

LIBRARIANS' PERCEPTIONS OF EMERGING TECHNOLOGIES

Thomas Keller, Elke Brucker-Kley and Philipp Stalder
ZHAW School of Management and Law
Winterthur, Switzerland

ABSTRACT

The article explores the perceptions of librarians towards emerging technologies and how they can proactively engage with them to enhance their professional lives and the experiences of their users. The digitization of content and the virtualization of the global information landscape has transformed the nature of library operations and the information-seeking behavior of users. In response, librarians must adapt to new competencies and face rapid technological change and innovations. The study presented in this article aims to achieve three objectives. Firstly, to survey the attitudes of librarians towards the potential use of emerging technologies in their professional environment, comprising cognitive, affective, and behavioral components. Secondly, to investigate the impact of a multilinear story on the attitudes of librarians towards the portrayed technologies, which deliberately shows different variants of the future. And finally, to determine whether there is a difference in attitudes towards emerging technologies between staff in academic and public libraries. The research design follows the method of Science Fiction Prototyping, which fosters critical reflection on the consequences of technological innovations. It comprises three main phases: identifying and analyzing the drivers shaping the future of the domain, developing the narrative to portray the impact of the technologies on people, and exposing the audience to the narrative and reflecting on the impact and resulting learnings. The study reveals a clear gap between cognitive and affective attitudes both before and after reading the narrative scenario. The portrayed technologies are in general overall more imaginable than desirable for the participating librarians. The conclusion is that librarians must engage proactively with emerging technologies and adopt new competencies to remain relevant in the 21st century. Science Fiction Prototyping offers a valuable approach to reflecting critically on the consequences of technological innovations and can contribute to better envisioning the specific use of emerging technologies in everyday work.

KEYWORDS

Technology Assessment, Science Fiction Prototyping, Multilinear Storytelling, Field Study

1. INTRODUCTION

Libraries are not isolated institutions but have always been a social space and a mirror of how society deals with knowledge and information (Verma, 2015). The professional identity of librarians has been shaped over time by the purpose of libraries but also by the characteristics of the media they provide to their users. Thus, librarians have evolved from humanistic custodians of knowledge to socio-technical professionals who have long used technologies to acquire, maintain and supply information (Tîrziman, 2017). However, the massive digitization and virtualization of the global information landscape over the last thirty years has raised very fundamental questions about the role of librarians in the 21st century. The information seeking behavior of library users and the nature of library operations have been transformed by the digitization of content and technologies that have revolutionized the way information is organized and accessed (Lee, 2020). In response, librarians emphasize their relevance as navigators and gatekeepers in a user-centered information delivery model, advising their users rather than focusing primarily on their physical and digital collections (Dold, 2013). The mission to ensure equal access to information (American Library Association, 2014) has by no means lost its importance, but it requires new competencies and an open mind. The ability to deal with rapid technological change and to use innovations more proactively is demanded (Liu & Shen, 2018), (Noh, 2015), (Yeh & Walter, n.d.), (Kane, 2017), (Buhalis et al., 2019). Consequently, it is essential that librarians consciously engage with emerging technologies that will shape both their professional lives and the experiences of their users. Emerging technologies are defined as technologies that are characterized by novelty, fast growth, prominent impact, uncertainty and ambiguity (Rotolo et al., 2015). Scenarios can contribute to better envision the specific use of emerging technologies in everyday work and to think in terms of alternatives (Bishop et al., 2007; Boerjeson et al., 2005; Bradfield et al., 2005). Multilinear narratives represent a format to interact with a future scenario, to make decisions and to experience the consequences in a tangible way (Brunner et al., 2020a; Koenitz et al., 2015).

2. RESEARCH OBJECTIVES

The research presented in this paper aims at three objectives.

(1) The first objective is to survey the attitudes of librarians towards the potential use of relevant emerging technologies in their professional environment. Attitudes in the sense of subjective opinions or feelings towards technologies comprise cognitive, affective and behavioral components (Eagly & Chaiken, 1993). The cognitive component shall be assessed through the dimension of imaginability, i.e. how tangible an emerging technology is or how concretely librarians can imagine it in their everyday future work life. The affective component shall be assessed through the dimension of desirability, i.e. to which extent librarians would like to see or not see an emerging technology as part of their future professional life. The behavioral component shall be extrapolated from the decisions that librarians actually make in relation to the use of technologies in the context of a multilinear narrative.

(2) The second objective is to investigate whether the multilinear story has an impact on the attitudes of the participating librarians towards the portrayed technologies (Brunner et al., 2020b), (Brucker-Kley & Keller, 2019). It is essential to the research design that the study is not based on a directional hypothesis. The question is not whether the narrative increases the

desirability of a technology, but whether the narrative changes the attitude of the subjects regardless of the direction. The multilinear scenarios are not normative but deliberately show different variants of the future. The decision whether a future is desirable or not lies solely with the reader.

