need of easy prototyping, and community groups and libraries acting as communal spaces for learning and creativity. The study, by making 3D printing accessible through familiar smartphone interfaces, has the capacity to democratize technology, fostering creativity, innovation, and learning among diverse groups who might otherwise be excluded from the 3D printing landscape.

3. RELATED WORK

By utilizing the conclusions of Hudson et al's study as discussed in "Understanding Newcomers to 3D Printing" on why people start using 3D printers and what challenges they face we can see the potential problems that the library communities have [6]. They recruited participants for interviews who did not have 3D modeling experience but have recently attended a 3D printing center along with self-trained print center employees/volunteers. Their transcripts were organized, coded, and analyzed "highlighting different aspects of the casual makers' workflows, the kinds of challenges that they faced, and how they attempted to resolve these challenges" [6] They found that less experienced and technical users have issues throughout the 5 step process of 3D printing, even experienced users run into issues in step 2A creating a 3D model and step 5 when the final 3D print does is not as expected/planned.
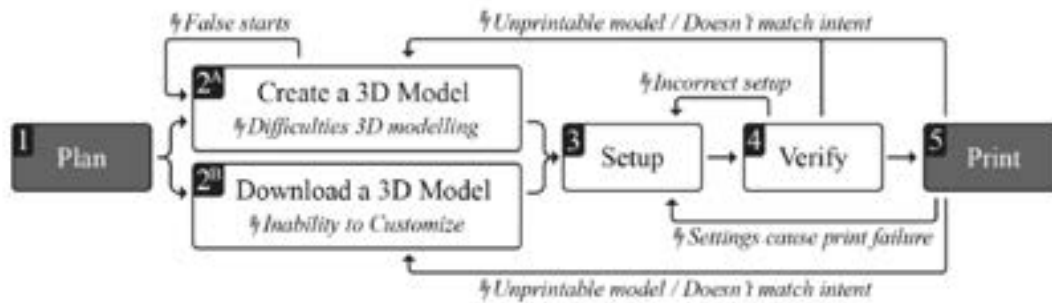
ıre 1: Workflow of 3D printing and common issues [6]

We plan on performing user interviews with librarians and library patrons to discuss their specific needs, which we expect to be similar to the methods that Hudson et al's study performed. This approach can provide us with unique perspectives such as the librarians who are expected to assist the community in 3D printing and maintaining the machines despite not necessarily having the training which will help us tailor our solution to the specific requirements of our target audience of the libraries.

The paper by Shewbridge et al. examines the challenges newcomers face in 3D printing, aiming to make it accessible to everyone. It underscores the difficulty newcomers encounter in specifying their ideas and communicating with 3D printing services. This paper's research focuses on the online 3D printing services and the issues with delayed communication with these services to create a functional end result. They explore how households would use a "faux 3D printer" to log and print items, and how these items could easily be purchased, making 3D printing a utilitarian appliance as much as a creative tool [11]. While existing research caters to enthusiasts, this study seeks to bridge the gap. Key findings encompass common ground, work coupling, collaboration readiness, and technology readiness[11]. The paper emphasizes the importance of demystifying 3D printing for newcomers, promoting accessible services, and providing guided systems for successful collaborations to broaden its user base. After understanding the conclusions of the paper and the methodologies they followed, it was more helpful to communicate with the communities and cater to their needs. The paper helped us realize that we need to perform user research or studies on what the community needs instead of just adding features or creating workshops. The community should be willing to learn new technologies and would like to learn something they can use on a daily basis instead of anything fancy or highly technical.

In the reading, Hudson et al. study how people who are not traditional Makers utilize 3D printing in universities, libraries, and schools. They found that many casual makers did not want to visit Makerspaces because they found it intimidating to approach the 'experts' in these spaces. Hence, the importance of "common ground" was noted. Common Ground is the knowledge and awareness collaborators share about a task and each other. Creating process common ground allows the breaking and updating of content common ground, and prevents collaborators from becoming "frozen" in their established content common ground [1].

According to the findings of the lab study, Google is frequently a dead end for newcomers to 3D printing. Three out of ten participants did not look anything up online, and of the seven who did, only four searched with terms similar to "3D print," and two simply scrolled through Google Image search results, but did not visit the 3D print source websites. Newcomers frequently did not trust search results from unfamiliar domains and felt more confident talking to people about printing than talking to someone online about printing [1]. Including a feature in our solution that allows users to search for nearby 3D printing locations could also be very beneficial.

