Chapter 7
Paid Crowdsourcing as Concept and Content Generator to Enhance Museum Experiences

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Abstract Current design and development practices for technologies in museums are costly and difficult to scale. We present a case study that shows that paid crowdsourcing is a viable approach for the design of a Museum app from concept to the development of a working prototype, and the creation of scalable content for over 80 museums worldwide. The concept that was developed is a quiz-type mobile app, the content of which was collected by existing crowdsourcing platforms. Our work extends prior studies of crowdsourcing in cultural institutions by reporting on the process, platforms, and data we utilized so that other institutions could replicate them. Paid crowdsourcing of content for a mobile museum application creates opportunities for new museum experiences that fit into the modern technological society. This emerging crowdsourcing approach addresses the evolving museum trend of being community-centered. The case study shows interesting opportunities for content modification regarding decent and up-to-date information which can make the application self-sustaining.

7.1 Introduction

Museums, nowadays, face several challenges. Among these, two important ones are related to the need to attract and sustain visitors, and viable ways to integrate modern technology. It should not come as a surprise that there might be a link between the two aforementioned challenges. Visitors are more likely to be more technology savvy and often might expect an interactive experience within museums. To face these challenges, museums are shifting from being collection-centered to being community-centered. The decision to take a community-centered approach further opens up more specific questions that museums may face: How to keep the visitors engaged during their visit in the museum? How to let remote crowds contribute to an interactive experience?

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To tackle these questions, one approach is by using social media. Through social media, such as Facebook and Twitter, museums try to directly communicate with the visitors, try to engage them more by promoting their services and products, and thus, attempt to build loyalty and encourage repeat visits (Padilla-Meléndez and del Águila-Obra 2013). However, the application of social media for museums is often limited in scope to marketing and promotional activities. Additionally, many museums do not fully exploit the potential of social media to engage and give voice to visitors, so that audience interactions are often passive or superficial.

Another approach for enhancing the visitor experience is the use of modern technologies within the museum's premises. Museum visitors are often confused by the purpose of technology in museum premises and it takes time for them to understand what to do (Csikszentmihaly and Hermanson 1995). A popular approach used within the premises of a museum is combining education and entertainment, called edutainment, to enhance one's learning experiences. For example, gamifying elements supported by technology can increase visitor engagement (Hamari and Koivisto 2015). Examples of other technologies to enhance visitor engagement include mobile-device-based walking tours or touch screens for requesting more information. A drawback of using these technologies, for the visitors seems to be that they find it difficult to divide their attention between the device and the environment (Ghiani et al. 2007). Moreover, one study reports that another drawback of this approach is that even if the target group consists of young people, designers may need to spend a lot of effort in explaining the task beforehand (Stuedahl and Smørdal 2015). Using technologies that are not intuitive inside a museum may affect the visit experience. Prior work shows that letting visitors contribute makes technology around museums more user-friendly and more approachable (Fidas et al. 2012). One approach that we like to suggest in this chapter revolves around the engagement of the crowd in codesigning or contributing additional content for designing technology.

A different way of creating positive experiences would be to let the local community contribute with private stories and experiences to historical sites and objects. More specifically, local communities can contribute by social activities or categorizing objects. In this way, the community is a producer and consumer of the created content (Stuedahl 2011). That involvement could lead to creating a sustainable relationship with the local heritage (Giaccardi and Palen 2008). One benefit for local community involvement is to provide a venue for community members to express their perceptions, interpretations, and expectations of their local heritage. A novel approach to connect to the local community is presented in Chap. 3 of this volume authored by Boonen, van der Heijden and Giaccardi, in which the visitors take museum objects home for a few weeks and then write stories about them, which then go back to the museum. Such approaches, although very useful and truly engaging with the museum's collection, are obviously limited to local aspects of communities and are hard to scale beyond a museum's locality.

Crowdsourcing is a rather novel socio-digital phenomenon that makes use of an ad hoc community that has the ability to scale beyond the local community. There are already a limited number of cultural institutions that have utilized crowdsourcing for a variety of purposes (Carletti et al. 2013; Oomen and Aroyo 2011). More specifically, prior literature reports six uses of crowdsourcing by cultural institutions: correction and transcription, contextualization, complementing collection, classification, co-curation, and funding (Oomen and Aroyo 2011). However, to our knowledge, no research efforts have been published in which paid crowdsourcing is tried as an alternative approach to developing technology and content (that does not directly contribute to the artifacts) of museums. Although in prior initiatives new assets have been created through crowdsourcing (Carletti et al. 2013), there is no study to the best of our knowledge that utilizes paid crowdsourcing to develop technology and content that is adjacent to the main collection (i.e., not enhancing the actual museum collection) and supports the visitors' experience in the museum itself. Furthermore, museums in the past have developed their own systems to support crowdsourcing initiatives (Carletti et al. 2013). Yet, only few museums have the resources and know-how to actually develop their own crowdsourcing systems. But nowadays, there is a plethora of crowdsourcing platforms that can be used or combined and repurposed for the needs of museums.

