Scaffolding Workbook to faciliate Movement-based Design Methods in Educational Setting

A case study

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Abstract

The way in which humans interact with technology is moving beyond traditional screen-based gestures of tapping and swiping. Consider the interactions with technologies like AR, VR, interactive light projection, or voice-based interactions with a smart speaker. The fields of sports technology, robotics, human-computer interaction (HCI), interaction design (ID) along with many others are readily incorporating design methods that help in crafting interactions for a wholistic bodily engagement of a user. In this thesis, we refer to such design methods as Movement-based Design Methods (MbDMs). In this thesis, we aim to help student teams adopt and work with MbDMs in an educational course setting. We explore the existing difficult areas in the educational setting that uses MbDMs. And build a low-tech tool in the form of a Scaffolding Workbook which caters to the facilitation needs of student teams during practical session of two MbDMs – Embodied Sketching and Experience Prototyping. We highlight the need of creating such tool, its influence on practices of the classroom and the process of creating the workbook, that can be used by future studies to create similar tools focused on improving the adoptability and execution of MbDMs.

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Chapter 1
Introduction

The increasing technological advancement of ubiquitous and pervasive technologies, like AR, VR, ubiquitous computing etc., has given rise to a number of products and services in our everyday lives that require bodily movements to interact with it. In this new wave of digital transformation, the way users interact and use the technology has gone beyond the traditional screen-based, GUI (graphical user interface) applications responding to swipes and taps to a more wide-ranging body-based interactions [1].

In the research field of HCI (human-computer interaction), which examines, researches, and designs interactions between humans and technology, it is referred to as the third wave of HCI [2]. In addition to the previous waves that focused solely on ergonomics and efficiency, this wave embraces a broader inclusion of human values, experiences, situated knowledge and meaning making [1], [2]. Thus, emerges the approach of movement-based interaction design that places heavy value in focusing on movements, sensorial qualities and lived cognition of a human body. This has meant for the HCI and interaction design (ID) practitioners to pay closer attention to the body experiencing a context and consequently bringing the bodily movements in the design process, through what can be understood as movement-based design methods (MbDMs). These methods are based on an embodied approach to designing where the body, its movements and its lived cognition play a central role. This in turn creates better *"conditions for technology-mediated human experience"* [3].

As the merits and application of these methods soar amongst the academic and industrial circles within the field of interactive technology, sports technology, robotics, and other similar fields, it becomes imperative that future designers engage and learn to work with these design methods. Researchers have made different tools and frameworks available in the movement-centric design sphere to help other practitioners adopt, execute, and analyse MbDMs. As discovered in the later chapters, these research works are aimed to inform mainly a practitioners' own use of MBDMs without illustrating the education aspect in detail. Only a limited number of research work is found to exist around the education of these methods that sheds light on teaching practices, and effective techniques that help student designers build knowledge around MbDMs.

This thesis explores the educational paradigm that employs MbDMs in order to find and learn about different ways in which working with these methods can be enhanced. By combining the insights from literature and practice we develop a novel, low-tech solution useful in the facilitation of MbDMs in a classroom setting. This is illustrated with two examples. Through the design and evaluation of the proposed solution we shed light on the aspects that require improvements in making these methods more approachable for novice designers.

1.1   Background

This project is aligned to the premise of a larger project of MeCaMInD (Method Cards for Movement-based Interaction Design) [4]. The MeCaMInD project is a partnership program across 6 European universities with the goal to develop method cards for movement-based design methods. The goal as stated on the website – *"The Method Cards for Movement-based Interaction Design (MeCaMInD) project explores how we can make a navigable and actionable method card toolbox in the fields of interaction design and sport & movement. MeCaMInD also focuses on disseminating the insights of the toolbox to students and design professionals across disciplines, as well as providing a greater understanding of how to create and enhance a movement-based creative design environment."*

One of the goals of the MeCaMInD project is to create a toolbox of methods useful in different fields. Another major goal is to make the knowledge and insights of the toolbox more understandable and accessible. This thesis is aligned to the latter goal. We investigate ways to enhance the movement-based creative processes within an educational setting for educators and/or learners. We primarily work towards making the MbDMs more approachable and accessible for student teams in an educational setting.

1.2   Thesis goals

In this thesis, we aim to enhance the experience of educators and/or students when working with MbDMs in an educational setting. To achieve this, we first explore the different areas related to MbDMs that are difficult for learners and educators. This exploration is done in two phases. First, we build a theoretical foundation of the several MbDMs as well as different adaptations in a classroom setting from the relevant literature. Then, we complement this knowledge with primary research consisting of real-world experiential feedback from educators as well as learners. In this stage of the thesis, we focus on locating any pain-points, inefficiencies, or improvement areas either in education or execution of MbDMs. Afterwards, we operationalize the obtained knowledge to create an intervention to enhance the facilitation in the practical execution of a MbDM for student teams. In this thesis stage, we learn about value addition of our proposed solution, its shortcoming, and the resultant influences on the practices of students and educators when executing a MbDM. Our efforts are directed to answer the following research questions-

Research Question 1
What are some difficult areas for learners and educators related to MbDM in an educational setting?

Research Question 2
What might we create to enhance the facilitation or education of MbDMs in an educational setting?

Sub Research Question 1
What are the influences of the designed intervention on the practices of learners and/or educators when executing the MbDM?

1.3   Approach and Structure of the Thesis

We approach the goals of the thesis by following a design process similar to the Double Diamond methodology [5]. Popularized by the British Design Council in 2004, the methodology is readily used by professionals and experts to create solutions for a variety of complex problems. It is comprised of two distinct phases that correspond to the two *Research Questions (RQ 1 & 2)* of this thesis. The first phase focuses on creating a deep and wide understanding of a challenge/problem whereas the second phase includes developing and validating design-led solutions [6].
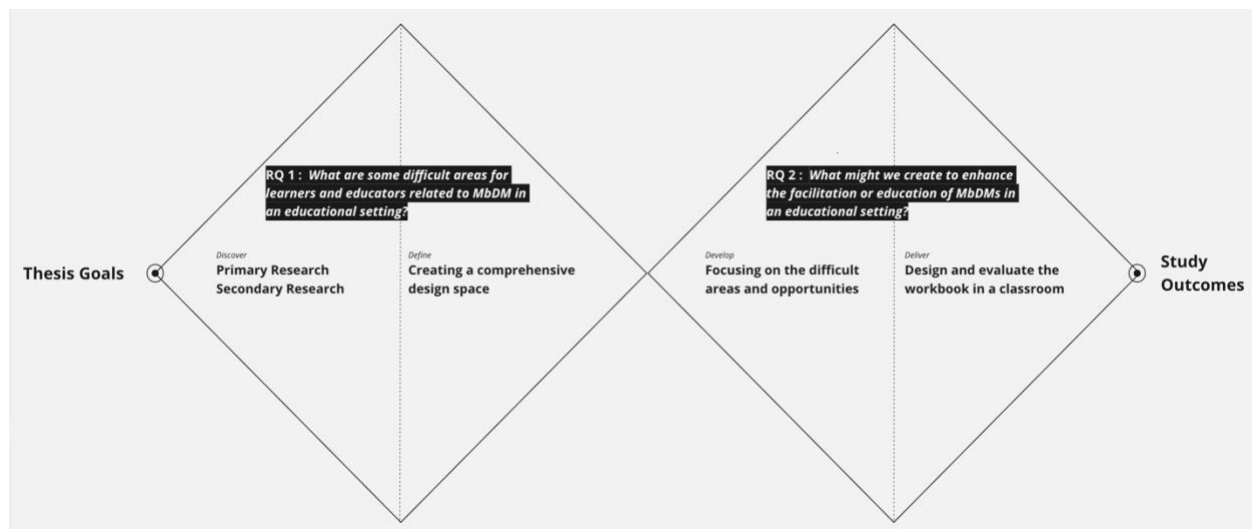
Figure 1: Approach of the thesis

The **RQ 1** correspond to the first phase of creating a thorough understanding. In this phase, we learn about the educational settings that employs MbDMs and associated difficult areas for educators and learners. In **Chapter 2,** we first begin by formulating a foundational knowledge of various MbDMs and the different kinds of skills needed from a practitioner, as mentioned in the literature. In **Chapter 3**, we look at the use of MbDMs in the educational setting. We review the relevant literature and learn about various adaptations, teaching practices, and challenges for educators and learners. Furthermore, we complement this knowledge by real-world insights obtained from an Expert and students previously experienced with MbDMs. We then, link all

three sources of information to construct a design space relevant for this thesis, consisting of difficult areas and opportunities for both educators and learners.

The **RQ 2** correspond to the aforementioned second phase of developing and validating design-led solutions. In **Chapter 4**, based on the created design space, we explore potential design-led solutions. And finally present a *Scaffolding Workbook* that aims to help student teams to get started and navigate executing a MbDM. In **Chapters 5 and 6**, we design two workbooks for two MbDM – Embodied Sketching and Experience Prototyping and validate its use in a real-world educational setting.

In **Chapter 7**, we present discussion on the methodology followed in the thesis, merits, and demerits of the *Scaffolding Workbook* along with contributions and future work. In **Chapter 8**, we conclude the findings obtained in the pursuit of the research questions mentioned in section 1.2.

Chapter 2
Understanding Movement-based Design Methods

The contents of this chapter were developed in the Research Topic phase of this thesis. In this chapter we explore the different kinds of movement-based methods as found in literature and build a foundational knowledge required for this thesis. Based on the found literature, we categorize the methods as per the skills required from its practitioner. This serves as the base for building further knowledge and a useful anchor before we learn the different adaptions of MbDMs in a classroom setting and view the related practices from the lens of two different users – educators and students.

Svanæs and Barkhuus [7] uses the term *body-centred design* for the methods which use understanding of the body (users' or designers') to create design artifacts which are a *part* or *whole* of the solution. Andersen and colleagues [8] defined the *movement-based design methods* as the "*techniques, procedures or tools that contain bodily movement to stimulate the designers experience, understanding, or creativity within the design process*". Although with some differences, a shared agreement in all these practices is about the use of body and its movement to explore, create and evaluate interactive experiences. Below we summarize and describe several movement-based design methods (MbDMs) and present a categorization based on a practitioners' point of view.