(3) A third subordinate objective is to determine whether there is a difference and change in attitudes towards emerging technologies between academic and public librarians.

3. METHODOLOGY AND APPROACH

The design, creation and evaluation of the multilinear story followed the method of Science Fiction Prototyping, an approach fostering the critical reflection of consequences of technological innovations (Johnson, 2011), (Atherton & Johnson, 2016). Science Fiction Prototyping comprises three main phases (Merrie et al., 2018): (1) Identify and analyze the drivers shaping the future of the domain (in this case the librarian profession); (2) Develop the narrative to portray the impact of the technologies on people; (3) Expose the audience to the narrative and reflect on the impact and resulting learnings.

The science fiction prototyping method allows future technologies to be experienced within a specific environment. The digital extension of the interactivity of the narrative offers the possibility to individualize the story to a certain degree (Pirker et al., 2014). In the creative third phase, "ramification of the science on people" according to Johnson (Johnson, 2011), the story is transformed into multilinear storytelling. The decision points it contains allow for variation of the elaborated premises and the reader can interactively determine the course of the story.

The focus in the pre- and post-survey is to capture attitudes towards emerging technologies that may change the profession of librarians. According to the tripartite theory, an attitude consists of the components cognition, affection and behavior (Eagly & Chaiken, 1993; Fabrigar et al., 2005). In the questionnaire, the cognition component is evaluated via the dimension of imaginability with the statement "I can imagine ...". The affection component is assessed via the dimension of desirability with the statement "I find ... desirable" and the behavioral component is assessed via the dimension of utilization with the statement "I would use ...". The statements can each be rated on a 5-point Likert scale with the end points "Do not agree at all" and "Fully agree". The statements were created based on constructs from the MEC Spatial Presence Questionnaire (MEC-SPQ) and the Temple Presence Inventory (TPI), as these are suitable for cross-media applications (Lombard et al., 2009).

3.1 Select Relevant Technologies and "Build the Future World"

First, relevant emerging technologies which have the potential to change the librarian domain in the future were identified based on literature research. To design a plausible stage for the technologies in use also the political, economic and sociocultural drivers had to be determined via a PEST analysis (Sammuto-Bonnici & Galea, 2015).

Care was taken to ensure that primarily technologies are used which correspond to the librarian role of the knowledge mediator ("gatekeeper" according to Dold (Dold, 2013)). The future of professional subject indexing is a recurring topic in library congresses (Keller, 2015; Toepfer & Kempf, 2016) as it ties up the expensive resources of studied staff. Automating subject indexing would bring great cost savings and possibly also an increase in quality. In

addition to subject indexing, finding information sources is also part of the gatekeeper's role. In information searches, Google in particular is the big competitor of libraries (Ball, 2012) and in the future also the offers of Generative-AI such as ChatGPT. The focus for knowledge transfer is the acquisition of information and the provision, retrieval and sharing of this information (research consulting).

The analysis led to the following five emerging technologies and technology-driven concepts which show great potential to change the future of the librarian profession. The majority of these are concepts driven by emerging technologies and not technologies per se. To reduce linguistic complexity, we will henceforth refer to them generally as "technologies":

- Smart glasses (Schweizer, 2014),
- Open Access (Homans & Wilen, 1997),
- Virtual Meetings (Laitinen & Valo, 2018),
- Artificial intelligence (AI) (Russell & Norvig, 2016), and
- Streaming services.

Smart glasses can be used to display various additional information, which supports independent information research in the library. Moreover, this creates additional information channels that are integrated into everyday life. However, this also creates a digital dependency for information procurement. Streaming portals enable unlimited access to media content with mobile use of information and entertainment independent of time and place. This increases the pressure on libraries to digitize their services and still offer them more cost-effectively. Open Access creates public and cost-effective access to knowledge resources for research, teaching, and personal knowledge acquisition. Yet, this is achieved through expensive licensing agreements for publication and thus by making research more expensive.

Communication with clients and staff will increasingly take place virtually, especially at university libraries. If the parties involved share their own screen with the other person, any loss of information can be minimized. In addition, artificial intelligence (AI) has the potential to automate many library activities and may also improve the quality of content. However, there is a risk that librarians and their long-standing expertise will be replaced by automatisms.

Potential future manifestations of the key drivers and their impact were defined by applying the creative-narrative scenario technique according to Kosow and Gassner (Kosow & Gaßner, 2008). For each technology premises for light, moderate and extensive usage of the technology in libraries were formulated as well as the corresponding "stage design" in terms of assumed future political, economic and sociocultural conditions.

According to Kosow & Gassner, we used the instrument of the "morphological box" to create the possible scenarios (Kosow & Gassner, 2008), because here different extreme values can be shown and thus the necessary parameters can be mapped. This parameterization leads to applicable guardrails for the different trajectories of the story and it ensures that alternative scenarios in a story with the same basic factors are worked out. It should be noted that the external factors cannot be directly influenced (Ritchey, 2009); these usually result from the technologies and the progression of the story.