The primary roadblocks to people entering 3D printing are the complexity of designing a model and accessing a 3D printer, HOWDIY Metadesign tool was developed to break down those major hurdles [2]. Based upon their research, surveying five experienced users running printing services where they help newcomers weekly, it was found through card sorting that a majority of newcomers wanted to replicate existing objects or to modify pre existing designs to personalize them. This supports the team's belief that a majority of the computer aided design software that is used for 3D modeling is more sophisticated then what a non-engineer or technical person

needs. This overly complicated software intimidates and prevents people from 3D printing. Their solution was not to create a simplified modeling software but a website that allows users to find models,and a tool to find nearby 3D printers. Unlike other creative mediums 3D printing has a relatively high equipment cost, with small hobbyist printers starting in the $300 dollar range. Currently the most popular method for those without a 3D printer to get started is to utilize a online service where users submit their designs and then if necessary the user can chat with the service to refine the design/printing specifications so then the service will attempt to print the design and if successful will send you the results [2]. This service model of 3D printing focuses on providing the user/customer with a final product. However, when studying the online 3D printing community websites Berman et al. discovered people's " preference for proximal services over online services when available, citing better consultation experiences and better prices" through social media open coding and statistical analysis [2]. We believe that this statement will be confirmed when interviewing the library community proving the benefit of this service.

4.   METHODS SECTION (STUDY DESIGN):

4.1 Information Gathering via Interview & Questionnaire

To learn more about how people use 3D printers in the library, we started by asking library staff and users to fill out a questionnaire. We created the questionnaire using google survey and shared it with the Middletown librarians and patrons. We aimed to have at least 5 people respond to the questionnaire, knowing that many people will not. THe questionnaire was designed to learn who has used a 3D printer, where they have used one, how often they use the 3D printers, what projects they work on, and any problems they face.

After collecting these answers, we carefully study the information to find common themes and patterns. From the questionnaire, we pick out individuals who shared interesting stories or faced specific challenges, and we chat with them more in-depth through interviews. These interviews let people share their experiences and ideas in more detail. Combining the questionnaire responses and interview insights, we analyze everything to create a detailed report. This report talks about who uses the 3D printers, what challenges they have, and what they enjoy. We even include direct quotes. Finally, based on what we find, we make suggestions on how to make the 3D printing services in the library better. The goal is to make sure everyone using the 3D printers is happy, and decisions about the library's services are well-informed.

This report outlines demographic data, questionnaire summaries, and key insights from interviews. It also proposes actionable recommendations for enhancing the library's 3D printing services, prioritizing user needs and addressing identified challenges. On the basis of the report, we can decide on performing a workshop to address their interests or look for a design solution more fitting to their needs and expectations.

4.2 Information Sharing Community Workshop

The 3D printing workshop's goal is to introduce college student library users to 3D printing. The hour-long workshop was split into two sections, an informational presentation and an hands-on activity with 3D pens.

The informational presentation provided the audience with the basics of how 3D printing is different from typical manufacturing, different types of 3D printing along with time lapse video examples and how 3D printing is used in industrial and hobbyist settings. Given that the audience is college students, providing this level of background information along with anecdotal personal stories about 3D printing. This way, they can see why it's so innovative and cool.

By the end of the presentation, we hope the audience had a better understanding of 3D printing, from how it's different to the cool things people are doing with it in both industry and hobbies.

After the presentation, we asked the participants to engage in a hands-on activity with the 3D pens. The hands-on portion of the workshop had the students use the 3D pens to add onto pre-printed keychain fobs. The pre-printed keychain fobs were printed on a team member's Prusa MK3S+ in glow in the dark PLA. The 3D pens provided were 3D Doodler Create+ . Students were provided various types and colors of 3D pen filament to add onto their keychain fob with. The end goal was to have them leave with a 3D printed item that they personalized.

Additionally various 3D printed items were provided for students to interact with and see for themselves what 3D printed items look and feel like. A majority of the items were printed with a fused deposition modeling(FDM) Prusa MK3 with various types of Polylactic Acid (PLA) filament. One item was printed with a Stereolithography (SLA) printer with an obviously more detailed result.