We wish to contribute to the literature by presenting a study that evidently shows that paid crowdsourcing—in combination with input from social networks—is a viable alternative for helping museums to: (1) ideate technological concepts; (2) decide which ideas are best; (3) design the visuals; and (4) develop the content for digital artifacts and experiences. In this paper, we present our experiences with paid crowdsourcing in developing a mobile application from scratch and generating its content having the crowd on the steering wheel. In this way, we present an alternative to the aforementioned approaches by reaching out to a crowd beyond local communities for the design of novel learning experiences in the museum that are technically and financially feasible and sustainable.

7.2 Method

Although there are different definitions of what crowdsourcing is, for our work we adopt a broad, encompassing definition:

"Crowdsourcing is an umbrella term for a variety of approaches that harness the potential of large crowds of people by issuing open calls for contribution to particular tasks" (Geiger et al. 2012).

It is evident that this definition includes paid crowdsourcing but does not exclude other platforms such as social networking systems.

The backdrop of the research we report in this chapter was a two week project, part of a postgraduate module taught at our university, on utilizing (as many as

possible) crowdsourcing platforms for design research with one of the end results being developing an app. At the start of the project, the team chose three topics: a Recipes app, a Photography app, and a Museum app. The topic chosen by the crowd was a Museum app. Subsequently, we asked the crowd by using a crowdsourcing platform what kind of functionalities the application should have.

Moreover, we crowdsourced the application's visual design. The next step was to create content for the application, by asking the crowd to come up with questions. To test the usability of the application, we used another crowdsourcing platform. Finally, the programming of the application was crowdsourced as well. In Fig. 7.1 the six stages are shown in an overview. We want to highlight that no stakeholders from museums were consulted due to time limitations. In the following section, we present in detail our process and results.

7.3 Process and Results

7.3.1 Need Finding with Crowds

In the first step (out of six), our team of three researchers held a brainstorm session in which three topics were chosen:

1. A Museum app for the purpose of encouraging users to visit museums by unlocking riddles;
2. A Recipes app for the purpose of creating new recipes with the crowd while playing a game;
3. A Photos app for the purpose of getting photos by people one crossed paths with.

In the next phase, we asked the crowd to: (1) rank the ideas from one to three, and (2) explain their reasons for their first choice. The results are shown in Fig. 7.2. We distributed the survey link in several platforms: Facebook, Twitter, Google+, LinkedIn, WhatsApp, and Skype. Eventually, 77 responses were collected in 20 hours and 29 participants ranked the Recipes app at the first place (Fig. 7.2).

Due to the favorable comments, we decided to work on the Museum app for which 26 participants ranked this in the first place. This is because participants were elaborating the most on the reason why they would like to have this application. First, a simple word count showed that participants used on average 24 words (SD = 29) to describe why they choose the Museum app. In contrast, this was only 13 words on average for the Recipes app (SD = 14). In Table 7.1 one can find some sample statements.

The quotes show that the Museum app seemed to be more appealing and participants felt more passionate about it, compared to the Recipes app. This is why we continued with the Museum app concept. This finding shows that it may be rewarding to have a mix of quantitative and qualitative measures to evaluate the

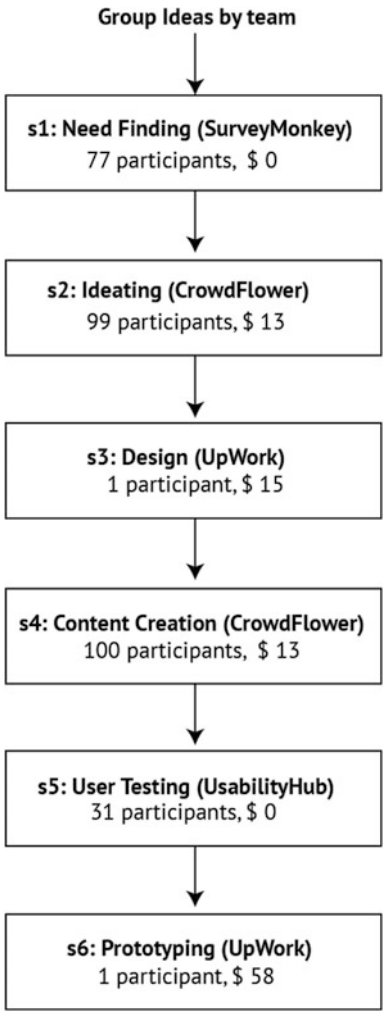

Fig. 7.1 Stages of the design process including the amount of crowd workers engaged, the utilized platform and the total costs for each step. For example, in Step 2 (S2) we utilized CrowdFlower by asking 99 crowd workers to help us come up with ideas about application features with a total cost of $13