2.1   MbDMs in HCI & ID

The growing interest in designing from and for the human body has led the researchers in HCI, ID and other related fields to develop an array of diverse design approaches. These approaches rely on the involvement of the body during the design and evaluation process. It requires designers to work with physical movements for the purposes of understanding ones' own bodily gestures and movements, gain understanding of users' movement and context through enactment and role-playing, and for communicating ideas and findings. In doing so, the moving body becomes a part of the design material for producing, exploring, and assessing design concepts [3], [9]. Inspiration of these methods and techniques has been taken from many different fields such as dance, theatre, somaesthetics and art practices etc.

2.2   Types of MbDMs

An elaborate collection and classification of 23 MbDMs is be found in the research paper [8] where the methods are arranged based on the *"(1) seven sub mediums that stimulate, form, or catalyse movement and (2) the type of design stage for which the movement will gain insights"*.
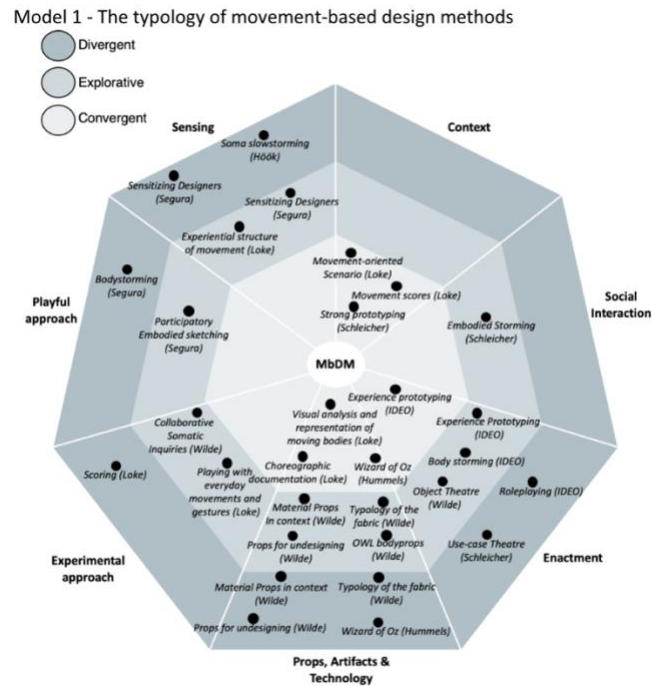
Figure 2: Typology of 23 MbDMs based on different stages [10]

In the process of understanding what each method entails, the execution practices, and possible outcomes; a distinction emerges between methods that help a designer focus on his own personal subjective experiences and feelings versus the ones that help him empathize with others'. This kind of demarcation is better explained in the framework presented by Svanæs and Barkhuus [7]. They present a framework of understanding MbDMs by bringing a designer's attention to point of view (1st, 2nd, 3rd person perspective) and tense (past, present, future). It describes different ways a designer can articulate, analyse, and evaluate the relation to their own and others' bodies. The three perspectives based on the point of view are [7, p. 10]-

1. *"Accessing one's own bodily user experiences through somaesthetic reflection (1st person).*
2. *Gaining insight about the bodily experiences of the users through kinesthetic empathy (2nd person).*
3. *Being a detached observer to oneself and the users (3rd person)."*

In the first-person perspective, the designer is focused on understanding his own bodily sensations and movements within (or out) of context of use. The emphasis is on drawing out a individuals' experience of their own feelings and bodily movements for the purposes of generating, reflecting and evaluation in the design process.

In the second-person perspective, the designer's attention is moved away from themselves to others' movements. The designer works with another person(s), a co-designer or a user, with the intention of empathizing with another persons' bodily movements. This ability to feel other person's movements and experience it through observation is termed as *kinesthetic empathy*

[7]. This can be achieved by either mimicking, sharing an artifact, a movement, or an idea with others [10].

In the third person perspective, the focus is no longer on empathizing with own or other persons' movements but to step back and create a distance to the body. In this perspective body is viewed as an object. The designer may observe a video recording of another person moving or view his own movements in the mirror for the sole purpose of analysing and improving the qualities associated with the movement. Different from the first two perspectives, it is an analytical approach to observing one's own or others' movements.

2.3 A Designer's bodily skills: 1st person perspective methods & training somatic sensibilities

The phenomenological stance by the French philosopher Merleau-Ponty, that the human body is a *lived body* has been the foundation of many works related to movement-based design [3], [7], [11], [12], [13]. The lived body is an amalgamation of past experiences, emotions, sensations, and interactions. Several design methods and practices foreground on a designer's body and movements as a resource to empathize, create and evaluate design artifacts. Many new insightful solutions can be achieved by placing a designer's rich and diverse *lived experience* at the core of the process, which otherwise may not be achievable by only cognitive approach [7], [12].

1st person perspective Methods
Embodied Sketching is proposed in [14], which is an activity-centred approach to ideation in which movement and play methods are used early in the design phase to not just ideate but to expand the design space from the very beginning of the design process. Designers are engaged in physical and playful activities to amplify their creativity and exploration capacities. Loke and Robertson [15] presents method of estrangement in *Moving and Making Strange,* where disrupting a habitual movement, for e.g., moving with eyes closed, brings a shifted awareness in spatial and temporal understanding of a designer. This changed awareness in their bodies leads them to uncover new insights. Wilde and colleagues [9] also uses *estrangement* to disrupt the *habitual* with the use of props, materials, and technology in *Embodied Ideation Methods*. By examining each participants' subjective experience with the *disrupted*, they provide a framework that helps bring the implicit felt qualities of embodied ideation methods into language.

Training the designers' skills
Hummels and colleagues assert the importance of *"designer as the movement expert"* and lists several guiding principles to develop a movement-based interaction [16]. In the recent past, a number of methods emerged with the sole purpose of enhancing the observational and reflection capabilities of designers on their own experiences. The intention remains that deepening the understanding of their own body and movements, a designer is better able to illicit the functional as well as experiential understanding of potential users' movements in an

interactive space [3]. As noted by Loke, there are things known and felt in the body which may be hard to visualize or articulate but can be easily explored and expressed through movement and touch [3].

Somatic approaches to train designer's skills

Loke and Schiphorst [17] notes that the trend in the design research in HCI over 20 years has seen rapidly growing interest in practically engaging with what they termed as somatic sensibility. Somatic sensibilities are concerned with reflecting on the lived experience of one's body through intentional observation and reflection on the sensorial qualities of the experience. It is an approach to design that stresses on the first-person felt experiences of the body to be central for creating, experiencing, or evaluating an interactive system. Researchers have mentioned several exercises to build and raise one's somatic sensibilities. These somatic exercises mainly involve directing a designer's attention inwards to their own bodily processes like breathing or moving. Methods like slow walks, Feldenkrais exercises in which a facilitator verbally guides a designers' attention inwards to their body's movements, help designers to reflect on their own experiences. In doing so, they are trained to regulate their awareness and are better equipped to acknowledge, articulate, and analyse much more nuanced components of movements.

"More and more interaction design is incorporating values of self-observation, auto-ethnography, somaesthetics and first-person perspective in the design of public, personal, social and everyday technologies. Somatic body-based practices train awareness of self and environment through directed attention to bodily sensing, feeling, and moving. This self-inquiry at the heart of somatic provides a rich experiential ground from which to understand and empathize with the experiences of others, the people for whom we design." [17, p. 1]

Soma slow storming is one such method by Höök, that places emphasis on a slow and thoughtful state of mind when interacting with a prototype [12]. Designer first engage in a mindfulness practice like meditation or yoga to attain a more relaxed state. The heightened senses then lets them reflect deeply on their interactions with the prototype. In the method *Collaborative Somatic Enquiry*, designers first do a mindfulness practice that brings their awareness in tune with their bodies. Then by moving silently in pairs they reflect on the qualities of their own movements in relation to one another [9]. Qualities here mean how smooth or jerky an action was instead of the action itself which can be reaching or grabbing.

2.4 Empathizing with other's bodily movements: 2nd & 3rd person perspective methods

This kind of MbDMs are based on a designers' *kinesthetic empathy.* The designers engage in a movement-based activity with others with the purpose of ideating, creating, evaluating a design problems or solution within or out of context of use.

Oulasvirta and colleagues [18] use a method called *Bodystorming* to design for ubiquitous computing. In this method the design team moves about and performs typical actions within the context of the design problem. The authors mention that bodystorming allowed a better understanding of social, physical as well as interactional factors within a context that otherwise are not easily apparent in a traditional ideation session. They also remark that the bodystorming sessions were more effective in idea generation as well as were more memorable for the designers than a traditional office-bound brainstorming session.

In the *Experience Prototyping* method, designers engage in role-playing, improvisation and bodystorming within the context of use in order to understand, explore and communicate design ideas [19]. In this approach the designers' experiences of real or imagined activities and the resultant artefacts are given priority. The authors say that "*The vividness of this owned experience creates subjective, lasting memories which influence and guide the designers' choices and decisions throughout all stages of the design and development process*" [19, p. 4].

Enactment has been used as a medium in different methods like *Object theatre* [9], *Use case theatre* [20] and *Strong prototyping* [20]. All these methods provide a way for the designer to envision alternate futures in the pursuit of exploration of ideas or evaluation of prototypes. By personally stepping into an imagined scenario and user movements, they are in a better position to produce knowledge and insights of the problem they are designing for.

2.5   Discussion

While some researchers focus on developing the movement skills, highlight the importance of designers becoming movement expert, bring focus to the designers' and users' bodies as a creative tool to invent as well as assess experiential and sensorial qualities of an interaction. Others focus on providing frameworks for representation of movement, exploring mapping of interactions, and evaluating the user experience. This project focuses on the former and in this chapter creates a knowledge base by studying the various kind of methods that could be supported in an educational setting. When exploring the different MbDMs, it became apparent that while having existed for over two decades it is still an evolving area of work. The characteristic involvement and study of movements in MbDMs, uncommon in other prevalent design education, can make it daunting for beginners such as design students. The framework presented by Svanæs and Barkhu provides a useful outlook on understanding MbDMs for someone just starting out and is a useful aspect to be included in our designs [7]. MbDMs are a unique combination of requiring sensing (one's own and others), feeling (from past, when placed in a context, empathizing), and doing (creating based on imagining future movements) from a designer. This might not lend itself as an easily adoptable design tool to a beginner without sufficient guidance and presenting it as a breakdown of its many components.