5. PRELIMINARY FINDINGS

5.1 Survey Findings

Initially we asked the participants to engage in the questionnaire to get a basic demographic data of the participants and their experience level with the 3D printers. On collecting the data from these questionnaires we realized that the maximum participants interested in this workshop were between the ages of 25-54. Though the participants between the age group of 25-40 were technologically advanced as opposed to the participants between ages 45-54, they found 3D printers to be complicated and tiresome. However, they wanted to learn more about the 3D printers and we were very excited for the activity at the end of the workshop.
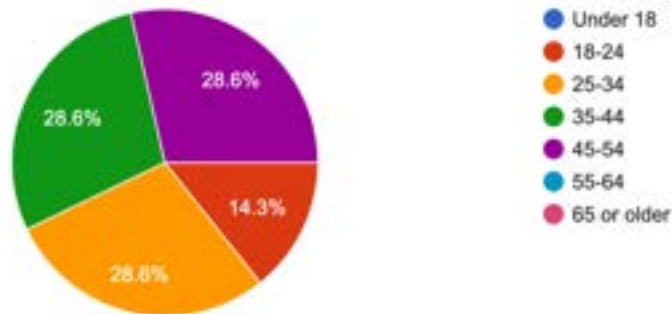

Which age group do you belong to?
7 responses

- Under 18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65 or older

28.6%
28.6%
28.6%
14.3%

Figure 2: Findings from the questionnaire shared on google forms

How often do you go to the Library?
7 responses

- Daily
- Weekly
- Monthly
- Work there; 3x week
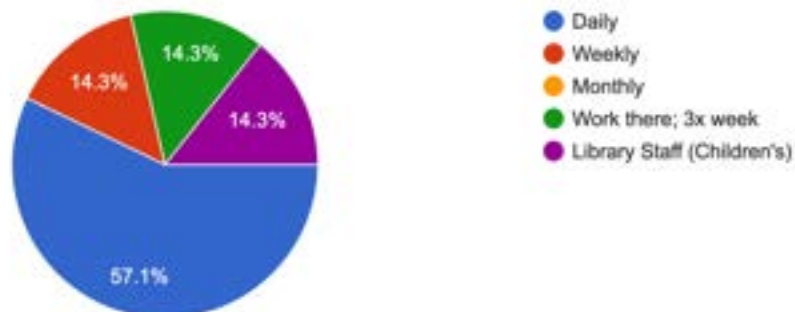- Library Staff (Children's)

14.3%
14.3%
14.3%
57.1%

Figure 3: Findings from the questionnaire shared on google forms

How many 3D models you have created from scratch?
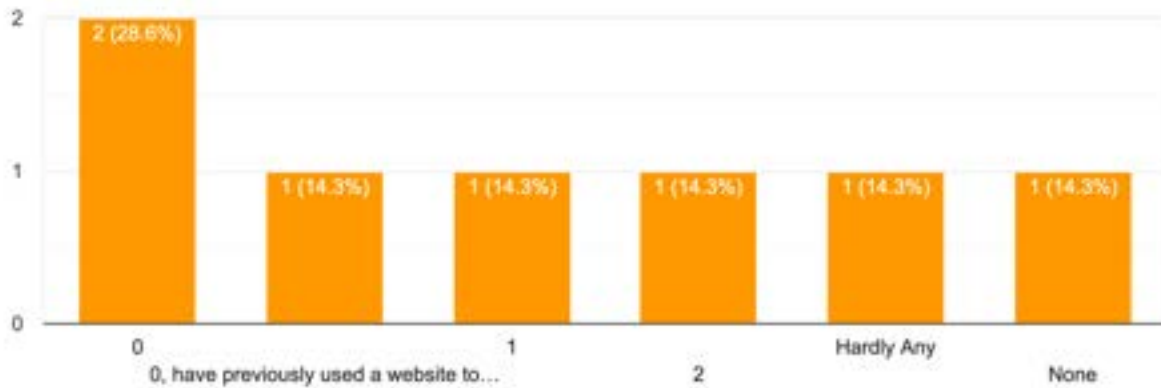7 responses

Figure 4: Findings from the questionnaire shared on google forms

On the basis of the data collected in the questionnaire, we asked a few of the respondents for the workshop at the UMBC Library on 14th November. We received a positive response and though there were a few who were unable to make it, we received an audience of 6-7 people.