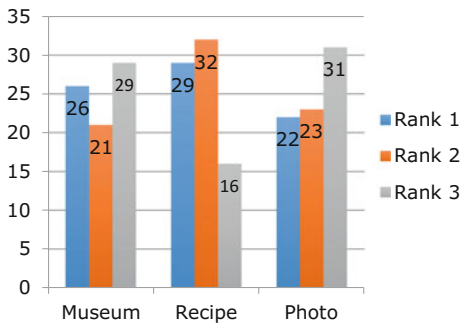

Fig. 7.2 Utilizing paid crowdsourcing to rank ideas that were themselves crowd-driven. The crowd (N = 29) ranked the Recipes app idea as most interesting but when looking at the arguments it was clear that the Museum app idea was the most favorable

crowd's responses during a design process. In our case, if we had not asked the open question we would have decided to continue with the Recipes app.

7.3.2 Ideating with Crowds

To specify the goal of the Museum app, we decided to detail a design statement: *Design an application which educates people about art/museums by making use of crowd wisdom: collectively working on cultural heritage in a fun and engaging way.* This design statement was based on how people can be intrinsically motivated, such as by sharing experiences and making learning situations fun (Csikszentmihaly and Hermanson 1995).

We first identified 14 different functionalities, six different rewards and four different names for the app. We then asked the crowd to show their preference for functionalities and rewards. Workers could select multiple options. Moreover, they were asked to vote for the name they liked best. For the data collection, we launched a survey on CrowdFlower.[1] This is a platform where surveys can be set up and distributed to all workers registered in this platform. We paid contributors \$0, 10 for every completed survey. In one hour, we received 99 responses from 36 different nationalities. Workers were told that they were contributing to the design of a Museum app, which would contain game elements.

After counting the data for the potential functionalities (in total 557 votes) seven main functionalities were selected based upon the highest rating (more than 40 votes—see Table 7.2). The same approach was taken for the rewards. In total 206 votes were received, and out of the six options, three main rewards were selected (more than 40 votes). Forty contributors chose the name "BrainChain" for the app, instead of Mucation (22 votes), BrainTrain (16 votes) or BrainGain (21 votes).

94 workers mentioned that they would play this game and 89 workers said they would be motivated going to museums by this game. Tables 7.2 and 7.3 show the different kinds of rewards and functionalities that contributors voted for.

7.3.3 Designing with Crowds

The next step after identifying the application functionalities was to come up with a design for the app. Our initial idea was to crowdsource some different designs and then let the crowd decide which design they liked the most. However, since there was only one UpWork[2] contributor (lady from Odessa, Ukraine) that offered to work for free, out of 15 offers that ranged approximately from \$0 to 60, we decided

[1] www.crowdflower.com.

[2] www.upwork.com.

Table 7.1 Sample results of the qualitative input from the crowd, with the reason why they preferred the app (either Museum or Recipe)

Museum app	Recipe app
"I would like to go to a museum more often. Somehow I always fail to do this"	*"I like to cook"*
"Look at that, it's great for people to learn about art and history on a playful way! Think actually about simple museums and other touristy stuff in your own Neighborhood that we seem to forget because we live here and don't care anymore"	*"Love cooking"*

Table 7.2 The rewards workers could choose from. We actually used the first three ones for the concept

Rewards	Votes
Free tickets to go to a proposed place to solve the next assignment	56
Coupons (can be spent anywhere)	47
Discounts on museums in general	46
Congratulation badges related to specific levels	24
Fixed amount of Points for solving an individual and crowd assignments	21
Medals related to specific levels	15

to work with her due to our limited budget (for our project we had a budget of $100). She wanted to improve her design skills and this gave her the opportunity to do so, as she was coached by the designer in our team. We developed a paper prototype and this was sent to her and after an iterative process with our team's designer, the first design was received within three days (see Fig. 7.3). The interesting element, in terms of design process, is that the role of the designer, in our team, shifted from being active on designing to monitoring the crowd contributor. The final design is shown in Fig. 7.4. Our results show that even with limited -or perhaps no- budget but rather for learning purposes, crowdsourcing platforms could assist museums in generating designs (Table 7.3).