Chapter 3
Finding out the difficult areas for learners and educators

In this chapter we investigate the use of MbDMs in educational paradigm to find answer to the Research Question 1- "What are some difficult areas for learners and educators related to MbDM in an educational setting?". We begin by reviewing the literature on the use of MbDM in an educational setting. The theoretical knowledge is then complemented by real-world insights gathered directly from an expert as well as students having prior experience with MbDMs. We then combine the themes identified from literature and primary research, with both set of users, to produce a comprehensive design space for this project. In the following chapters, knowledge obtained here is frequently referenced to make important design decisions.

3.1   Review of literature on the use of MbDM in an educational context

In literature, educational courses employing the MbDMs differ in terms of teaching practices, course structure, stage of the design process at which MbDM is included and its intended learning purpose. MbDM is employed in a classroom for many reasons such as to study and understand the role of movement and its qualities as a design material, learn to channel one's own somaesthetical experiences through movement and translating it into a design concept; or simply engage with the MbDMs to evaluate their design solutions. In this chapter, we get a closer peek at the approach to teaching MbDMs in educational settings and report of few challenges along with some recommendations from educators.

The research papers ([21]–[28]) analysed in this section, offered a wide range of interesting student design work, different ways of adapting a MbDM and valuable insights and observations from different classroom contexts. Although there were many differences in the way a course is structured, organized and its intended goals, a good number of similarities came across in the course format, teaching challenges, composition of student cohort and shared view on the role of students' somaesthetic appreciation in a design concept.

3.1.1 Course format

In most cases, format of the course was based on an *art studio culture*, where design critiques and supervised project work play a much larger role than lectures [25]. This kind of setup puts emphasis on hands-on learning which strengthens a student designer's creative and reasoning ability through constant observation, creation, reflection and defending their designs [21], [25], [11]. Another common feature was that most of these works, that centred around educational setting, were within the realm of HCI and ID (more specifically tangible interaction design). Almost all the works share accounts of a postgraduate educational setting except one by Martin and Roehr [23] which shares accounts of an undergraduate course.

3.1.2 Couse Composition: Students educational background

All the works report a highly diverse education background of the students in the classrooms. It could be a direct consequence of these papers primarily written by HCI and ID educators where a cohort is typically made up of students with background in technology, design, philosophy, engineering, and psychology. Although, all authors agree that having a diverse student team has many advantages like each person bringing a unique set of skills, variety of field specific lenses to inspect a problem or a solution, range of individual creativity, variation in peer critiques and learning from each other's practices. Tsaknaki and colleagues mentioned that this variety in audience makes teaching a particularly complex task as it should be aimed at a heterogenous group with different comprehension capabilities [28]. They also mention that design practices like soma design, which focuses first on experiencing, feeling, and employing a first-person perspective, clashes with most students' prior design knowledge based on more prevalent design approaches commanding one to first understand the problem, ideating, prototyping, and testing to arrive at a final solution [28].

Lundgren and colleagues advocates the benefits of heterogenous groups [22]. They express that various design exercises, ranging from technical to aesthetic, require a balanced approach that can be easily attained in a team with diverse background. Therefore, they promote formation of a heterogenous student group, based on their diverse backgrounds and self-expressed skills. Another observation mentioned in their work *Teaching Interaction Design*, is that the abstract and vague nature of the open problems (typical in interaction design) tends to frustrate the students mostly with engineering backgrounds, as they are used to set boundaries of right and wrong [22]. The authors report that this particular issue can be resolved with periodic supervision and directing the students' attention to the free nature of the project.

3.1.3 Teaching MbDM: Emphasis on first person reflection of students

While many papers do not include details of the practical session and experiences of students and teachers in a MbDM activity context. The research paper by Erkut and Dahl [27],[29] and Tsaknaki and colleagues [28] briefly elaborates these in helpful details. Despite differences in activities, design exercise and final design concepts, all the three works focus on developing a first-person somaesthetic appreciation in the student designers. In these course setting, students engage in many different movement exercises in order to learn to perceive and reflect on the movement qualities by bringing their awareness to their bodies (soma).

Following movement exercises are mentioned that helped student designers to develop a first person somaesthetic appreciation –

1. Walking: *"through wide or narrow door openings"* [29]; *"playing with spatial design, changing directions, tempo and interactions"* [27]; *"slow-walking in the forest"* [28].

2. Breathing: *"see-saw breathing"* [28]*;" focusing on the rhythms, duration and pauses of the breath, moving body parts or eyes with the breath"* [27].
3. Working in pair: *"contact-improvisation and leading and following"* [28] *; "choreographing a fight scene, using objects and hands touching"* [27].
4. Focus on quality of movements: *"isolation of the body parts, imagining and performing moving as being, made of or in oil, sticks, bee, smoke, and mud (and observe how they change the movement qualities of self or others)"* [27]*; "Feldenkrais exercises, making the familiar strange"* [28].

Along with undergoing the movement activities, students also learn theoretical knowledge in lectures, by reading scientific literature and engaging in classroom discussion. In these works, it is reported that the final design concepts by the students demonstrate rich somaesthetical qualities with nuanced qualities of movements and subtle interactions [12], [13], [28].

An interesting observation pointed out by Erkut and Dahl [27], is that the final design outcomes are influenced by not just students' movement skills they learn in the course but also by their own experiences with movement activities. The design concepts that had frequent references to nuanced qualities of movement were made by students who had a prior background in movement activities like dance, tai-chi, and mixed martial arts. They do however remark that direct effect of this is difficult to assess and reports comparisons where student with similar movement backgrounds had difficulty in achieving the same aesthetic and kinesthetic appreciation. Tsaknaki and colleagues [28] also mentions that the somaesthetic appreciation relied on many factors and one being if *"students engaged in similar processes by themselves"*.

3.1.4 Creativity enhancing exercises

Apart from regular design activities, all papers seem to unanimously agree on the inclusion of small exercises at the beginning of a practical session to enhance creativity of the student designer. The educators in [23] introduces a weekly exercise called Tiddles, a 15-minute hands-on exercise; involving play-doh, Lego, paper, clips etc; before each lab or class that requires students to engage in fun, playful exercises. Such exercises were reported to not only help spur creativity in the students but also allowed teachers to draw students' attention to aesthetic and functional qualities of a design. To liberate a students' creative inhibition, fears of working with material and constraints of viability, Tsaknaki and colleagues conduct a small exercise in which they prompt students to provide solutions to a "ridiculous request" [28]. Students were encouraged to imagine any possible solution not necessarily functional, to not question and reflect too much on their ideas.

3.1.5 Educators' Suggestions

Tsaknaki and colleagues [28] reports that the students found it difficult to integrate their experiential learnings (which they arrived at by doing various soma exercise like Feldenkrais breathing, slow walking, contact improv etc.) to the overall design concept [28]. The authors

connect this to a known challenge of the soma design process in which documenting a soma experience is difficult but equally important to refer to during the design process. The authors also exclaim that the students should be assisted in extracting and abstracting insights, from the theory as well as the movement exercises, that feed into the next design activity. Another challenge mentioned is the need for repeated return to the soma experience that the students aim for in their design concept – "*We should have encouraged our students to do the body works they found interesting repeatedly, to keep the experience as a common thread throughout their work*" [28]. The authors also wonder about the suitability and effects of introducing fast, fun exercises as opposed to slow exercises, based on the project brief. The richness of interactions shown in the student design concepts encourages corresponding educators to include an even more *substantial experiential component* in their next iterations [27].

3.1.6 Evaluation/Assessment Criteria

Many educators mentioned the challenges associated with evaluating an interaction design work [23], [25], [29]. The heterogenous nature of the student group sometimes meant that the grading expectation was that of an engineering course where goals are clear, and assessment is objective as opposed to assessment in a design course that is assessed through critique, dialog, and considers the *rigor of process* in addition to success of the result [25]. They also point that sporadic, smaller interactions that do not command full attention are often unjustifiably ignored in the evaluation. Martin and Roehr also brings up the challenges of coming up a fair rubric to value creativity of the piece, attention to detail and quality of the report as opposed to simple submission of the deliverables [23]. Other authors offers resort to these issues. They use the learning outcomes set at the beginning of the course as the evaluation rubric to provide transparent feedback [27].

3.1.7 Reflection

The quantity of literature on teaching/facilitating MbDMs in an educational setting was found to be quite limited. It is also noteworthy that the papers reviewed in this section did not focus on providing explicit and detailed accounts of working with MbDMs but more on providing observations and learnings on the overall course activities by highlighting outcomes in student design work. A key insight uncovered in this section is that the composition of a classroom plays a key role in determining the educator's efforts in curriculum formation, deciding the teaching style and various course activities. Also, the educational as well as extra-curricular background of a student becomes an important factor that influences their performance and engagement in such courses where MbDM is employed.

It was also found that these papers did not report students' perspective while working with these methods. Few observations of student behaviour and challenges they faced are presented through an educator's lens. This is a significant piece in forming an overall comprehensive understanding of improvement areas in MbDMs education. The brief number of insights on the challenges of working with MbDMs gauged in this section, were insufficient to

draw conclusive direction and hence was followed by primary research with students and educators in the upcoming sections. The learnings on the course format, structuring of a practical session, activities involved in execution of a method served as seeds of the queries/ discussion with the educators and learners in the next section.

3.2 Real-world insights from The Expert

In the previous section, the insights were mostly generalized without delving into the pain-points of the either of the users (students and educators) in depth. In this section we gather feedback from an expert to inform our view on the educators' pain points and challenges when working with MbDMs in an educational setting. The cohort of MeCaMInD is filled with individuals that are high achieving researchers who also teach university level courses. Therefore, we invited one of the MeCaMInD experts for qualitative research. Two other researchers from the cohort reviewed the survey and gave feedback and supplied additional questions for the interview. Unrelated to the cohort, a third researcher also answered the same survey later on, giving opportunity to use it during the reflection phase of the project (sec 7.3).