5.1.1 Age demographic

At the start of our workshop, we asked people to fill out a questionnaire to learn more about them and their experience with 3D printers. What we found was that most of the folks interested in our workshop were between 25 and 54 years old.

Now, within this age range, there was a bit of a split. The younger group (25-40) was more comfortable with technology, while the older group (45-54) found 3D printers a bit tricky and tiring to deal with. Still, both groups were curious and wanted to learn more, which got us pretty excited for what was coming up in the workshop.

Even though the older people felt a bit overwhelmed by the technology, everyone seemed excited about the activity we had planned for the end of the workshop. It looked like everyone was ready to dive in and tackle the challenges of 3D printing, and that anticipation added a lot of energy to the room. So, despite the initial concerns, it seemed like our workshop was going to be a great opportunity for everyone to learn and have some fun along the way.

5.1.2 Frequency of visits to the library

According to the responses recorded in the google forms, we got to know that almost half of the population visits the library on a daily basis. In some form or other, everyone visited the library due to some reasons. The frequency of visits to the library might also be due to the fact that we targeted the population living near the library or college going children who need a place to study.

It's insightful to learn from the responses recorded in the Google Forms that nearly half of the surveyed population visits the library on a daily basis. This high frequency of library visits suggests a strong connection between the community and the library. The diverse reasons cited for these visits indicate that the library serves various needs for different individuals within the population.

The fact that the surveyed population predominantly consists of those living near the library or college-going individuals seeking a conducive study environment provides context to the high frequency of visits. Targeting this specific demographic aligns with the observed patterns, emphasizing the library's role as a valuable resource for daily activities and educational purposes.

Understanding the population's regular engagement with the library is crucial for contextualizing the findings of any initiatives or projects conducted in collaboration with the library community. It reinforces the idea that libraries can play a central role in community-based projects, such as the introduction of 3D printing technology discussed earlier, by leveraging their existing strong ties with the local population.

Name	Which age group do you	How often do you go to tl	How did you first become	How many times have yc	How many 3D models yc
Mary Dixon	35-44	Work there; 3x week	Family or friends	~30	0, have previously used i
Lenora Grackin	45-54	Daily	Work or office environme	0	0
Monica Spilis	45-54	Daily	School or education	2	1
Theresa Schneider	35-44	Library Staff (Children's)	Library	1	0
Jainam Basra	25-34	Daily	Family or friends	Once a week	Hardly Any
Priya	25-34	Weekly	Online sources (websites	Never	None
Tejo Gayathri	18-24	Weekly	Family or friends	0	0

5.1.3 Experience with the use of 3D printer

In our study, we observed that among the participants, the majority, specifically 5 out of 7 individuals, had no prior experience with 3D printers. In contrast, 2 participants had some level of familiarity with these printers. Interestingly, none of the participants had any prior exposure to 3D pens. Moreover, half of the participants were unaware of 3D pens until the event. One participant thought that the 3D pens were similar to a Gluegun. Notably, there was an expressed curiosity among some participants to explore both kids' and adult 3D pens, with the aim of discerning potential differences between the two. These findings collectively highlight varying levels of familiarity and interest in the realm of 3D printing and pens among the study participants.

5.2 Findings from the interviews

Before commencing the workshop, we conducted interviews to delve into the participants' personal and professional experiences. We inquired about the frequency of their printer usage and whether they encountered any issues with printers. Additionally, we sought insights into their initial encounters with printers and whether they had to troubleshoot or adapt to new devices. Their utilization of public spaces, such as libraries, was also explored. Participants were asked if they had ever assisted someone with printer-related problems and encouraged to share their experiences.

5.2.1 Previous use of the 3D printer and its familiarity

Surprisingly, the majority of participants revealed that they had not previously used a printer. However, they exhibited a keen interest in 3D printing, having consumed various online resources to understand the intricate process. One participant stood out for having hands-on experience with a 3D printer but having not faced any challenges requiring troubleshooting.

What stood out even more was that none of the participants knew about 3D pens. This lack of awareness not only gave us insights into their familiarity with regular printers but also signaled a chance to introduce new and exciting tools like 3D pens during our workshop.