7.3.4 Creating Content with Crowds

Our application needed questions as content. Instead of coming up with these ourselves, we decided to crowdsource the questions by again using CrowdFlower. The task description for contributors was to become quizmasters, and we asked the following questions: *What is your favorite museum?* and as a follow-up: *What quiz question can you ask about the museum collection?* We also asked what their favorite art piece is in that museum and as a follow-up: *What question could you ask about this art piece?* Out of 100 responses, we could actually create 115 open

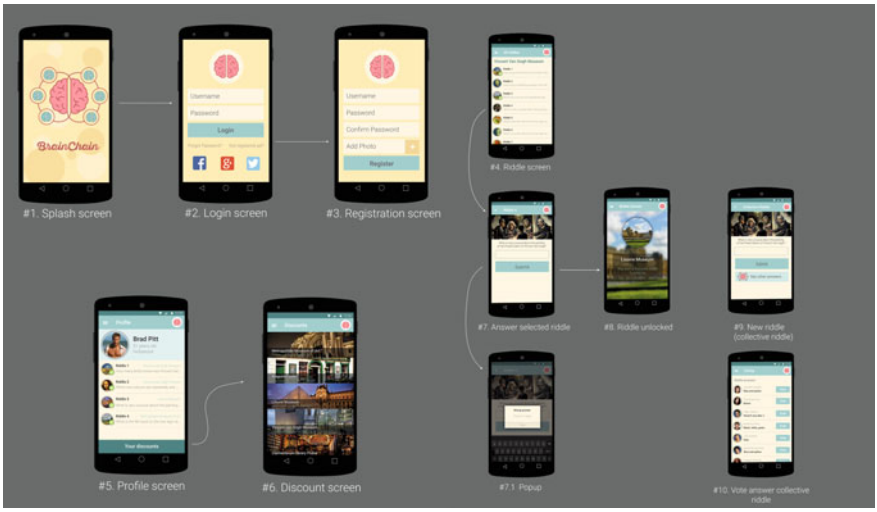

Fig. 7.3 First Graphic Design crowdsourced through UpWork (graphic design done by a worker from UpWork)

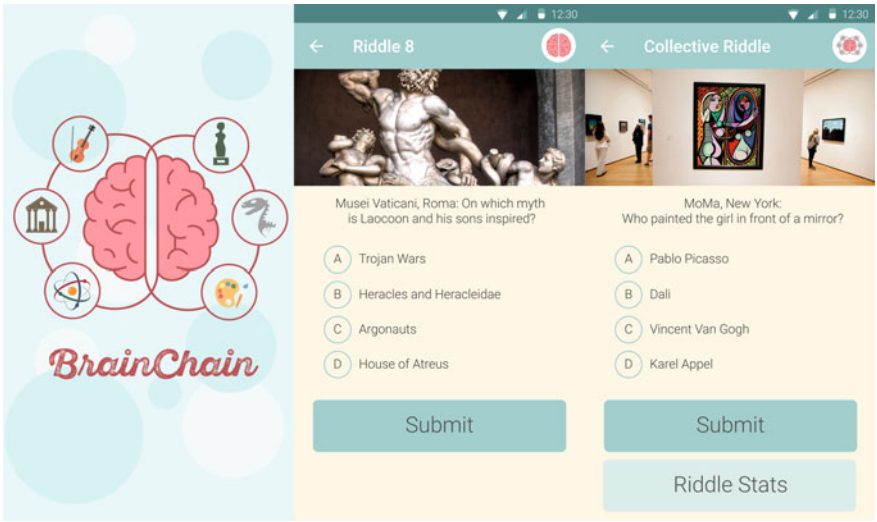

Fig. 7.4 Final BrainChain design. Screenshot of the landing page and the collective and individual questions

questions. From this input we used only 25 questions for the first prototype, to make it work in the short amount of time we had for our project (see Appendix 1 for the 25 selected questions). Our results show that there is a plethora of diverse

Table 7.3 The functionalities contributors could choose from. We actually used the first seven rows for the concept

Functionalities	Votes
Different Museum themes (architecture/sculptures/paintings etc.)	62
Receiving "points" by giving an individual correct answer	62
Difficulty levels	53
Extra reward for entering a certain level	46
Chatbox to chat with other users	42
History of solved assignments	43
An overview of reviews of museums	40
Receiving "points" by giving a collective correct answer	36
Limited attempts to solve the assignment (e.g., three attempts)	35
Connecting to social media	34
Limited time to solve the assignment (a countdown)	33
Having a look in another museum somewhere in the world, through someone else's "eyes"	28
Share your location with other users	24
An overview of which museums your friends visited	19

Table 7.4 Results of content creation through CrowdFlower. The task description and metrics

Content derived from: CrowdFlower
Task: Imagine being a quizmaster and create questions about your favorite museum
Metrics
Time to complete the task: 4 h
Responses: 100, 95 useful
Worker Nationalities: 35
Paid: 10 cents per participant
Number of museums: 80
Questions: 115

content that can be created in a short time and with a small budget with paid crowdsourcing for creating museum related quiz questions (Table 7.4).