The research consisted of an open-ended survey followed by a semi-structured interview. The main goal of the survey and interview was to –

1. Explore an instructor's POV and assess the areas particularly in education/ facilitation of MbDM, that are challenging or unnecessarily bothersome.
2. Recognize the practices, techniques or factors that result in a smoother adoption and execution of a MbDM within the classroom setting.
3. Learn about any intervention opportunity that improves the education/ facilitation of MbDM

3.2.1 Method

Setup

A survey in an Excel format (Appendix A) was shared with the expert via email. After receiving their response to the survey, they were invited for a follow-up interview with the student researcher and supervisor of this project. The interview followed a semi-structured approach (see Appendix B for prepared questions) and lasted for about 60 minutes.

An ethics approval with reference number RP 2022-24, was obtained from the EEMCS faculty at University of Twente (UT) to conduct these interviews.

Interviewee

The interviewee is an experienced researcher and an active member of the MeCaMInD cohort. They are also involved in teaching a number of MbDMs in master's level university course of Embodied Interaction, where students learn and engage with MbDMs first-hand to design a solution.

Data Collection

We used the survey responses to come up with questions and themes for further exploration in the interview. A list of questions was prepared in advance containing feedback and revisions from two separate subject experts, see Appendix B. During the interview, the data was collected in form of notes which were later compared and reflected upon to form a shared understanding of the most notable themes, issues, and opportunity areas.

Data Analysis

The survey as well as the interview responses were analysed using thematic analysis.

3.2.2 Findings

This section comprises of the main findings of the survey and interview with the expert. Findings from both are combined into broader themes. The relevant themes are presented below and cover the topics of typical challenges the students face when working with MbDM, various signifiers of student knowledge and distinctive skills exhibited by strong students.

Classroom setup

This section presents the usual classroom setup of the courses (co-)instructed and/or facilitated by the Expert. It is included in the report for the purpose of providing a fair reference point to the reader. The expert's classroom followed a *flipped classroom setup,* where students learn more by hands-on exploration and discussion than relying on direct instructions/lectures. While that was the case, their knowledge building was further supplemented by teaching activities that covered different aspects related to MbDMs, such as –

1. Hackathon sessions to sensitize students towards different available technologies. And towards materiality of non-technical objects that can give rise to different kind of sensations.
2. Lab sessions on Laban analysis, proxemics for getting in touch with their bodies and for providing a vocabulary to talk about movement as well as for setting the building blocks to understanding embodiment.
3. Various silly physical exercises, like back mirroring, at the beginning of sessions to get them comfortable in moving their bodies and facilitate familiarization within a team.
4. Prescribing scientific literature readings before the physical MbDM session.
5. Site visits (whenever feasible) to let the students build a good understanding of the context for which they are designing solutions.

Throughout the course, students were encouraged to harbour a divergent thinking and entertain disparate views about the design problem. expert mentioned that ideation phase usually begins right from the start of the course until the stage of building final prototypes. Students were prompted to try out multiple ideas in the physical MbDM session and aim to maximize the potential of things that works. During the MbDM sessions students, although assisted, were expected to become facilitators themselves, to switch roles and learn from each

other, and not rely on teacher's instructions. The student's work was evaluated based on the final showcase of their working design and an annotated portfolio where the design decisions were expected to be either based in literature or real-life observations.

Typical Challenges

In the survey, several questions were directed towards getting to know the challenging aspects of working with these methods for both an instructor/facilitator as well as students. The expert mentioned the following in the survey response:

1. For instructor/facilitator –
   "Communicating the method and helping students become facilitators themselves"
   "To prompt students to come up with particular use situations"
   "To make them think of particular material qualities"
2. For the students –
   "Initially when they read the methods: they do not know how to practically go about implementing them. But the other activities help"
   "I think once they try it, they are happy with it, but it might not have the easiest threshold (i.e., To get started)"
   "Initially, it is difficult for them to think of materials beyond the digital, but they get used to them soon"

Moreover, the expert also mentioned that a student's background and personality traits also prevent them to fully engage with these methods and thus, affect their overall performance in the course. For example, students with engineering background, without prior experience with such ways of designing, often find it extremely hard to relate to these methods. And others with a reserved or shy personality find it challenging to be in the spotlight and to freely express themselves. In such cases, discomfort leads to reduced engagement in the course.

Major Signifiers of Learning

The expert provided some insights into a few markers of knowledge more commonly visible in strong student and their teams –

1. Explore: The strong groups were usually the ones taking an exploratory approach to design and trailing many methods during their design process.
2. Appropriate: The teams that were able to adapt and appropriate a MbDM to their use-case usually showed appreciable work in the course.
3. Bold: The stronger groups often ventured outside their previously acquired knowledge to entertain different ways of interaction and pay attention to different qualities of embodied experience.

Different Skills of a Student

The expert was asked about the different skills of a student that can make working with these methods easier for some. Besides temperamental factors like being a dedicated student and committing to the course activities, expert mentioned the following:

1. Students with more soft skills have a better experience overall.

2. Some students who were already skilled in paying attention to their bodily movements, because of doing activities like stage performance, dancing, or martial arts outside class, were able to tap into that tacit knowledge and apply it to understand/work with these methods.
3. Prior skills in iterative design, interaction design and even participatory design were mentioned as very important. It sets up the students for successes as they are familiar with some parts of MbDM design process. This results in a more independent, self-regulated execution of these methods.
4. Student knowing each other in a team was also said to be helpful factor. It reduces one less obstacle in adoption of the method.
5. Student's ability to reflect was also mentioned to be one of the important factors. For example, if they have the ability to critically reflect on their design choices, ability to reflect on different aspects of a MbDMs (soma aesthetical part, on physicality of movement, on bodily feelings etc). Or if they can self-reflect on a more personal level, like how can I make this better.

The students were helped in developing different skills during the course through various educational activities (as mentioned under the 'Classroom Setup'). The expert mentioned that, while these activities help most students, it does not always work for all students as it is highly dependent on their personality types. The nature of performing these methods is such that it puts the person in uncomfortable and unfamiliar position. People with different personality traits deal with it differently.

3.2.3 Reflection

The expert provided useful insights into the very intricate dynamics of a classroom. Not only did they share their teaching practices that helps build different knowledge blocks for students but provided a key insight about the students' behavioural and attitudinal calibre that contributes to their success when working with MbDMs in a classroom. Learning about the teaching practices gives us an idea about the different mediums used to convey the information to students and the role of a particular information in knowledge building. The technique to make students discuss and learn from each other in a group setting to make them self-reliant while executing the MbDM, was particularly interesting. The expert's reflection on students behaviour sheds light on peculiarity of some MbDMs. The characteristic involvement of expression through bodily movements poses challenges to students with reserved personalities. It poses hard but interesting aspects to consider when thinking about a solution in this design context.

3.3 Real-world insights: Inputs from students

The insights thus far have explored an educator's side more than a learner. In this section, student's point of view is considered to keep the problem space inclusive. To gain a better understanding into the difficult areas of MbDMs for a learner, we interviewed four students who had successfully completed one of the courses at the UT that employs MbDM.

The main goals for the interview were –
1. What is the current experience of students when engaging in MbDMs?
2. Identify areas where they experienced friction/inconvenience when working with MbDM, its responsible source and their corresponding needs.

3.3.1 Method

Setup
The participants were recruited via an email invite, Appendix C. The interested participants received the information sheet (Appendix D) prior to the interview. The interviews were conducted online in Microsoft Teams and followed a semi-structured format that consisted of some prepared questions (Appendix E). On average, an interview lasted for about 45 minutes.

An ethics approval with reference number RP 2022-24, was obtained from the EEMCS faculty at University of Twente (UT) to conduct these interviews.

Participants
Students who had previous experience of working with a MbDM in an educational course at the UT were invited for the interviews. For easier recruitment, invitation was emailed to the cohort of the course - Designing Interactive Experiences '21. Out of the 6 participants who responded, 4 were able to attend the interview. All participants were master's student at the UT studying either of the programmes – I-Tech (Interaction Technology) or IDE (Industrial Design Engineering). Among 4 participants, 3 were female and 1 was male. Their ages ranged between 20-26. All participants were asked for their verbal consent at the beginning of the interview which was recorded.

Participants' MbDMs
The participants were experienced with methods - bodystorming, somaesthetic reflection and embodied sketching. Thus, the findings in the upcoming section are limited to these methods and is not intended to be generalized for other the MbDMs.

Data Collection
Participant's personal data collected was limited to their name, age, and brief education history (university and major of their bachelor's study, and master's major). The interview was video recorded with the auto-transcription feature, for the purpose of analyses in the future. Interviewer also jotted down observations and thoughts after each interview.

Data Analysis

The student responses gathered during the interview were analysed using thematic analysis. Common themes running across participants are formalized into insights that inform the solution presented in this project.

3.3.2 Findings

The thematic analysis is presented in this section. Themes are grouped in three broad categories. ***First category*** details their approach to learning theoretical background and practicalities of MbDM before a workshop. ***Second***, details their experience of MbDM workshop for ideation purpose. ***Third***, details their experience of MbDM workshop for prototyping purposes. Considering the similarity in the responses, each category contains three themes. ***First theme*** is *Status Quo*, which details their existing approach and ways of working. ***Second theme*** is *Things that did not work well*, which reports the struggles they faced during different stages of the design process. And ***third*** is *Self-employed interventions*, which details general tips, anecdotes, or interventions students employed for a smoother execution.

The section concludes with an additional category of *Retrospective Thoughts and Feelings,* containing two themes. These themes are accounts of the participants' retrospective thoughts on the ***likable*** and ***improvable*** aspects of working with MbDM.