Due to the applied three characteristics light, moderate and extensive, three story strands had to be worked out when creating the scenario. Each of the three storylines requires different nodes at which it is possible to switch from one to the other. In this way, it is always possible as a reader to influence the degree of digitization during the development of the individual story.

3.2 Develop the Narrative

Once the stage was set and the key technologies to be portrayed were selected, a multilinear story was developed in which librarians can make technology decisions and experience the consequences of those decisions. In this paper, only the structure of the story is outlined since the presentation of a multilinear story in a linear fashion does not correspond to the format. The English translation of the multilinear story is available online (*LibraryStory*, n.d.). The structure of the multilinear story is depicted in Figure 1. The rocket symbol at the bottom left symbolizes the starting point. Each rectangle contains a text passage. If a passage has more than one outgoing arrow the passage contains a decision point which determines the subsequent course of action. If a passage has no outgoing arrow the decision point contains a logic expression which prevents a visualization of the story flow. The only exception is the passage at right border of Figure 1 which is the end point of the story.

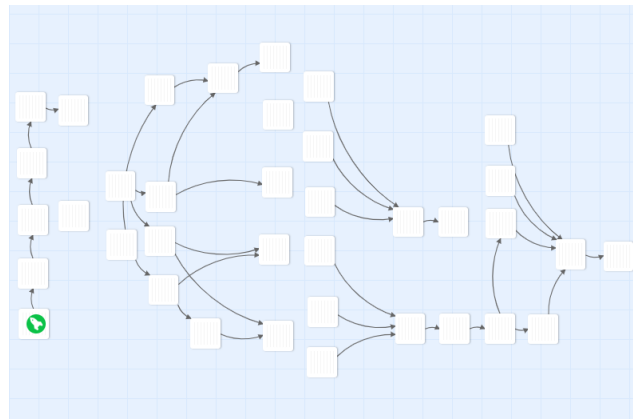


Figure 1. Structure of the multilinear narrative

3.2.1 The Introduction

The reader

- is placed in the role of a librarian,
- creates her/his own identity, by which she/he is addressed in the story, and
- is introduced to the future setting in which the story takes place as shown for a reader with the name “Tom” in the following section.

Very good, so other characters address you as Tom.

This interactive story is about immersing yourself in the everyday life of a librarian. These situations take place in a distant future in which very advanced technologies are available. These can greatly relieve us humans and are omnipresent in everyday life. With your decisions, you influence the extent to which a technology is used. In doing so, you change the course of story.

At this point, it should be pointed out that some situations have been artificially shortened or simplified. The author is aware

that everyday life in a library is more diverse, and reactions to certain events are very simplified. This simplification is for reading flow and comprehension purposes only.

Before starting, please answer the following questions about your attitude towards the technologies presented. Your data will be stored anonymously in Switzerland and will only be evaluated in the context of this master thesis.

Imagine Tom, you're in your mid-30s. You've been working in a library since you became a professional. This is already something special: most of your colleagues are now in secondary education or in another professional field. But you like your job, because it is very versatile and reasonably paid. That's why you regularly take advanced courses online to develop yourself further in your professional field and to stay up to date. Otherwise, you lead a rather quiet and regular life.

As part of the introductory text the reader is also asked her/his opinion about the imaginability, and desirability of the technologies mentioned above that may be relevant in the future life of a librarian as depicted in the following three figures.

Smart Glasses

2. Smart glasses are already in use in logistics and industry and support work with augmented reality. Can you imagine support in the library through this technology?

Choose... ▾

3. Do you find it desirable to have this technology assist you in your library work?

Choose... ▾

Open Access

4. Open Access means cost-free and barrier-free access to scientific information of any kind. Do you feel this is a desirable development?

Choose... ▾

5. Can you imagine all scientific publications being public and freely accessible in the future?

Choose... ▾

Figure 2. Imaginability and desirability questions for 'Smart Glasses' and 'Open Access'

Automation

8. The digitization of library workflows means that more and more jobs can be eliminated in the future due to automation. Can you imagine that?

Choose... ▾

9. Do you feel this trend of job losses due to automation is desirable?

Choose... ▾

AI

10. At the moment, artificial intelligence (AI) is still in its infancy. But there is increasing talk of individual processes being taken over by an AI.

Can you imagine that both administrative and advisory processes in the library will not only be supported by an AI, but will be completely taken over?

Choose... ▾

11. Do you find it desirable for administrative and advisory processes in the library to be handled by an AI?

Choose... ▾

12. Do you find it desirable for administrative and advisory processes in the library to be supported by an AI?

Choose... ▾

Figure 3. Imaginability and desirability questions for 'Automation' and 'AI'

Streaming Services

13. In recent years, the commercial use of music, films and series has been transformed from physical carrier media to streaming offerings. Can you imagine that such a development will also be possible for books?