7.3.5 Testing with Crowds

Having the design and the content, the next step was to test this with the crowd. UsabilityHub[3] is another crowdsourcing platform that offers several kinds of design tests. At this platform, we earned "karma points" by contributing to others' projects.

[3]www.usabilityhub.com.

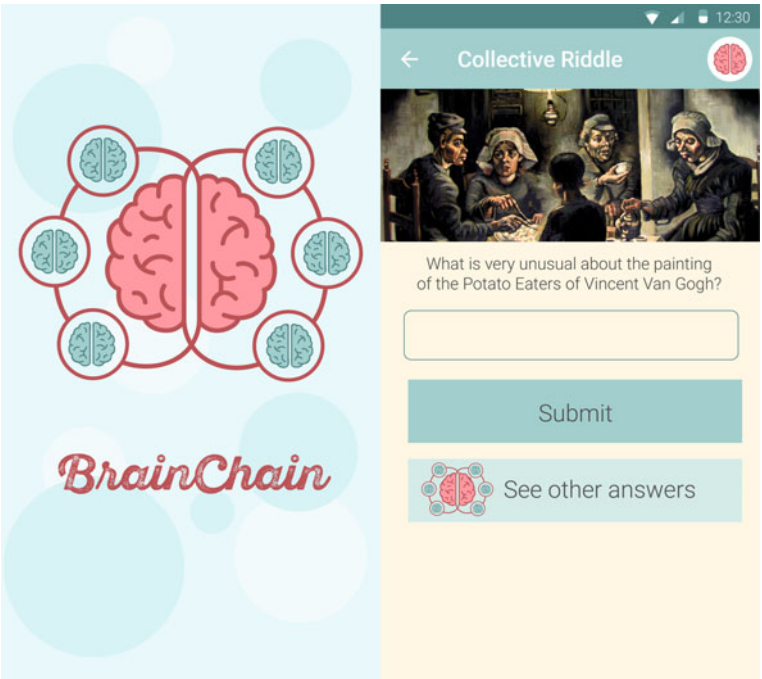

Fig. 7.5 Screens which were checked for usability, focusing on the functionality, and the intention of the application (graphic design done by a worker from UpWork)

Being a worker or a contributor in this sense means filling in questionnaires or participating in preference or flow tests. With the karma points, we could "pay" our own contributors and therefore, were able to stick to our tight budget.

The first test we conducted was a short questionnaire about the design of our app. In total ten participants were asked. The purpose of this test was to find out what people would expect after tapping on a user interface element. The following questions were asked about Fig. 7.5:

Imagine you are going to the museum, where you see advertisements with this picture of a mobile app.

1. *What do you think the application is about?*
2. *What would you expect to happen when you click on submit?*
3. *What would you expect to happen when you click on see others?*
4. *What would you expect to happen if you click on the brain image in the upper right corner?*
5. *Do you have any design recommendations?*

Most workers thought the application was a brain game (5 out of 10) or a museum quiz (3 out of 10). Other responses were that it was to boost imagination or to share expert knowledge. We also asked what they would expect after clicking on

the submit button. The results showed that they expected to see the right answer after submitting it and they also wanted feedback. This is something we did not think about at that stage. Beforehand, our idea was that they would go to the home screen instead of seeing the right answer. The brain icon was interpreted as a way of going to the home screen or to settings. The workers were also asked to give suggestions about the design. The only feedback we received was that the readability of the text in the buttons should be improved.

The second test was a *flow-test* and was also conducted at UsabilityHub. Ten workers were asked to complete the following tasks: *you are going to (1) play an individual game, (2) choose game 4, (3) submit the answer, (4) go back to the main screen, (5) check discount, and (6) go back to the main screen*. The first task was not completed, and this was probably due to the confusing task description. We could have asked them to click on an individual game. For task (3) submitting the answer, they might have thought that they would have had to write an answer, which was not necessary for continuing the test. The lesson we learned from this, is that instructions need to be piloted before asking the crowd workers to participate in the test, as there can be unexpected unclarities in the formulations of the instructions.