These insights not only provided a comprehensive understanding of participants' familiarity with traditional printers but also highlighted their curiosity and enthusiasm for emerging technologies like 3D printing. The absence of awareness about 3D pens indicated potential areas for introducing novel tools and technologies during the workshop.

5.3 Findings from the workshop

During the workshop, participants shared diverse perspectives on their experiences with 3D printing technology. A notable theme emerged around the perceived difficulty of working with 3D printers, with many expressing initial intrigue but finding the technology challenging in practice. Despite this, some participants conveyed a sense of fascination and amazement, emphasizing the appeal of witnessing the 3D printing process and the impressive nature of the resulting products.

"The 3D printer looks very interesting but is actually very hard to work with" - Participant

"I was always fascinated by the products made by the 3D printer and it is really amazing to see one in person." - Participant

5.3.1 Awareness of the partial challenges of 3D printing

One specific challenge highlighted was the use of 3D pens, which participants found to be tiresome and time-consuming. Although there was a desire to create personalized keychains, some individuals expressed constraints on their time and suggested that simpler alternatives might be more suitable. Interestingly, despite these challenges, there was a positive note as some participants indicated a willingness to use 3D pens again, indicating an underlying interest in the creative possibilities offered by this tool.

"Working with the 3D pens is actually very tiresome and time consuming. I really want to make personalized keychains but don't have so much time to use the pens. Something simpler might work." - Participant

This feedback shed light on the practical challenges faced by participants, emphasizing the importance of considering time efficiency and simplicity in the activities planned during the workshop. It also highlighted the need for a balance between introducing innovative tools like 3D pens and ensuring that participants, especially those with limited time availability, could engage in activities that align with their preferences and constraints.

"I would use these pens again." - Participant

Despite the challenges expressed, there was a positive note as some participants indicated a willingness to use 3D pens again. This indicates a recognition of the creative potential that 3D pens offer, suggesting that, with adjustments to the approach or activity, participants may be more inclined to explore and appreciate the capabilities of this tool.

Figure 5: The participants trying on 3D pens to create keychains

Figure 6: Some of the keychains made by the participants

5.3.2 Motivation behind learning about the 3D printer

The participants gave us feedback, and what stood out was that even though they knew the 3D pens and printer had challenges, they were still eager to learn more. Their main reason for wanting to learn these new tools was to create cool stuff for their homes. One participant, for example, wanted to use the printer to make parts for things at home, like a cup holder for his sofa.

But the really interesting part was that most of the participants were excited about using the printer to make special gifts for their family and friends. They liked the idea because it was a budget-friendly way to give gifts, and it felt more personal. They could customize the gifts with their friends' names or make them in different colors, adding a special touch. So, despite the challenges, the motivation to create unique and personalized items was a big driving force for the participants.

The participants in the workshop exhibited a strong motivation to use 3D printing for creating items, with a notable emphasis on making personalized gifts for others rather than for themselves. The desire to craft unique and thoughtful presents for close relatives and friends was a recurring theme, showcasing an appreciation for the creative possibilities offered by 3D printing in the realm of gift-giving. Participants recognized the cost-effectiveness of this approach, considering it a budget-friendly way to produce customized gifts. Alongside the gift-centric motivation, there was a practical aspect to their interest as well. Some participants expressed a need to use 3D printing for household item repair and customization, exemplified by a participant wanting to create a cup holder for their sofa's armrest. This dual motivation, encompassing both creative gifting and practical household applications, provides valuable insights for designing future processes that cater to the diverse interests and needs of participants engaging with 3D printing technology.

5.3.3 Space constraints for owning a 3D printer

Practical considerations also surfaced in the feedback, with participants mentioning space constraints at home as a barrier to owning a personal 3D printer. However, there was a potential solution suggested – participants expressed an interest in accessing 3D printers at nearby libraries, leveraging existing community resources and spaces they frequented daily.

"I don't have enough space for a 3D printer at home, but would love to go to a nearby library to work on the printers. I visit the library everyday anyway." - Participant

This reflects a practical approach where individuals consider leveraging existing community resources and spaces they visit regularly in their daily routines. This sentiment underscores the importance of community accessibility and the utilization of shared spaces to facilitate engagement with 3D printing technology, overcoming individual constraints, and fostering a communal approach to learning and creating.