Choose... ▾

14. Do you find such a streaming service for books desirable?

Choose... ▾

Figure 3. Imaginability and desirability questions for 'Streaming Services'

3.2.2 The Main Part

The course of the narrative (following a working day) is outlined right at the beginning and basically portrays three possible narrative threads:

- Light usage of the technologies
- Moderate usage of the technologies
- Extensive usage of the technologies

The story starts in a neutral area of three possible narrative strands. However, the first decision made already steers the reader into one of the two extremes, either light or heavy digitization. This first decision can be toned down a bit at the next fork of the road, or the chosen path is further consolidated here. After that, the story proceeds in these two opposites (light or strong digitization) and it is only possible to use the technologies either more or less strongly in the given narrative threads. In the course, decisions are made about the use of various technologies or the fear of "being replaced by a machine" is averted.

Table 1. Light and heavy digitization line-up per aspect

Smart Glass	Smart Glasses are just emerging, used mainly in industry.	Smart Glasses are worn by almost everyone as a complementary gadget to the smartphone.
Open Access	Access to scientific publications is only freely available with licenses from universities. Only a few scientific articles are freely accessible to the public	Most scientific publications are freely accessible when they appear on university repositories. The costs are charged at the time of publication.
Virtual Communication	Virtual communication is used selectively for some meetings or conversations.	Almost everything is done by virtual communication, without virtual reality one is no longer competitive.
Artificial Intelligence	Artificial intelligence exists, but it is still so far inferior to human intellectual labor that it shows no added value.	The use of artificial intelligence is almost ubiquitous in shift planning, content indexing and information research, but also in customer service.
Streaming Services	The use of electronic works such as e-Books remains constant at 25-30%.	Private companies are now offering unlimited access to e-Books at low prices, and libraries can no longer keep up.

The plot of the story follows various dialogues, which are personalized. The reader is addressed in the second person ("you") to create a certain intimacy and identification with the protagonist. The library plot is kept as general as possible, so that the everyday work situations can take place in a public library as well as in an academic library. The complexity of a daily work routine is simplified as much as possible but presented as tangible as possible so that librarians can familiarize themselves with it. Decisions are built in the story whenever the librarian has a choice to use a technology more or less intensively. This leads to the splitting of individual narrative threads and increases the complexity of the possible storyline.

3.2.3 The End

Depending on the storyline driven by the decisions of the reader. The story leads to one of the following three open endings:

- “Obsolete”: Rather dystopian with a negative impact, but with a professional reorientation as a silver lining on the horizon (Figure 4).

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It's Friday and KeyWords has convinced the whole library staff in no time. Now Hanspeter has invited me again for a talk. Virtually, of course.

"Hi Hanspeter, what a week!"

"Hello o. Yes there has been a lot going on. That's why I wanted to talk to you. **KeyWords** is according to our calculations more efficient than our employees and will take a lot of work off our hands. Therefore, we will cut several jobs in the course of this year. Unfortunately, you will also be affected by this reduction. But you're still young, you have good chances and a new orientation could certainly appeal to you."

The whole thing hits me quite unexpectedly. I didn't expect that at all today.

"Hmm, yes, I really like my job in the library, and I particularly enjoy working with the users. Sure, I could certainly add on some further training, but still... How did you imagine it?"

"Well, we can keep you busy until the end of the year. We still need support, especially in training the tools, but after that it would probably be over. Until then, you have time to reorient yourself and think about what you want to do."

"Yes, then I guess I have no choice... I'll think of something."

Saddened, I end the meeting. I don't have to worry about finances; the unconditional basic income provides for the bare necessities. Still, I'm saddened by the outcome of this work week... I guess I'll now spend my weekend re-planning my future. A second education in the social sector might be something for me....

Figure 4. The dystopian end, 'KeyWords' is a name of a fictional software product

- "Irreplaceable": Rather conservative with few changes to the status quo (Figure 5).

TimeMaps has taken over the desk shift planning, but really not much time can be saved so far, according to predictions. If my estimations and those of **TimeMaps** are correct, I will still have a lot to do in the next years. So my job is versatile and secure even in the distant future.

Figure 5. The end with only a few changes, 'TimeMaps' is a name of a fictional software product

- "Unburdened": Rather utopian with major technology-driven changes that open new freedoms for self-fulfillment (Figure 6).

The indexing by **KeyWords** works very well. I will use the now freed up time in the indexing department to attend a further education. Therefore I will submit a request to Hanspeter to reduce my workload to 40% next spring. I will invest the time gained in further training. Since we have an unconditional basic income and state support for further education, I can take this step without having to worry, despite the financial loss from my professional activity.

Figure 6. The end with new opportunities

The multi-linear narrative was implemented as an interactive hypertext (Twine) accessible via any internet browser. The quality of the artefact was validated via prototyping and thinking-aloud test-runs in four iterations along three dimensions: usability, immersion and transformational capability.