The last test was conducted on UsabilityHub. This was a *preference test* with 11 workers. The purpose was to test which logo would better convey the purpose of the app. We provided a short description of the application and then contributors had to choose between two alternative logos (see Figs. 7.4 and 7.5). Ten out of the eleven people chose the current design (Fig. 7.4). The overall time of receiving answers from participants from UsabilityHub was very short: between 10 and 15 min per test.

7.3.6 Prototyping

As a forementioned, the aim of the project was to explore what and how existing crowdsourcing platforms could be used for the development of a Museum app. After designing an interactive prototype in Axure, we uploaded that again in UpWork together with a detailed task description. After one hour, there was a response from a Ukrainian developer who was willing to program a working prototype. Due to our limited time schedule, the programmer had only one day left for programming the application and therefore, he only coded part of the app. Our experience shows that it was easy to find a programmer for a reasonable amount of money. The programmer was paid $58 for about 24 hours of work.

7.4 Discussion

In this study, we aimed to demonstrate that paid crowdsourcing—in combination with input from popular social media networks—is a viable alternative for helping museums to: (1) ideate technological concepts; (2) decide which ideas are best; (3) design the visuals; and (4) develop the content. In our study, we asked crowd workers to contribute to the creation of a Museum app in relation to these four activities. The design process of the BrainChain app unfolded in a short time span of two weeks, carried out by a team of three people plus the different workers in crowd sourcing platforms and with a limited budget of $100. This shows that the four activities can be carried out efficiently by making use of existing crowdsourcing platforms. This is an important finding, as until now museums have engaged with crowds by developing their own platforms (Oomen and Aroyo 2011). Our study shows that it is not necessary to design and develop a completely new platform since existing platforms were used. We expect that the resources and know-how to design novel crowdsource-based systems to engage with crowds can be limited for museums. Thus, our study suggests that to overcome this lack of resources and know-how, museums can use existing crowdsourcing platforms.

Moreover, our study revealed three main learning points about how to make use of existing crowdsourcing platforms to develop an (crowdsource-based) application for visitor engagement. These learning points relate to

(1) awareness of existing crowdsourcing platforms including their benefits and shortcomings,
(2) knowledge of how to use them effectively, and
(3) experience in combining them.

Our case study showed that the right type of existing crowdsourcing platforms need to be found to get started. The existing crowdsourcing platforms differ in their focus (crowd creation, crowd voting, crowd wisdom or crowd funding), their expenses, quality control, and immediacy (Geiger et al. 2012; Scholz 2015). In our case, mainly crowd creation platforms were used for the design and content creation of the mobile application. Although crowd creation platforms related to design contests (e.g. DesignCrowd[4]) often ask for starting fees beyond our budget, low-cost, bid-oriented and yet, immediate crowdsourcing platforms exist as well. These platforms allow crowdsourced workers to improve their skills. For example, in our study, multiple potential workers responded to the design proposal for the Museum app which was posted on the crowdsourcing platform of UpWork.[5] Subsequently, one of the UpWork workers offered to work for free in order to learn and expand her online portfolio. Since her graphic design deliverables of the mobile application exceeded our expectations, we did financially reward her to show our appreciation of the smooth collaboration and the high quality of deliverables.

[4] www.designcrowd.com.

[5] www.upwork.com.

Positive feedback, online reviews or recommendations could also be a reward option due to the value of reputation. We want to highlight that we do not advocate unreasonable, low payment for designers working in crowdsourcing platforms. We merely report our findings which were based in the limited budget and time we had in our hands due the course's constraints. We did observe the need of learning and getting better by practising and at least the designer we found turned to crowdsourcing platforms to fullfil that need. Future work should look more carfefully into how to support that need without financial compromise.

Aside from finding the right platforms, the crowd needs guidance (Dow et al. 2012). The development of the Museum app demonstrated that paid crowdsourcing can be a viable approach for ideating technical concepts, decision making, graphic design, and content creation. Nevertheless, to receive such fruitful design outcomes it matters how the crowd is involved by the initiator. It needs to be clear for the crowd what is expected from them and it needs to be appealing to generate productive outcomes. Therefore, our advice is to let the crowd know that they are part of the application development. In this case study, the crowd knew what the application was about, why their participation was important, and how their input was going to be used. Contributors were triggered as well by playful storytelling. Moreover, a responsive, proactive attitude of the initiator was required throughout the graphic design, because immediate and online feedback on visuals was essential for establishing common ground. When we as commissioners were not able to give feedback on the multiple design outcomes of the UpWork worker, the crowd was asked to make a design decision through crowd voting. Therefore, our advice is to use other platforms when needed to avoid providing vague feedback which could impede the creative process. Throughout the study, we asked the crowd to make a decision which was in turn provided to the UpWork worker. This type of workflows that utilize crowd workers in a chain of events within the design process is also known as crowd algorithms (Bigham et al. 2015). Both approaches of coaching the UpWork worker properly and involving other crowdsourcing platforms for decision-making went hand in hand and thereby, fostered an immediate and fruitful design process.