Before the Practical Session

Status quo

In the duration leading up to the physical MbDM session, participants' learning was mainly comprised of getting to know the method's significance and a theoretical overview of the involved activities. The sources of learning were primarily the prescribed literature in the course, along with class lectures. None of the participants reported on having a prior knowledge about what the practical implementation of the method meant from them. Like, participant P2 said—

> *"No, we sort of just dove into what professor told bodystorming was. Maybe I read a bit about it before but not quite a lot... and then we just got into it"*

Things that did not work well

Participants were asked to share their thoughts on what they would do differently in retrospect for this phase in the design process. Many participants noted that having a better expectation from the session would have reduced the time it took for the team to orient themselves during the MbDM session. The expectations were mainly around knowing how to go about practically doing the method, kind of outcomes they can expect from the session and how to effectively use the time to find answers to their goals. Participant P3 said the following that watching an example video about the method beforehand would have reduce the time they spent to understand during the actual session -

> *"Maybe like a video about people that were doing that... that would have taken less time to understand. I could do that beforehand instead of in the session"*

Another participant remarked along the same lines, and additionally mentioned that besides saving the time spent on figuring out stuff in the session, having prior info would have also led them to be more receptive of the method. Participant P2 said –

> *"I mean, I don't need to read up on it to do a role play, but I do need to have some sort of basic information why it is used and what can I expect, how to do it. Like what are the outcomes that I can expect. So, if I had known that maybe I would have been a bit more open to do that... So, in the end I did achieve the same goals, but if I read up on it a bit more then I would have achieved it a bit sooner you know"*

Things that made it work

All participants reported that their teams started following the instructions without necessarily understanding it fully and after going through several iterations learnt the different aspects of performing the MbDM. As noted by participant P1, in such cases a team's ability to collaborate and work collectively towards figuring out became a crucial factor. This also impacted the individual's as well as a team's collective response to relate with and execute a MbDM.

MbDM session for ideation

Status Quo: Preparation for the session

In preparation for the MbDM session, participants focused on the deciding the materials or objects they would use during the session for its purpose, aestheticism, materiality, and exploration. Other things they focused on were the goals for the day and details of their design concept. This was mainly discussed quite briefly at the start of MbDM session, usually with the team-members present. Participant P1 says –

> *"Yeah, I think we mainly discussed what we are going to bring and what we are and what was our aim for that particular day."*

Status Quo: During the session

In first physical MbDM session, participants engaged in what can be termed as embodied storming. The session's objective was to produce divergent ideas by constantly enacting the ideas, reflecting, and reiterating. Most participants' team reported to follow a combination of brainstorming and embodied storming. During the session, main factors considered for ideation were setting of the actual context they were designing for, different details of the context like objects and people, and different ways in which to engage the user. Participant P3, when designing an interactive experience for children, noted –

> *"...if you'll be too high because some shelves are too high and then we have to think about those things ... also what will be the entrance or the start of the experience and how can you actually lure children in your experience ..."*

Things that did not work well

Resistance to leaving old ways: Moving away from previous habits and mental models, based on UCD/HCD approaches, was reported to be a big hurdle time and again. The teams and/or individuals were not keen on leaving their comfort zone which inadvertently meant that the method was met with an apprehensive reception. Also, in times of uncertainty the teams or individuals would resort back to their usual way of ideating, by brainstorming. Participant P2 said –

> "Initially it was like a new step, right.. so initially it was quite a bit of going back and forth. We mostly resulted to brainstorming because we were used to it. But then we tried to force ourselves to do it and then once we started to do it more, it kind of grew up on us."

Physical barrier amongst strangers: Another commonly reported struggle was the awkwardness participants felt when working with a new set of people. All participants said that the social barrier added counterproductive weight to the overall process. It took some time before the teams could be comfortable enough with each other to explore and engage with their bodies without hesitation. Participant P3 says –

> "...OK then I can be weird and uh crawl on the ground and make weird noises, but it was strange because we weren't that familiar with the group yet …"

Dealing with strange unknown: The ideation session was comparatively a bit more challenging than the second session which was intended for prototyping.[1] One of the reasons elicited by P1, was the lack of proper understanding of a method that's not ordinary –

> "…I think some of my project members, or some of my teammates they thought that it was really strange and they didn't understand it and were just super strange all of the time. So, then they wouldn't really get out of their comfort zone and do the more crazy stuff"

Another reason noted by P4, was the ambiguity of not knowing clearly what their design concept was at that stage. This made it hard for their team to assess the usefulness of different things they were observing and thus deriving meaning from it –

> "In the beginning it was hard because we did not know have our idea yet so you don't really know what useful information you're seeing sort of"

Self-employed interventions

Leveraging skills learnt elsewhere: One of the participants mentioned that it was particularly easy for them to engage in the physical execution as they were previously familiar with practices from drama and musicals. They also mentioned that this invited other team-members to freely engage with the physical. P3 mentioned –

> "I did some drama and musical, so I was familiar with not being myself, but I never experienced it in educational manner, no"

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[1] In the classroom where the experiments were conducted, similar feedback was reiterated from the students not using the designed scaffolding.

Getting comfortable with the team: Although multiple participants mentioned the struggle of awkwardness within a team, one participant's (P2) team proactively sought to change this. They conducted an ice-breaking session amongst the team, without being instructed to. P2 mentioned that the ice-breaking session expedited the process of initial awkwardness. The participant P2 said –

> *"And then we sort of took it upon ourselves to do an ice breaking session… But that was a bit later, not at the beginning. In the beginning, we were just forced to do this"*

Later, P2 also remarked that their team was able to tackle the course's challenges because they functioned well as a team and had no problems or hesitation between them. They said –

> *"There was not any problem or hesitation between us so that's why our team, at least what I think out team functioned really well"*

Figuring it out together: Participants were asked to elaborate on the ways they were finally able to commit to the physical aspect of the method despite struggling with initial awkwardness within the team and being pushed outside their comfort zones. The commonality in their response sheds light on the importance of teamwork when engaging in these methods. Albeit with uncertainty, teams forced themselves to trust the instructions set out for that session. Participant P1 said –

> *"We just forced ourselves to do it and once we started doing it, we didn't feel that awkwardness anymore"*

Participant's(P4) team adopted a democratic approach and used open-ended questions for stimulating group discussion. Their team would have such discussions at the beginning of the session and at regular intervals during the session. P4 said –

> *"OK. What do we think about this? Like what are we supposed to do or, like should we make this interaction?"*

The Prototyping MbDM session
Status Quo

After the first session, participants had generated and explored several ideas as teams. The aim for the second session was to explore idea(s) more in depth while focusing on several experience elements of the overall system. The participants also created a rough approximation of the design concept, to be presented to others outside their teams to get feedback.

Focus on artifact and its real-world use: The participants reported their team was focused on figuring out the qualities of interaction with their designed artifact and also placing their envisioned experience in a real-world scenario. When asked what kind of goals they had for the session, Participant P3 remarked the following: (their main interaction artifact was integrated with a shopping cart)

> *"How the cart was moving, Was it feeling natural or was it really awkward for the other person? Like if there's a second person in the supermarket, obviously there will be someone else right? How would you deal with that?"*

Scenarios and user quirks: The participants reported on using some aspect of enactment like scenarios and user personas for iterating on their design concepts. Participant P2 said :

> *"Apart from that we crafted different scenarios, we also drafted different settings of use, like if this will be in a vegetable section or a fruit section…"*

Another participant P3, having a background in drama and musical, said that their team not only gave attention to different user personas but also introduced unusual quirks of a user in a persona and then explored their design concept more.

> *"… you have to be in the role, so sometimes I was like OK, now I be a very annoyed child for example… in each round I changed my role and that's what I did on my own"*

Assuming different roles: Another common activity participants did was shift the roles between acting like a user, system, or an observer. The participants did not clearly remember if this was instructed to them or not. Although it was not directly acknowledged by the participants, in hindsight it is apparent that doing this informed their design concept from each team-member's subjective experience. Like participant P1 said –

> *"And when you were the child, I tried to explore different interesting things. And then as the narrator you started thinking about OK, what exactly do I want this child to be doing…"*

Observation Styles: Almost all participants remarked that while testing with people outside their team, one team-member assumed the role of the observer. This person would normally capture important points either mentally or on a notebook. Occasionally observer would also capture snippets of experience on video using their own phones. These snippets were moments of unintended or bad experience for the user. The team would afterwards discuss to resolve it using video as the reference. Participant P4 said –

> *"we took videos and then we saw which parts were really awkward for them how they behaved like with their body language and stuff. Apart from that there was also a neutral observer from our team who saw different areas"*

Things that made it work

General feelings amongst all participants were that of settlement and comfort, which also lead them to a feeling of having a more pleasant experience in the second physical session. Participants were asked to elaborate on the reasons or factors that made the second MbDM session more pleasant for them. They articulated the following reasons -

Better expectations: The participants were better accustomed to the practicalities of a MbDM session during the second round. They also had a better footing in terms of knowing their design concept in parts. This resulted in a feeling of ease and settlement. For example, participant P4 noted -

> *"This is not about preparation, but I think for the second bodystorm we know more what to expect because we already did a lot of it, it was easy"*

Knowing what to explore: Another cause of the second session going well for all participants were having a better idea about their design concept and things that they wanted to explore. Participant P3 noted –

"It became kind of normal or something, so it felt really like we knew what we wanted to explore"

Getting familiar: There appeared to be a common theme in participant's responses that familiarity promoted a positive feeling in them. For some, familiarity was with the context and for others it was with movements. On getting used to different elements of the method, P1 exclaimed –

"We're getting used to different kind of elements of the method, maybe by different roles or by moving a certain way. So, the more we did it, the more comfortable we got"

P3 exclaims along the same lines –

"I think we walked in the "[context]" for 20 times or maybe even more, So everyone got a bit familiar with every role they could play"

Things that did not work

There were not many reports of challenges/struggles during this phase of the design process. However, a rather interesting insight brought forth by P3 was the difficulty in making complete sense and use out of the events that transpired in an iteration. They mention that because the team-members were engrossed in the bodystorming activity and were constantly improvising, that they would sometimes discover a useful information, but it would skip their minds by the time bodystorming session finished. Additionally, they also mentioned that at times it was unclear how they could derive useful insights from an iteration. P3 said –

"Because not every enactment we could keep in our mind"

"... sometimes unclear what we could have as insight out of it... What I just told you that was a nice insight, but it wasn't always the case … Sometimes it was like we did a round, now OK we cannot really say something about it"

Retrospective Thoughts and Feelings

As closing remarks of the interview, participants gave their retrospective thoughts on key challenges and the likable parts of doing MbDMs.