3.3 Analyse the Impact of the Narrative Intervention

The impact of the resulting narrative intervention was evaluated online. Subjects were recruited via digital channels from libraries and professional networks in the German-speaking part of Switzerland and Germany. Each participant went through a fully logged continuous online session that included a pre-survey, reading the hypertext story and a post-survey. Both survey rounds and the logging of the narrative intervention were conducted anonymously via a digital platform (Elke Brucker-Kley & Thomas Keller, n.d.).

For all the technologies mentioned above, one question each was asked about future imaginability ("Can you personally imagine that technology X will be dominant to perform tasks Y or Z in libraries?") and desirability ("Do you personally want technology X to be part of your everyday work in the library?"). The responses to pre- and post-surveys were collected using a 5-point Likert scale Table 2. Applied five-point Likert scale (Table 2).

The post-survey was concluded by one additional open question, "What other thoughts and open questions does the story trigger in you? ". The number and content of answers to this optional question were used as a proxy to evaluate the effect of the narrative on the readers willingness to reflect and discuss. Both surveys were an integral part of the multilinear story and can be viewed online (*LibraryStory*, n.d.).

4. ANALYSIS AND FINDINGS

Statistical analysis was performed using SPSS. All data are available online (*Survey Data on OSF: Digital Futures - Library*, n.d.)

The verbal qualifiers of the 5-point Likert scale that were used for the pre- and post-survey were quantified as presented in Table 2.

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Table 2. Applied five-point Likert scale

Imaginability	Desirability	Value
Very likely	Very desirable	5
Rather likely	Rather desirable	4
Possibly likely	Possibly desirable	3
Rather unlikely	Rather not desirable	2
Not likely at all	Not desirable at all	1

4.1 The Characteristics of the Participants

The total of 457 analyzable records can be grouped according to the following characteristics: Gender, age, and library type.

Table 3. Participants by gender

Gender	No answer	Diverse	Male	Female	Total
[#]	10	3	101	343	457
[%]	2.2	0.7	22.1	75	100

The gender distribution of the sample (Table 3) corresponds to the gender distribution of librarians in the surveyed geographies. Librarians are among the professions most influenced by gender. More than 80% of librarians in Switzerland and 75% of librarians in Germany are women (BfS, 2018; IAB - Institute for Labor Market and Profession Research, 2017).

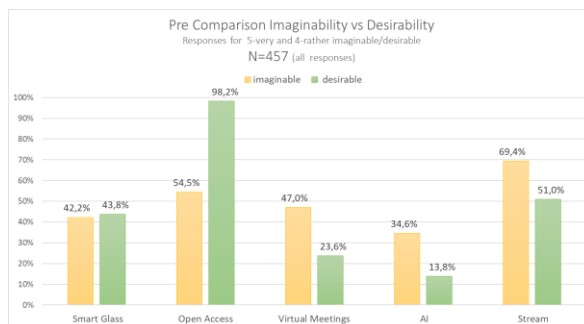


Figure 7. Imaginability and desirability of the portrayed technologies in the pre-survey

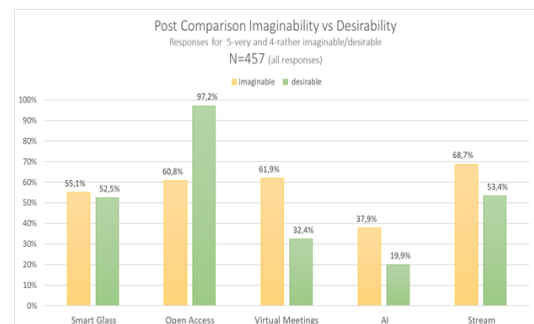


Figure 8. Imaginability and desirability of the portrayed technologies in the post-survey

The age distribution of the subjects does not reflect the age structure of librarians in the surveyed geographies. Librarians younger than 50 are more strongly represented in the survey than in reality. Age distribution data for information and documentation professions in Germany show that more than 47% of employees in that profession are 50 years and older, compared to 35% across all professions.

The sample shows that approximately $\frac{1}{4}$ of all participants work in a public library and almost $\frac{3}{4}$ in an academic library. The actual distribution of library staff according to Swiss library statistics (BfS, n.d.) is $\frac{2}{3}$ in public libraries and $\frac{1}{3}$ in academic libraries. In Germany the

jobs in public and scientific libraries are almost equally distributed (02. *German Library Statistics*, n.d.). Thus, academic librarians are more strongly represented in the survey than in reality shows.

4.2 Imaginability Versus Desirability

The first objective was to identify the attitudes of the participating librarians towards the portrayed emerging technologies before reading the narrative scenario. Based on the results the cognitive aspect (imaginability) and the affective component (desirability) of the attitudes towards the technologies can be compared. For this purpose, the responses for "very likely" and "rather likely" as well as the responses for "very desirable" and "rather desirable" were cumulated. The responses for other options were not considered for this analysis.