Aside from the investigation of what and how existing crowdsourcing platforms should be used, our view on the functionalities of the application matured over time, because we became more familiar with crowdsourcing ourselves. The Museum app developed, BrainChain, provides the opportunity for content creation and is regarded as being adaptable to renewed exhibitions due to the content evaluation of the crowd. However, research is still needed to find out how the content can be managed accurately by the crowd without the help of cultural heritage experts. A way to do this is, for example, to let the other users evaluate potential quiz questions, which already happens in the Question Factory of Trivia Crack. This allows for checking the questions on accuracy (Crawley 2015). Therefore, it is possible to let the crowd actively create and evaluate digital museum content as an attempt to enrich the user experience in museums by providing flexibility in modification. Since museum collections can change rapidly, frequent

and perhaps automated content management by the crowd is required for maintaining accurate quiz questions.

By providing the opportunity to add questions to the Museum app, the visitor experience is captured. An added question about an artifact can show where the user has been and how an artifact is perceived. Chapter 12 by Rozendaal, Vermeeren, and Issidorides will elaborate more about capturing the user experience. By conceiving museum audiences not only as museum quizzers but as the creators and validators of museum content, they actively take part in and are part of museum design and content creation processes, as demonstrated by the case of the BrainChain app. Based on this experience, we envision the BrainChain app to be self-sustaining and cost-effective, an example of how paid crowdsourcing can be fruitfully employed in other museum experience design projects.

This process also enabled us to further develop our views on the importance of strengthening interconnections between audiences and museums and to enhance visitors' engagement. In this case study, we wanted to create a mobile app by the crowd for the crowd in order to enhance visitors' experience. As written by Csikszentmihaly and Hermanson (1995): *"... one of the major underdeveloped functions of museums is to provide opportunities for individually meaningful experiences that also connect with the experiences of others.*" In our study, this idea of being connected to the experience of others is reflected in the functionality that all people are contributing to the collective quiz questions of BrainChain. By taking part in (e.g., being a gamer) and being part of (e.g., contributing to the content creation) the BrainChain app is envisioned to go beyond the usual visit by conceiving museum experiences as interconnected through the contributions of crowds not tied to the proximity of a single museum. Such an approach could even go beyond local communities and single museums, e.g., it could be applied for constellations of different cultural institutions connected through the interpretive acts and creative activities of diverse crowds. Thereby, such an approach could potentially contribute to people's international museum experiences and would go from museum experience design focused on a single museum to an approach that fosters connectedness across multiple museum audiences and even multiple museums (Shih et al. 2016).

Museums may face challenges about how to keep the visitors engaged and how to let the visitors contribute to content creation. Paid crowdsourcing is an alternative to marketing oriented social media and limitedly scalable (local community) attempts for developing technology that is adjacent to the main collections and enhances visitor's experience. We believe that digital crowdsourcing media are likely to foster greater public engagement. However, in our study, we could not investigate in depth the potential for increased public engagement, and therefore, we suggest that this is an aspect to be validated by future research.

Furthermore, we acknowledge that it is yet unknown whether museums themselves are able to undertake such a design process. The desirability and capacity to engage in similar design processes still needs to be evaluated within the remit of specific museums. However, we hope with this chapter to contribute to the proliferation of such usage. An important lesson learned from our study is that while

experimenting with existing platforms we (as a design team) experienced that our role shifted from being designers toward being facilitators of design, which required changing our mindset (Radice 2014). Although we were in control as facilitators, to a certain extent direct control was given to the crowd to make design choices about BrainChain, especially when we did not have the answer. Facilitating a design and development process rather than having the expertise to actually perform it might better suit museum employees. Prior research has shown that when involving "unwitting participants" contributes to inspiring technologies that cultural heritage experts could not think themselves (Díaz et al. 2016). In essence, crowdsourcing affords the entry of a limitless pool of "unwitting participants" in the domain of museum experience design.

7.5 Conclusion

Paid crowdsourcing is relatively unexplored as being an effective and efficient approach for participatory museum experiences. The case study of BrainChain, which we reported in this chapter, shows how paid crowdsourcing can be a method for museums, not only for ideation, design, and software development but also for content creation. Our experience shows that during this process our role shifted from designers to facilitators of the design process. All throughout, crowd workers needed both clarifications and feedback, which implies as well that the overall process can be time-consuming. Future facilitators of such crowdsourced design processes should take into account that it does take time to review the crowd input, however, acknowledging as well that the crowdsourcing process has the potential of becoming self-sustaining. Furthermore, providing emerging digital technologies for crowdsourced Museum app content is likely to create opportunities for visitor engagement in more rewarding participatory museum experiences and provide new avenues and models for community building around museums. Using paid crowdsourcing means reaching out to people way beyond the museum walls and potentially to people from all over the world.