Figure 7: Snapshot of the workshop conducted

"I came here for the keychains, but the workshop was more informative that I thought." - Participant

Furthermore, the participants' expectations and the workshop content were explored in the feedback. Some attendees initially attended the workshop with the specific intention of engaging in the keychain-making activity. However, feedback indicated that the workshop surpassed these expectations by providing informative content that went beyond the anticipated hands-on project. This suggests that the workshop successfully delivered valuable insights and information, contributing to a more comprehensive learning experience for the participants. Overall, the feedback offers a nuanced understanding of participants' experiences, providing valuable insights for refining future workshops and addressing specific challenges encountered during the event.

6. DISCUSSION

The findings from our preliminary study provide valuable insights into the challenges and opportunities associated with introducing 3D printing technology to a diverse audience, specifically within the library community. Our initiative to simplify 3D printing technology and make it accessible to a broader audience aligns with the motivation to bridge the gap between tech-savvy individuals and those less familiar with the intricacies of this technology.

We decided to work on this project because we all agreed that 3D printing should be something anyone can do, not just people who are good with technology. When we were thinking about what project to do, we thought about different ideas. But what really convinced us was seeing how one of our team member's mom was interested in being creative but had a hard time with technology. This made us realize how important it is to make the 3D modeling part simpler.

To understand more about what people need, we talked to librarians and people who use the library. From these conversations, we found out that many people are interested in 3D printing, but they find it a bit too complicated, especially if they aren't tech-savvy. This strengthened our belief that there's a need to make 3D printing less challenging for everyone.

Our approach is informed by related work, particularly the insights from Hudson et al.'s study on newcomers to 3D printing [1]. Their research emphasizes the challenges faced by users, especially in the design phase, and the importance of demystifying 3D printing for newcomers. Our findings align with their conclusion that newcomers often struggle with the technical aspects of 3D printing, even after understanding individual software tools [2]. This insight reinforces our mission to simplify the 3D printing process.

The preliminary findings from our methods section highlight several challenges faced by potential users, including the perceived complexity of designing a model and accessing a 3D printer. The use of 3D pens, while intriguing, was found to be tiresome and time-consuming, suggesting the need for more user-friendly tools. The positive response from participants regarding accessing 3D printers at nearby libraries indicates a potential solution to space constraints and a desire for communal resources.

The feedback we got from our community workshop tells us that people really liked the part where we shared information. It seems they want to learn more than just doing hands-on stuff. This is important for planning future workshops; we should make sure there's a good mix of interesting information and things to do. Also, the interest in using 3D printers at libraries is a big deal. It opens up a chance for us to work together with libraries. By doing that, we can make 3D printing more available to people in the community. It's like teaming up with these places to make 3D printing easier for everyone.

The implications for future workshops stem from various sources related to 3D printing and design education. It's crucial for workshop organizers to consider the impact of 3D printing on cognitive processes in education, as highlighted in studies on the effects of 3D printing in design thinking and education [9]. Understanding how 3D printing influences learning can inform workshop design to optimize educational outcomes.

Additionally, workshops should take into account emerging trends, such as the rise of makerspaces and outsourced 3D printing services. This involves exploring collaborative environments and understanding how participants might engage with external resources to enhance their 3D printing experience.
Moreover, when considering 3D printing in the corporate digital training landscape, workshops should delve into the potential benefits like rapid prototyping, hands-on learning, customization, and personalized learning. However, organizers need to address potential challenges such as cost, training, quality control, intellectual property, and sustainability, ensuring a comprehensive approach to the integration of 3D printing in training and development programs [10].

While creating keychains serves as a practical and introductory activity, future workshops could benefit from diversifying project options to align with the broader implications of 3D printing. Understanding the cognitive impact, educational trends, and corporate applications of 3D printing suggests that workshops should offer a variety of projects, considering the interests and needs of a diverse audience.