The data show that smart glasses are equally imaginable and desirable for the participants before reading the scenario (Figure 8). Practically all participants would like to see Open Access as the predominant paradigm to access scientific publications, but only 50% can imagine this for the future. For all other technologies, the gap between envisioning and embracing the technology in their everyday work life is the other way around. This is particularly true for Virtual Meetings and AI. The participants consider it realistic that Virtual Meetings will dominate libraries in the future but wish this to happen to a much lesser extent. The vision that AI could not only support but take over certain administrative and advisory processes in a library completely, is significantly less imaginable and clearly less desirable for the participants.

The second objective was to find out whether the multilinear narrative has an impact on the attitude towards the portrayed technologies. Figure 9 illustrates imaginability and desirability after the participants went through the multilinear narrative. Table 43 compares the data from the pre and post survey and shows the relative change for the positive responses presented in Figure 8 and Figure 9. Both imaginability and desirability have increased moderately for all the technologies after reading the narrative except for the desirability of Open Access and the imaginability of Streaming Services. However, the clear gap between imaginability and desirability has remained. A more in-depth discussion of the impact of the multilinear narrative on the subjects' attitudes including the full spectrum of responses follows in the next section.

Table 4. Pre/Post survey comparison

	Pre survey		Post-survey	
	Very or rather desirable	Very or rather imaginable	Very or rather desirable	Very or rather imaginable
Smart Glass	43.76%	42.23%	52.52%	55.14%
Δ			20.00%	30.57%
Open Access	98.25%	54.49%	97.16%	60.83%
Δ			-1.11%	11.65%
Virtual Meetings	23.63%	47.05%	32.39%	61.93%
Δ			37.04%	31.63%
AI	13.79%	34.57%	19.91%	37.86%
Δ			44.44%	9.49%
Streaming	50.98%	69.37%	53.39%	68.71%
Δ			4.72%	-0.95%

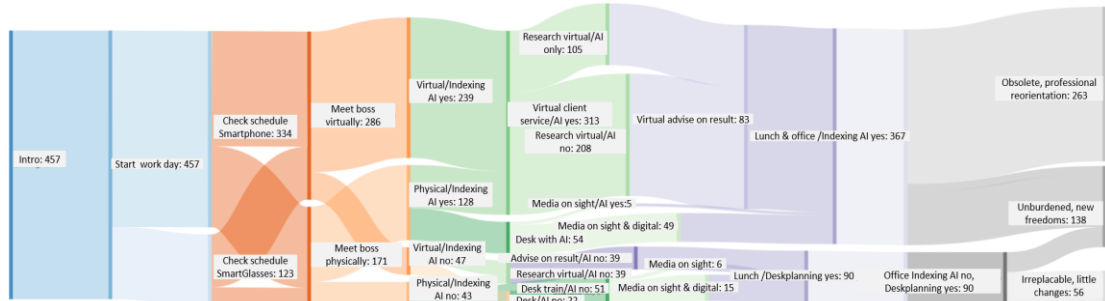


Figure 9. Sankey diagram illustrating the different paths the participants have taken in the story

4.3 The Impact of the Narrative

Based on the logged history of the individual paths of all participants (N=457) a Sankey diagram was generated (Figure 9). The thickness of the strands represents the quantity of the individuals who chose the different paths when interacting with the multilinear story. The Sankey diagram shows that many participants chose the strands with strong digitization. 313 participants opted for virtual customer service instead of supporting users on-sight at the customer service desk. Nevertheless only 105 participating librarians decided to leave the research for the user entirely up to AI in the virtual mode. 208 participants chose the virtual route but rejected the support of AI in conducting research. 263 participants closed the narrative experience with the rather dystopian ending (loss of job and professional reorientation). 138 experienced the rather utopian ending (freed up resources used for new ways of self-fulfillment). 56 participants left the experience with a rather conservative ending (light digital transformation resulting in little changes to the status quo).

How did this predominantly dystopian narrative experience affect the attitude of the participants? The bubble charts visualize the change in attitude of the participants before and after the multilinear narrative for each portrayed technology, exemplarily for AI (Figure 10, Figure 11) and Smart Glasses (Figure 5, **Error! Reference source not found.**) in this paper. The verbal qualifiers of the full Likert scale were recoded into numerical values (Table 2). Each datapoint is plotted in the coordinate system to express the response of the participant before (x-axis) and after (y-axis) the narrative experience. The bubble size represents the number of participants with the same response pattern. The bubbles along the diagonal of the diagram represent those participants whose attitudes remained the same before and after the narrative. The bubbles above the diagonal represent those participants who consider a technology more imaginable respectively more desirable after the narrative. The bubbles below the diagonal stand for negative changes in imaginability respectively desirability after the narrative.