While crowdsourcing platforms differ in their costs, quality control, and immediacy, decent content creation is mainly dependent on how the crowd is involved. Future research is needed to cover the subjects of incorporating accurate adaptability in crowdsourced content creation and the peer review mechanism, the (software) development of the application itself and the evaluation of the application in the context of use. Finally, although existing crowdsourcing platforms could be used in their current form to support design and technical activities in museums, future research can also look into the development of specialized crowdsourcing platforms that exclusively focus on museums and cultural heritage institutions.

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Appendix 1 Quiz questions provided by Crowdflower workers (in bold the right answers)

#	Museum	Question	Answers
1	Philippine Museum, Manila	Who made the Spoliarium?	**Juan Luna**
			Luna Juan
			Picasso
			Dali
2	Indian National Museum, NewDelhi	How many art pieces does this museum have?	**200,000**
			250,000
			100,000
			500,000
3	Paschendale 1917, Zonnebeke, Belgium	What is the museum about?	**Fight of Paschendale**
			Victory of Paschendale
			Loosing of Paschendale
			Constitution of Paschendale
4	National Historic Museum, Sofia Bulgaria	Who made the Samara flag?	**Nuns**
			Soldiers
			Wife
			Themselves
5	National Historic Museum, Sofia Bulgaria	How many Items you can find in the museum?	**650,000**
			100,000
			1000,000
			500,000
6	Salarjung Museum, Hyderabad	What is a talking clock?	**English bracket clock**
			French Clock
			Russian Clock
			German Clock
7	El Prado, Madrid	In which century Madera made Las Meninas?	**17th**
			16th
			15th

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			18th
8	Musei Vaticani, Roma	On which myth is Laocoon and his sons inspired?	**Trojan Wars**
			Heracles and Heracleidae
			Argonauts
			House of Atreus
9	Louvre, Paris	Who painted the Mona Lisa?	**Leonardo da Vinci**
			Rembrandt
			Dali
10	Louvre, Paris	How many works are exhibited?	**35,000**
			20,000
			15,000
			45,000
11	Cappella Sansevero, Napoli	Who sculptured the Veiled Christ?	**Giuseppe Sanmartino**
			St. Antonio
			Davor Salhi
			Michelangelo
12	MoMa, New York	Who painted the girl in front of a mirror?	**Pablo Picasso**
			Dali
			Van Gogh
			Karel Appel
14	The museum of vintage ladies dresses, Kiev	When is the first lace parasol created?	**1772**
			1872
			1672
			1972
15	Victoria, Kolkata	Who is the architect of the museum?	**William Emmerson**
			Jean Paul Gaultier
			Henry Berkeley
			Anthony Lake
16	Athens Museum, Athens	Are all the statues in the museum complete?	**No**
			Yes
17	Museum for physics, Brussels	Where is this the Iguanodon found?	**Bernissart**
			Anvers
			Brussels
			Liege
18	Imperial Museum, Janeiro	Which year the museum starts their historic collection?	**1943**
			1843

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			1899
			1950
19	Kiev Museum of Russian art, Kiev	When is Boris and Gleb painted?	**14th century**
			13th century
			15th century
			16th century
20	Museum of Macedonia, Skopje	Which artifacts are from Kokino?	**Cans and Jars**
			Plates and cutlery
			Pots and pans
			Jewelry
21	Ancient Museum, Thessaloniki Greece	What flag symbol had the ancient Macedonians in Greece?	**Vergina Sun**
			Vergina Moon
			Dorgina Sun
			Dorgina Moon
22	Hagia Sophia Museum, Istanbul	What do the mosaics reflect?	**Christian Iconographics**
			Islamic Iconographics
			Jew Iconographics
			Hindu Iconographics
23	Reina Sofia, Madrid	What type of art is in Reina Sofia?	**Modern** and **Contemporary art** Renaissance
			Midevil
			Bauhaus
24	Victoria Museum, Vijayawada	Who is the founder of the NIZAM Dynasty?	**MIR QAMARUDDIN Khan**
			Mir Ahmed Ali Khan
			Mir Hidayat muhi udin
			Mir Said Muhammad
25	Rijksmuseum, Amsterdam	Who Painted the “Nightwatch”?	**Rembrandt**
			Van Gogh
			Karel Appel
			Mondriaan

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