Participants in future workshops might be interested in activities that not only provide hands-on experience but also align with the broader educational and corporate implications of 3D printing. This could include sessions on the cognitive impact of 3D printing in education, explorations of emerging trends like makerspaces, and discussions on the potential benefits and challenges of incorporating 3D printing in corporate digital training. Offering a well-rounded program that considers educational, safety, customization, and corporate aspects can enhance the overall value and accessibility of the workshop for participants

7.   CONCLUSION

In conclusion, our project on "3D Printing in Community Libraries" has provided valuable insights into the challenges and opportunities associated with making 3D printing accessible to a broader audience, particularly within the library community. Our mission to simplify 3D printing technology aligns with the needs of individuals who may not have a technical background. Our research, inspired by related work, emphasizes the importance of demystifying 3D printing for newcomers, addressing issues in the design phase, and promoting accessible services.The preliminary findings from our methods section shed light on challenges faced by potential users, including the

perceived complexity of designing a model and accessing a 3D printer. Through engagement with public libraries, we identified a growing interest in 3D printing among users who find the technology challenging. Also, through active collaboration with the UMBC library, we engaged with the library community, conducting a workshop on November 14th, 2023. The positive response from participants, along with the findings from our methods section, shed light on challenges faced by potential users and emphasized the importance of addressing these challenges to make 3D printing more user-friendly. The feedback also highlighted the interest in accessing 3D printers at libraries, showcasing the potential for collaboration with educational institutions and libraries to enhance 3D printing accessibility. Overall, our initiative aims to collaborate with libraries, such as UMBC, to make 3D printing more available and user-friendly, fostering a creative and inclusive community.

- Wrote the follow up interview questions asked at the beginning of the workshop.
- Analyzed the data from the google form and recruited participants on the basis of the data collected.
- Wrote the preliminary findings of the paper.
- Documented the workshop by taking pictures and engaging in conversations with the participants. During these discussions, I gathered quotes and comments from the participants, capturing their insights and thoughts on the workshop.

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APPENDIX

Questionnaire:
Link to the questionnaire form: https://forms.gle/nWAKtPZG2fLPgwCaA

- Name

- Which age group do you belong to?

  ○ Under 18
  ○ 18-24
  ○ 25-34
  ○ 35-44
  ○ 45-54
  ○ 55-64
  ○ 65 or older

- How often do you go to the Library?

  ○ Daily
  ○ Weekly
  ○ Monthly

- How did you first become aware of 3D printers and their functions?

  ○ School or education
  ○ Work or office environment
  ○ Family or friends
  ○ Online sources (websites, videos, forums)
  ○ Library
  ○ Other:

- How many times have you used a 3D printer?

- How many 3D models have you created from scratch?

- What are the most common issues you've experienced with your 3D printer? (Select all that apply)

  ○ Designing issue
  ○ Printer not responding
  ○ Poor print quality
  ○ Filament issues
  ○ Model processing problems
  ○ Other:

- "Could you please provide a scenario of any issue or issues you have faced while using a 3D printer, if applicable?"

- How do you usually resolve 3D printer issues?

  ○ Troubleshoot on my own
  ○ Seek help from a friend or family member
  ○ Search online for solutions
  ○ Reach out to library staff
  ○ Other:

Interview Script:
Welcome Intro:
Thanks for coming today. I am _____ and I'm a grad student at UMBC for Human Centered Computing focusing on how people interact with technology so tech can be improved. I'd also like to introduce (NAMES OF CO-MODERATOR, OTHERS).

<u>Informed Consent</u>
We are conducting research on 3D printing at public libraries. This is an exploratory project where our main goal is to see how the community uses public technology. Your participation is voluntary and will involve an informal interview that will last between thirty minutes and an hour. Do not worry, there is no right or wrong answer. Do you give verbal consent to participate in this interview? Does anyone have any questions or objections?

<u>Questions</u>
- Demographic questions
  - Job title
  - How long have you been in your current position?
- Basics about library
  - How many staff members are there?
  - What days are the most busy at this library?
- 3D printer questions
  - How long have they had the 3D printer?
  - What software do they use
  - Who at the library is proficient with the 3D printer and software?
  - How frequently are there issues with the printer?
  - Of the community that uses the 3D printer the most?
  - What percentage use the 3D printer only once? Percentage who use the 3D printer multiple times?

<u>Closing</u>
Thank you so much for your time. Your input was insightful, may we contact you if we have any other questions or for further research?

[Workshop informational presentation](#):

Objectives

★ Learn about 3D printing

★ What are the Different Types of 3D printing?

★ What are the different uses of 3D Printing?

    ○ At Home?

    ○ In Industry

★ Create your own 3D printed item!