Likable aspects of MbDM

Novelty: The novelty of MbDMs were highly appreciated by all participants. It led to an expansion in their design toolkit. Multiple participants mentioned that it helped them to have a new perspective to designing. They view things differently and as a result were able to think of solutions in new ways. Participant P1 said –

"Really helps you to come up with and see things you wouldn't have seen"

Immediacy of Results: These methods were compared to the rapid prototyping concept where the outcomes are achieved in fast-paced iterations. The participants were very intrigued by this particular function of MbDMs. As P2 noted-

> "Even during the prototyping phase, if he had a new idea we didn't like, sit and discuss about it, we just added it to our original setup and we sort of moved around it and saw how it worked. If it worked, yeah, we keep it and move on. If it didn't, we just, yeah, reiterate."

Creative freedom: The ability to create in a new way was appreciated along with the degree to which creativity can be achieved and expressed with MbDMs. Because the methods were quite unusual it also pushed the students to think differently. P4 said –

> "I felt more creative, like inspired because of not being in this normal environments so it felt more free and… more open or something… and in the end, we got really interesting results out of it"

Challenging aspects of MbDM

Unfamiliarity to MbDM: All participants mentioned unfamiliarity, at least once, as being one of the main detractors in the initial stages of their process. It was hard for them to get started and navigate the first session without really knowing what has to be done and how. At these moments students resorted to their known way of designing. This is evident in the response of P2 –

> "Initially like it was a new step, right? So initially it was quite a bit going back and forth. We mostly resulted to brainstorming because we were used to it. But then we tried to force ourselves to do body storming and then once we started to do it, it kind of grew up on us. It was really interesting. And then we didn't just talk like if we had new ideas, let's put it into the environment and run through and we got like immediate results"

The participants mentioned that initially they had to take a leap of faith and simply do the methods as instructed, without necessarily understanding it completely. Over a few rounds the value in the obtained results convinced them to keep going and not falling back to previous methods.

P2 illustrated an instance where they tried to introduce bodystorming to a different team in a non-educational setting that was designing a wearable. They mentioned that despite repeated efforts the other team-members remained sceptical and did not adopt it. The main reasons were said to be that the method was awkward to engage in and the team was unsure of the value in stepping away from a previously known method. The participant P2 noted –

> "No, they were not familiar with the method, so they felt awkward many times even though when they tried it, it went well. Yet they didn't want to do it. They simply stood there and started discussing rather than acting it out"

Unusual methods: Multiple participants mentioned that the unusual way of involving their bodies to express and create made them uncomfortable. This was further heightened by the fact that team-members were new to each other. Participant P3 exclaimed-

> *"I was like, OK, then I can just be weird and uh quality crawl on the ground and make weird noises and but it was a bit strange because we weren't that familiar with the group yet… so that could be a bit that I was a bit hesitant…"*

Team dynamics: The importance of a collaborative team came up many times in the student interviews. The participants who were satisfied with their teams' results were persistent in their efforts to build a healthy team dynamic. This was done to overcome the social barrier. One participant mentioned the need to do an ice-breaking in their team after the first MbDM session. They were triggered to so because of awkwardness felt by the team-members. Gradually the team-members achieved a comfort level which made it easy to engage in the MbDMs. Another participant also noted that doing the methods become easier with a known set of people. P2 said –

> *"The type of team, like if it's between friends, then it's a lot easier because there's the barriers are open. But if it's between some strangers or new people… there's almost always a barrier that you don't generally cross"*

As the designing happens in a group setting, the collaboration in a team inadvertently also effected the quality of the designs as noted by Participant P1. They said that the quality of their end results was negatively affected because the team lacked collaboration. They said –

> *"We didn't really have a lot of collaboration within the group, and I think that would that was kind of a shame because then I think the project would be better in the end"*

3.3.3 Reflection

Although, the found publications and the expert interview, provided a good deal of understanding about the various teaching activities, adaptations of MbDMs as per various kinds of course settings and findings through context-based case studies. They lacked descriptive, subjective encounters from a learners' perspective. Interviewing the former students helped us construct a more well-informed, comprehensive understanding of the design context of this project.

The nature of qualitative interview worked well in getting candid and elaborate responses from the students. A large amount of useful information was gathered on the challenges that students face and the self-employed techniques that provided resort to some of these challenges. The mentioned challenges become valuable sources to be considered for preventing similar pitfalls in a possible intervention and provides a strong direction for perceiving solutions. And the shared self-employed techniques become a set of very useful recommendations to include in the design of a possible solution as these were tried and tested in a real-world context.

3.4   Summarizing

In this section, we link the valuable knowledge gathered from literature, the Expert, and experiential insights from students to construct a design space for this project. Through this, we inform our understanding of the intricate dynamics of a classroom that employs MbDMs. We get a better insight into the causes for the difficult areas and different processes followed by students and educators in an educational setting. This understanding becomes useful as we move towards ideation in the next chapter.

Representative Task Breakdown

We used the method of task analysis to understand the typical aims, tasks and motivations of educators and learners in a classroom setting. We demarcate the tasks in two phases. First, building the theoretical knowledge of a MbDM. Second, physical execution session of a MbDM. Through this, we gain a chronological overview of educators' and leaners' goals, actions, and processes followed in pursuit of their respective goals.

Furthermore, we map the previously discovered challenges and recommendations (sec 3.2, 3.3) for both users as per the two classroom phases. This way we produce a more comprehensive view of the educational setting that employs MbDM. During ideation in chapter 4, this comprehensive design space serves as a suitable medium for the purpose of problem finding and exploring possible solutions.

It is to be noted that the responses from the educator and students, that inform the task breakdown, had considerably different classroom setups and goals. This meant that the kind of tasks, sub-tasks and the order of implementation for them was different. Therefore, the task breakdown below takes a more generalized form without dwelling into detailed sub-tasks. Figure 3 depicts the formulated design space where the source of information is depicted. (See Appendix K to zoomable image.)

Source : Literature Source: Educators Source: Learners
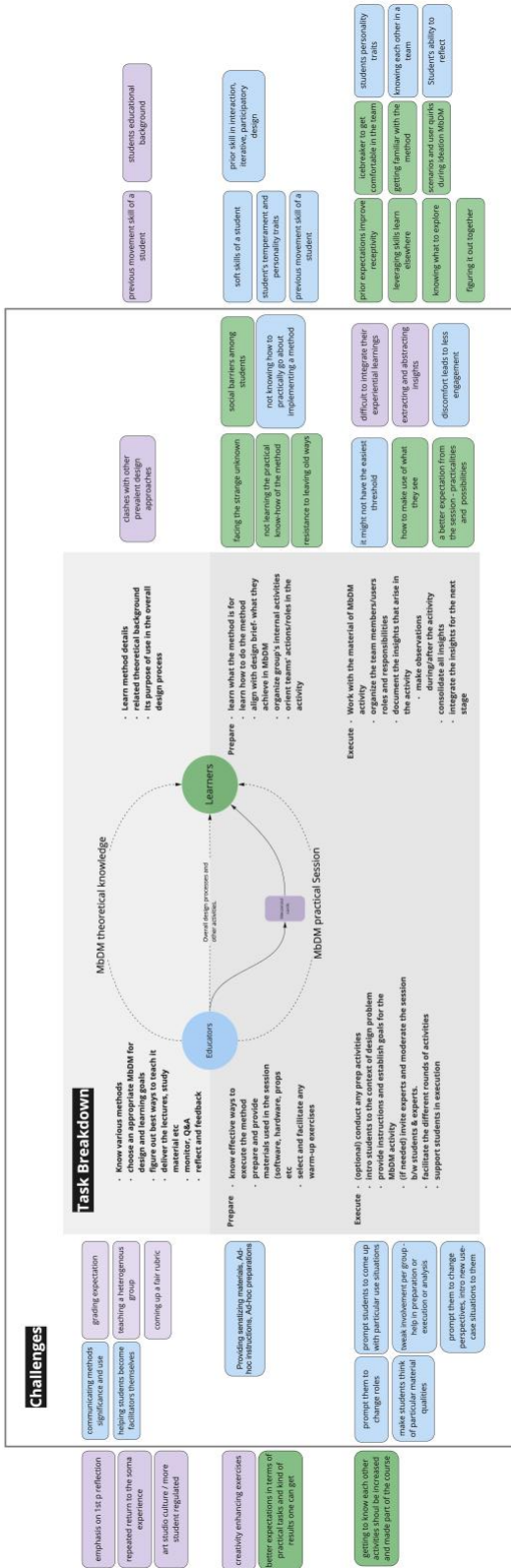
Recommendations or Things that worked

Challenges

Task Breakdown

MbDM theoretical knowledge

Learners

Educators

Overall design processes and other activities

MbDM practical Session

Prepare
- Know various methods
- choose an appropriate MbDM for design and learning goals
- figure out best ways to teach it
- deliver the lectures, study material etc
- monitor, Q&A
- reflect and feedback

Prepare
- know effective ways to execute the method
- prepare and provide materials used in the session (software, hardware, props etc)
- select and facilitate any warm-up exercises

Execute
- (optional) conduct any prep activities
- intro students to the context of design problem
- provide instructions and establish goals for the MbDM activity
- (if needed) invite experts and moderate the session b/w students & experts
- facilitate the different rounds of activities
- support students in execution

Prepare
- Learn method details
- related theoretical background
- its purpose of use in the overall design process

Prepare
- learn what the method is for
- learn how to do the method
- align with design brief- what they achieve in MbDM
- organize group's internal activities
- orient teams' actions/roles in the activity

Execute
- Work with the material of MbDM activity
- organize the team members/users roles and responsibilities
- document the insights that arise in the activity
  - make observations
  - during/after the activity
- consolidate all insights
- integrate the insights for the next stage

Educators challenges:
- communicating methods significance and use
- grading expectation
- helping students become facilitators themselves
- teaching a heterogenous group
- coming up with a fair rubric
- Providing sensitizing materials, Ad-hoc instructions, Ad-hoc preparations
- prompt students to come up with particular use situations
- prompt them to change roles
- make students think of particular material qualities
- tweak involvement per group- help in preparation or execution or analysis
- prompt them to change perspectives, intro new use-case situations to them