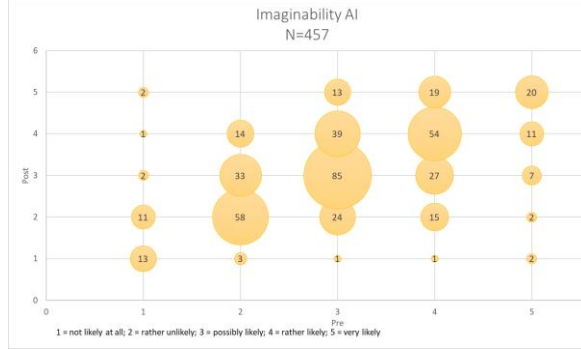


Figure 10. Imaginability of AI before and after reading the narrative

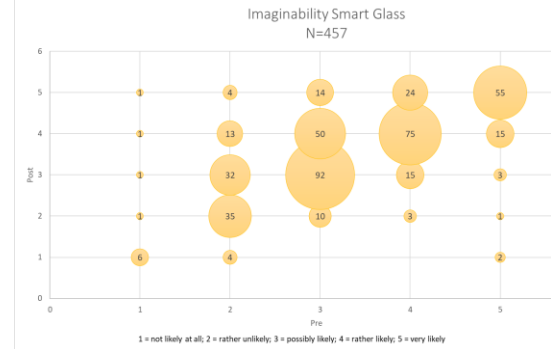


Figure 11. Imaginability of Smart Glasses before and after reading the narrative

The bubble diagrams clearly show the strikingly high proportion of users who have not changed their attitude according to pre- and post-survey. The bubbles along the diagonals in the case of smart glasses and AI represent more than half of the participants. The attitude towards Smart Glasses has not changed for 58% (imaginability) and 56% (desirability). Attitudes towards AI have not changed for 50% (imaginability) and 56% (desirability).

Overall, the changes were small but nevertheless statistically significant. Significance was tested using the Wilcoxon signed ranked test, with a 0.05 significance level. For all technologies except for Streaming the measured differences between pre- and post-survey results were statistically significant for both imaginability and desirability. The null hypothesis that the narrative has no impact on the attitude of the participants can therefore be rejected for four of five technologies.

The bubble charts also show which technologies are more polarizing than others. In the case of the desirability of AI (**Error! Reference source not found.**), for example, the bubble diagram reveals that almost one-third of the participants retained a negative attitude (rather not / not at all desirable). For Smart Glasses, the opinions are mainly in the indifferent and positive range and are more dynamic in terms of change from indifferent (3) to more desirable (4) (**Error! Reference source not found.**).

To get an aggregated view on the strength of the changes in attitudes for each technology the sum of weighted positive and negative changes was calculated (v: variance in change, p: number of participants with the same variance in change)

$$\sum_{v=-4}^{v=4} p_v \times v$$

The results are presented in Table 4. Except for the desirability of Open Access all technologies show an increase both of imaginability and desirability in the post-survey. Smart Glasses and Virtual Meetings became the most tangible for the participants.

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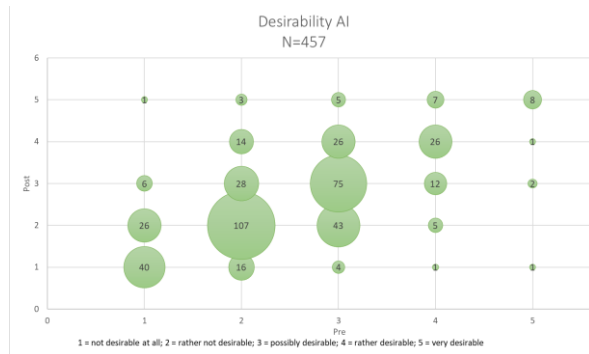


Figure 12. Desirability of AI before and after the narrative

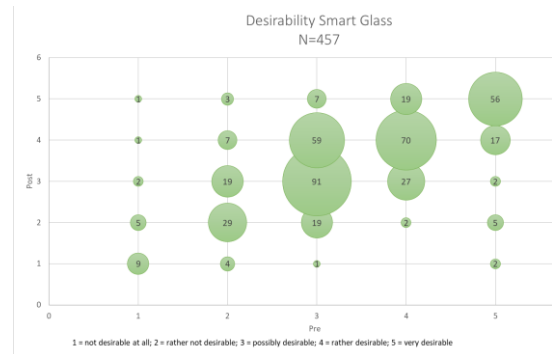


Figure 13. Desirability of Smart Glasses before and after the narrative

To compare and evaluate effect sizes in a standardized manner Pearson's r value was calculated based on the pre- and post-data (Table 5). Applying the classification for effect sizes in the social sciences according to Cohen (Cohen, 1988) (0.1=small, 0.3=medium, 0.5=large) to the results, it must be clearly declared that the effect size is small. For AI the effect is negligible, although statistically significant in the Wilcoxon test (0,04 for imaginability and 0,008 for desirability).