Traditional:
Subtractive Manufacturing

Process where material is removed with turning, milling, drilling, grinding, cutting, and boring. The material is typically metals or plastics, and the end product has a smooth finish

Modern:
Additive Manufacturing

Process that creates a three-dimensional object layer by layer using materials such as plastic, metal or composite from a digital model

Types of 3D printing

Stereolithography (SLA)

SLA uses resin that hardens when exposed to lasers. SLA printers selectively solidify a layer of resin building the object up layer by layer.

Selective Laser Sintering (SLS)

A laser moves over a bed of fine powder, and wherever the laser touches, the powder melts and fuses together to make a solid layer. This happens layer by layer.

Fused Deposition Modeling (FDM)

The 3D printer moves around and adds layer upon layer, and as the plastic cools down, it forms the shape of the object.

3D Printing in Industry

★ Rapid Prototyping
★ Housing and Construction
★ Precision Parts for Aerospace
★ Custom Prosthetics
★ 3D Printed Organs
★ Dental Implants

3D Printing at Home

★ Repair Parts for Household Items

★ Customized Organizational Tools

★ Customized Home Decor

★ Easy Presents

★ FUN!

Create a Keychain!

Prof. Feedback

-Note: this feedback is only provided to the person who submitted the report. Please share it with other team members.
-Overall, a strong first draft with interesting findings that can benefit from more details and structure as described below:
-Some inconsistency with using the template, with text shifted to different margins in different sections of the paper. In the next version, try to adhere to it as much as possible.
-I recommend using a title more reflective of the specific things you did. Also, it seems like you had a different title that is mentioned later in the paper.
-The introduction describes your intention, but it is unclear why introducing people to 3D printing is desirable. Are you interested in supporting people's learning, creativity, or other experiences? It'd be good to mention that in the introduction. Also, you can include a research question or two reflecting on what you expect to learn from the project.
-In the motivation section, it is fine to mention that you were motivated by seeing the need for creativity in one of the teammates' mothers but you can go further and say why finding an easier pathway for them to use 3D printers can be helpful and who would potentially benefit from it.
-The related work section covers good papers, but there aren't enough details presented about what each research project did. For each paper, please include more details about their methods, participants and what they found. Then, it will be made more clear where your recommendations and relationship to your paper come from.
-When referring to papers, you don't need to include their name in the text. including the authors' names and reference numbers is enough to distinguish the paper. For example, see the papers we have read earlier in the semester.
-You had done a great job in designing a hands-on design activity and a survey to facilitate access to 3D printing for novices. I'm glad you got to use the 3Doodlers and that participants were interested in using them in the future!
-In the methods section, you have two subsections, one for each activity which is good. You have to write out the information about who participated in each study and how many people participated. These are currently presented in a list at the beginning of each section. Also, it seems you are describing a future workshop in section 4.2, but you present data about it later in the Findings section. In the next version, please clarify what actual activities have taken place. Part of the confusion is that in the written format, you mix present and past tenses when describing data collection methods. Since these activities should have taken place when you write the final report, you can consistently refer to them in the past tense.
Also, in the methods section, it'd be helpful to have a table that summarizes information about the participants (demographics, level of previous experience, etc., if you have this data). You can also give participants numbers (e.g., P1, P2, P3 …) and associate the quotes to each person when you mention them in the Findings section.
-You can combine futures 2 and 3 to save space when presenting survey data. Also, please add more interpretations for what this data means. did it meet your expectations or was it a surprise? Why in either case?
-The findings section is very interesting, and I really enjoyed reading the quotes and seeing the figures you have included!
-You can add more structure to the findings section by adding a subsection based on your findings. For example, it seems like participants are aware of the partial challenges of 3D printing (this can be one subsection) and describe it in some detail. At the same time, they enjoyed the experience and might do something similar in the future (this can be a second subsection. Also, for each subsection, you can include quotes and for each quote, an interpretation that describes what it means.
_Also, I was wondering if you saw participants describe being motivated to 3D print things in order to make things for themselves or for others (sometimes this is interesting to understand to design gift creation processes in the future.
-The discussion brings together your findings and connects them to previous research, which is good. Are there specific implications about designing similar workshops in the future that you would like to share with readers? Do you think creating keychains should be repeated in the future? What other kinds of activities or information do you think similar participants would be interested in? Sharing some thoughts about this in the discussion can strengthen it in the next iteration.