Learners challenges:
- clashes with other prevalent design approaches
- facing the strange unknown
- not learning the practical know-how of the method
- resistance to leaving old ways
- social barriers among students
- not knowing how to practically go about implementing a method
- it might not have the easiest threshold
- how to make use of what they see
- a better expectation from the session - practicalities and possibilities
- difficult to integrate their experiential learnings
- extracting and abstracting insights
- discomfort leads to less engagement

Recommendations:
- emphasis on 1st p/ reflection
- repeated return to the soma experience
- art studio culture / more student regulated
- creativity enhancing exercises
- better expectations in terms of practical tasks and kind of results one can get
- getting to know each other activities should be increased and made part of the course

- previous movement skill of a student
- students educational background
- soft skills of a student
- prior skill in interaction, iterative, participatory design
- student's temperament and personality traits
- previous movement skill of a student
- prior expectations improve receptivity
- icebreaker to get comfortable in the team
- students personality traits
- leveraging skills learn elsewhere
- getting familiar with the method
- knowing each other in a team
- knowing what to explore
- scenarios and user quirks during ideation MbDM
- Students ability to reflect
- figuring it out together

Figure 3: The design space for the project

Chapter 4
Introducing Scaffolding Workbooks

In this chapter, we further towards answering the Research Question 2 of the thesis. Using the design space formulated in Chapter 3 as a foundation, we ideate a few possibilities and assess their suitability to enhance the facilitation of MbDMs in an educational setting. We then present the final solution as a Scaffolding Workbook to cater to the facilitation needs of student teams during the execution of MbDMs. The chapter concludes by describing the overall process of designing and evaluating the workbook as well as the details of the educational setting where this study takes place.

4.1 Ideation

4.1.1 Setting Guiding Principles

The field of MbDMs make for a fascinating area with immense opportunity for innovation and exploration. As we moved towards the ideation stage, we laid out few principles to help us navigate this area of immense possibilities. We revisited the goals of the project and the learnings from the background research to come up with following guiding principles.
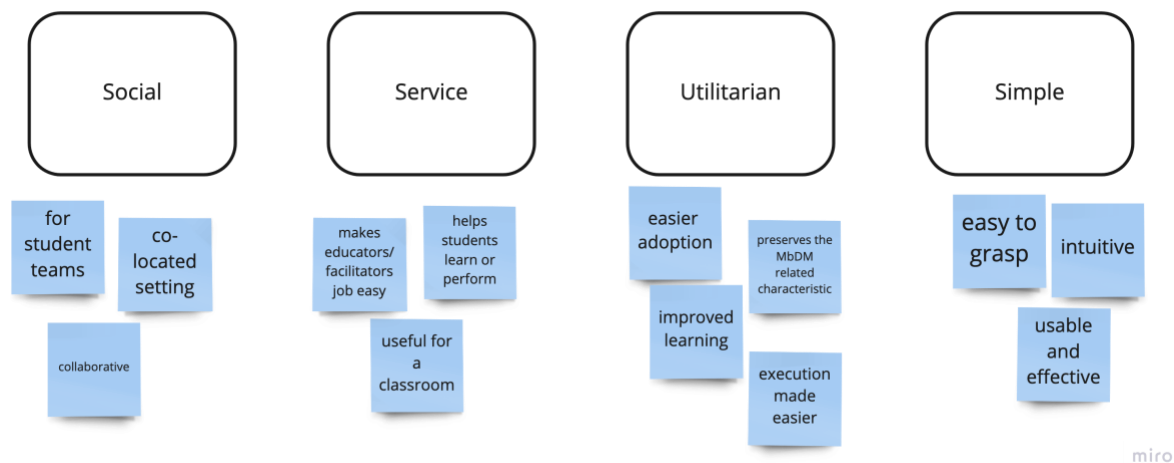
Figure 4: Guiding principles for ideation

- Social: Several MbDMs require constant collaboration and back-and-forth within the team members. The solution must not be disruptive to co-creative, social, and collaborative characteristics of MbDMs. A key requirement of the project was also to build a solution for an educational setting, which meant creating for co-located, social activities all the more important.

- Service: The solution must be able to serve either or both set of users towards achieving their goals. The goals for an educator/ facilitator were to effectively impart the theoretical knowledge, help teams self-facilitate, provide their expert facilitation. For a student designer the goals were to learn, to use MbDMs to create their respective design project.
- Utilitarian – The solution must enhance the experience of working with MbDMs in an educational setting.
- Simple – In our research we uncovered that there exists a threshold to using MbDMs which might not be the easiest to get over. Therefore, a solution must be easy to grasp and work with, without adding more strain.

These principles guided the following ideation. It shaped our outlook towards the selection of problems and the kind of solutions we imagined appropriate for resolving them. It also made assessment of ideas straight-forward, thus directing the path to the final solution (section 4.1.4).

4.1.2 Initial Explorations

Using the design space as the foundation (figure 3) and the guiding principles, we thought of a few possible solutions (figure 5). Each idea was evaluated against all the guiding principles to determine its impact and suitability to answer RQ 2. This brought clarity on whether an idea was worthwhile of the efforts to figure out its implementation requirements and details. In the upcoming sections, we present the investigations carried out for the two most promising ideas.
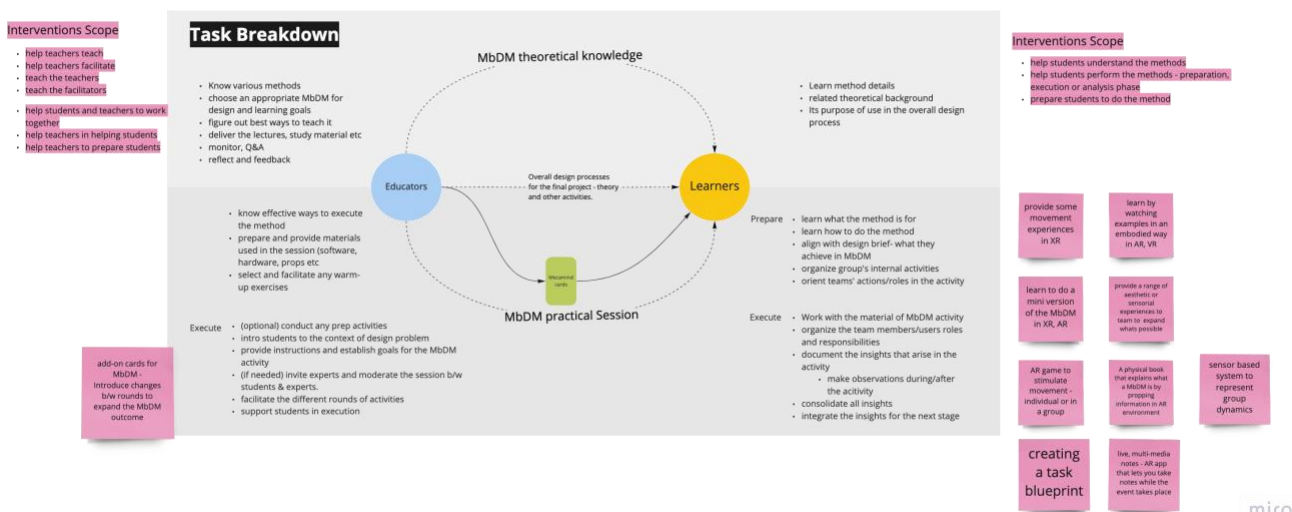
Figure 5: Initial idea explorations

4.1.3 Investigating AR based intervention

One of the early ideas considered as a possible intervention was an AR (augmented reality) application that let its users physically engage in an MbDM and provided capabilities of creating a shared augmented space and capturing the events from a first-person perspective. A shared augmented space that is visible to all team-members physically executing a MbDM together could be useful in variety of ways such as communication of ideas supported by visual aid, building of imagined design quickly, experiencing the interactions with a design and mimicking a context of design for investigative purposes. The ability to capture the first-person perspective footage could be a novel and effective way to catch valuable information about multiple aspects of interaction with a designed artifact or a context of interest. We imagined many possibilities, within and outside an educational context, where such an intervention could be useful.

In an educational context, the students could also use this application to build design ideas quickly by fetching different kind of design elements (like drawings, 3d objects, picture etc) of their own or from the web and placing it in the augmented physical space. This allows the team-members to learn more about their designs by interacting with it and makes reiterations speedier. The ability to create an augmented space could also be used for mimicking a physical context of interest, thereby providing an opportunity to learn more about the contextual elements through the experience of moving within it. Additionally, by watching a recorded footage from a 1st person perspective, the students could potentially learn the nitty-gritty detailed procedures of physically engaging in a MbDM before their own session. This makes the learning process itself embodied to a certain degree and provides a peek into how a MbDM is performed, making this knowledge directly transferrable to their own MbDM session.

Outside the educational setting, the ability to capture first person perspective information as a user/ designer performed an MbDM, offers a potential resort to the challenge of documenting embodied information [31]. The visuals from this perspective when supplemented with a think-aloud approach could capture the overall feelings and experience and create valuable data for the design team. Additionally, an extended use of the application could be useful for remote design teams to engage in MbDMs through sharing an augmented designed space.

The feasibility of this idea was investigated through the researcher's self-usage of an HMD (head-mounted display) AR device – Microsoft HoloLens 2. This particular device was chosen for its hands-free design and rich multi-modal interactions. The aim was to investigate the advantages and disadvantages of using such a device alongside MbDM and the possibility of realizing the aforementioned application capabilities. Namely, recording first-person perspective video and capturing stills, sharing the same augmented space amongst users that are co-located, and the ability to create and modify the augmented space by fetching multi-media content. Below we present our experience of using HoloLens 2, from the perspective of building an app to be used alongside MbDM. Note that the below information pertains to the HoloLens 2 capabilities at the time of conducting this investigation in March 2022.