Table 4. Weighted changes of attitudes from pre to post survey

	Weighted change pre- to post survey	
	Imaginability	Desirability
Smart Glasses	+115	+50
Open Access	+60	-27
Virtual Meetings	+124	+76
AI	+43	+49
Streaming	+1	+18

Table 5. Effect sizes

	Effect size r	
	Imaginability	Desirability
Smart Glasses	0,20	0,10
Open Access	0,14	0,10
Virtual Meetings	0,21	0,15
AI	0,07	0,09
Streaming	0,00	0,04

4.4 Differences Based on Library Type

The Mann-Whitney U test with a significance level of 0,05 was applied to validate the statistical significance of differences between the attitudes and changes in attitudes of employees in public and academic libraries. Only for Virtual Meetings a statistically significant difference between public and scientific librarians could be identified. While 60% (52% post) of public librarians considered virtual meetings to be rather not or not at all desirable, only 37% (35% post) of scientific librarians shared the rather negative attitude. For all other technologies, no statistically relevant difference could be observed and the null hypothesis ("There is no difference in attitudes between employees of general public and academic libraries") thus can be confirmed.

5. DISCUSSION

One goal of this study was to determine librarians' attitudes towards emerging technologies that are likely to change the face of their profession. This revealed a clear gap between cognitive and

affective attitudes both before and after reading the narrative scenario. The portrayed technologies, except for Smart Glasses, are overall more imaginable than desirable for the participating librarians. AI and Virtual Meetings are the technologies with the least desirability. The result for Virtual Meetings was probably also influenced by the pandemic. Libraries were either closed or reopened with heavy restrictions and a high share of librarians was working from home while the study was conducted. The desirability of Virtual Meetings nevertheless increased after reading the narrative. The futuristic version of meeting colleagues and clients virtually was seemingly more desirable than the current reality. With AI, attitudes were more entrenched. Here, there was not even a small effect on attitudes, neither on imaginability nor on desirability. With AI, nevertheless, the change in attitude among those who were in the middle of the Likert scale before the narrative (3 of 5) is noteworthy. 153 (33%) of participants considered AI "possibly desirable" before the narrative. Only 75 (16%) retained this indifferent opinion after the narrative, 31 changed their attitude to the more positive, 47 to the more negative. This example shows that despite statistically small effects, the narrative nevertheless enabled many participants to form an opinion. This is confirmed by the fact that 55% of the participants in this study used the optional free text field at the end of the survey to share thoughts and open questions triggered by the narrative.

For Smart Glasses, Open Access and Virtual Meetings the effects on imaginability were stronger than on desirability. The narrative was able to make these technologies and their impact on everyday professional life more tangible. The fact that the majority of participants opted for highly digitized paths of the multilinear narrative may have contributed to this effect.

However, it is questionable whether these decisions in the multilinear story are suitable as determinators for actual behavior. For example, the fact that 68% of participants chose virtual customer service might suggest that librarians do not mind the loss of customer contact. However, it can also simply mean that many librarians were curious to experience this version of customer service in the narrative. It is notable, that for 4 of 5 technologies desirability slightly increased, even though 58% of participants completed the story with the dystopian ending. This could indicate an insufficient level of immersion and believability of the story, which had been defined and tested as quality criteria for the narrative. However, it can also be taken as a positive indication that the story lives up to its claim of presenting different versions of the future as neutrally and descriptively as possible, rather than normatively convincing readers of good and bad versions of the future. The motivation behind this research was not to increase technology acceptance among librarians or to warn them about the consequences of digitization, but to promote a conscious engagement with emerging technologies.

6. CONCLUSIONS

Multilinear scenarios haven proven to be suited to make technologies imaginable. If we assume that imaginability is a prerequisite for engaging more consciously with technological change, multilinear narratives can contribute to a discourse on digitization and its consequences for the future of a profession.

We also consider the small changes in desirability to be relevant for this purpose, as they are an indicator that the readers of the narrative have developed a more differentiated attitude. Whether stronger effects are shown with more extreme scenarios is an interesting question for future inter- and transdisciplinary research. A multilinear narrative is a special form of

intervention. It cannot be strictly controlled, even if it is created with the scientific methods outlined in this paper. The design of the narrative is ultimately also an artistic act and, despite testing, some bias in its creation cannot be prevented. The results of the study and feedback from readers suggests further design elements and design criteria worth exploring:

1. Avoid oversimplification. The attempt to make the experience fit for staff both of public and scientific libraries did not work well. Public librarians found that the role of a library as a social space was underrepresented in the narrative.

2. Embed the possibility to experience the narrative from another perspective, e.g. of the library user. Roles and perspectives would allow to widen the scope of the audience and to pick or swap roles before and/or in the course of the story.

3. Reconsider the exclusive and irreversible choice of a path. Asking the readers at the end whether they like this version of the future or whether they want to start the story again or return to a specific decision point, seems a promising new element both for the readers' experience and the research design.

4. Experiment with alternative formats for multilinear narratives. In the broader context of this study, we experiment with immersive Virtual Reality (VR) to increase the emotional engagement of users. A "SciFi generator" allows to create VR experiences from textual Twines. Comparing the effects of textual twines versus immersive VR experiences is an interesting field of futures research.

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