Initial assessment of the idea

Promoters

There are two primary ways of input and interaction offered in HoloLens 2 – gestures and voice. HoloLens provides an onboarding tutorial on gesture-based interactions while the tutorials on gaze and voice-based interactions can be accessed in the main menu after onboarding. The gaze-based interaction is limited to select object (hologram) types. All these input and interaction capabilities offer placement and modification of augmented objects nearby or far away in space. The quality of interactions is found to be quite rich, enabled by 6 DOF movements and intuitive interactions like pinching, pressing, and swiping. This makes it suitable to be used for a purpose that places great value in the quality of interactions. The device also offers the capability to take stills and capture continuous video through the use of buttons on the edge of the HMD device. Voice commands also allow this interaction. The device does not come with an in-built feature with which two co-located users can share a single augmented space. For this, we found a native app built by Microsoft called Mesh App. In this app the users could share the same augmented space and could also import multi-media items from local storage in the augmented space and engage in collaborative design activities. Importing videos was not supported and there was no in-app functionality to capture videos and photos.

Shortcomings

Although we found many convincing reasons available features to pursue building an AR app, there were some shortcomings in physical affordances and technical capabilities of using an HMD AR device while engaging in a MbDM.

The major detractor for us was the impact of using such a device on the MbDM because of two factors. ***One***, ***the interactions were glitchy and/or unresponsive*** at times. And there is a considerable learning curve before a user gets accustomed to working with these interactions fluently. We see this issue getting resolved as the technology matures but at the time, it was unsuitable for a purpose where the quality of interactions is of vital importance, as in many MbDMs. The nature of MbDM demands for a rapid communication and collaboration within the participants where insights arise from rampant co-creation. We estimated that the inaccurate and jagged interactions could hamper the spontaneity, as required in methods, and result in participants being more focused on the device interactions rather than the method activities. ***Second***, ***the visual and physical strain*** from using the device was also notable. This made us reconsider the negative influences on a practitioner's physical abilities to engage with the method and the potential to deteriorate their interest in the activity itself.

Additional to the physical factors, latest version of development kit shared by Microsoft, that made the core functionalities of Mesh app (such as world and object locked hologram and spatial mesh) were not open for public use at the time of this investigation. These were crucial features envisioned in our idea.

4.1.4 Investigating a scaffolding approach

One of the objectives of this project was to help with the facilitation of MbDMs in a classroom setting for either or both set of users. To satisfy this objective, we considered another direction of solution that was based on a service design approach. In section 3.4, we identified the tasks, processes, and knowledge exchange between the two set of users. We then mapped their pain-points associated with two phases - theoretical knowledge building and physical execution. We carefully considered the previously accumulated insights and intervened at an area with the most number of commotions, that is during the practical session of the MbDM session.
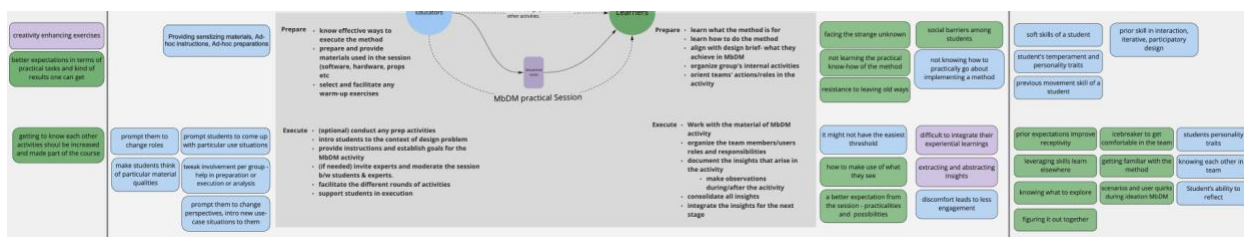
Figure 6: Targeted area of the classroom

Background

In the beginning of the physical execution, both students and teachers reported a gap in the teams' knowledge. It was reported that teams were unclear about how to practically implement the MbDM, about which they had gained theoretical knowledge in the course. Due to this knowledge gap student teams often struggled to arrange their expectations, actions, and eventually their team's collective efforts towards accomplishing design goals. Experienced students reported that this gap filled after some iterations or by the second physical session of MbDM. But during the initial sessions, a considerable time was spent to figure out the approach of implementing a MbDM as well as determine and manage their team's activities. Moreover, the students reported on observing positive effects on their team's productivity and increased coherence within the team once they had figured out their approach to execute a MbDM. On a closer look, this area also demands the most ad-hoc involvement of the educator. The educator is expected to tweak the type of their involvement as per a team's demands (help in preparation, change team's tasks etc.), provide expert insight meaningful for particular team, help the teams achieve their goals while keeping them in-line with the course goals etc.

A student team also puts evident efforts to organize their meta-responsibilities of functioning as a team, such as creating comfortable enough atmosphere with each other that promotes sharing and expressing, distribution of tasks and duties, orienting their collective efforts for the day, and doing all this while moving forward in the direction of the ultimate goal of designing as per the course brief. In combination with other identified issues (in Section 3.3), this additional load might potentially detract a team's efficiency, their collective receptivity towards the MbDMs, and overall attitude of engaging with MbDMs.

The Idea

We took inspiration from the concept of worksheets/ templates/ models, that acts as a scaffold to helps its user achieve a goal [32]–[34]. As we found that the threshold to get started with the MbDMs was due to inexperience and knowledge gaps within a student team. A scaffold (workbook) could potentially lower this threshold by offering a succinct system to compensate for the knowledge gaps and inexperience, thereby saving the teams time and effort. Moreover, we found an opportunity to assist the teams throughout the practical execution of the method. Thus, the workbook could streamline a team's workflow by outlining clear approach and tasks. And positively impact a student team's experience and inadvertently the educators' experience too.

Initial assessment of the idea

Suitability for this research: The worksheets are directly suitable for the goal of this project - to help a student and educator facilitate a MbDM. It aids that student design teams in self-regulating their team's execution of MbDM during a practical session.

Low-tech artifact: One of the things that we discovered during the XR explorations (discussed in 4.1.3) was the impact of technology on the MbDM activities. The nature of these methods is such that it requires constant discussion and reflection within oneself and within a team. The added layer of technology might, one, amplify the social barrier that we already discovered to be problematic from the student interviews and two, prevent students from fully tapping into the experiential qualities, an important aspect in a number of MbDMs. We could circumvent these issues through a low-tech solution.

Tackling the reported challenges: The challenges of unfamiliarity, lack of resources needed for right orientation and clarity on actions etc., were envisioned to be easily remedied with the structured task blueprint of a workbook.

Novelty: In the initial stages of exploring this idea, we referenced other worksheets/canvases to understand the logic and content that goes in the design of such artifacts. In that search, (to the best of our knowledge) we encountered no worksheet/template/model that caters to the physical execution of a MbDM. The one exception to this is the generative Body Map template, by Núñez-Pacheco [35], that is used to document the felt experiences in a soma-based design.

Based on the initial assessment we brought this idea forward for implementation. More details of designing and evaluating the final worksheets is described in upcoming chapters 5 and 6.

4.2   The Scaffolding Workbooks

The workbooks are designed to enables adoption and execution of a MbDM. It is intended to be used in conjunction with usual teaching activities of a regular classroom setting. It presents a schematic representation of tasks and actions for a novice design team and helps them to

independently begin and navigate the different tasks needed to perform a MbDM. In chapter 5, we create and evaluate a Workbook for Embodied Sketching that contains 2 worksheets. In chapter 6, we create and evaluate another workbook aimed at Experience Prototyping that contains 3 worksheets.

4.2.1 Composition of the workbook

The Worksheet
Each workbook consists of multiple individual worksheets. Each worksheet contains a schematic representation of tasks, actions, and sometimes step-by-step instructions. The considerable amount of empty space left on the worksheets is to encourage the teams to capture and store the useful information collected during the workshop.

Detailed Description
Each worksheet is accompanied with a detailed description for clarification purposes. Some students may not be familiar with every term, activity, or task mentioned on a worksheet. For easier understanding and avoiding confusion, a detailed written description for every item of the schematic representation is provided alongside each worksheet. Description contains meaning of the term, its significance in the designing phase and a brief usage approach.

Medium of use
The tangible aspect of the worksheet is worthwhile to mention. Worksheets are primarily meant to be used in their physical format. A set of worksheets along with corresponding descriptions, are combined together to form an A4 sized workbook. During the evaluation, student teams received the workbook along with A2 posters. It was decided that the best medium of use during a MbDM workshop is on large A2 posters. The large size offers greater visibility and bigger area to work for its users that are in motion.

As a secondary medium of use, we also created a digital copy of the workbook in Miro. This was done to provide flexibility to the design teams that may want to work digitally or store digital copies of the physical (filled) workbook.

4.3 Design and Evaluation of The Workbooks

The overarching process of designing and evaluating the two workbook was the same. Below we present an overview of the different stages. A detailed implementation of design activities of each stage can be found in the relevant (Ch. 5 and 6).
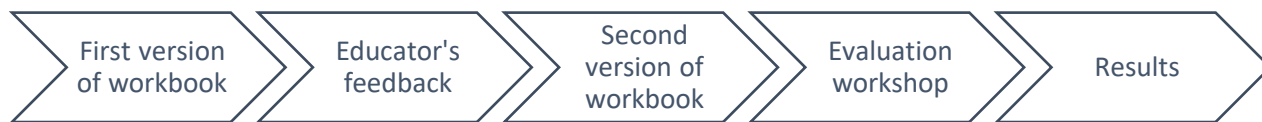
```
┌──────────┐  ┌──────────┐  ┌──────────┐  ┌──────────┐  ┌──────────┐
│First version│  │Educator's│  │ Second   │  │Evaluation│  │ Results  │
│of workbook │  │feedback  │  │version of│  │workshop  │  │          │
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```

Figure 7:Design and evaluation process of the workbook

1. First version of worksheets

The first version was created based on the workshop goals as well as the knowledge and insights gathered from literature review, expert, and student interviews. The literature served as the cornerstone for breaking a MbDM into actionable steps, defining the information relevant to each step and the information flow. Additionally, the insights gathered from the expert and the students were considered for two purposes. One, to circumvent the common pitfalls. Second, to include recommendations based on experience that made adoption or execution of MbDMs easier for students.

2. Educator's Feedback

The worksheets were discussed with the primary educator of the course in an evaluative session to get pre-liminary feedback. The feedback included the structuring of information, task and goal specification, adding useful instructions, and tips and tricks for making the worksheet better serve the purpose of the workshop.

3. Second version of worksheets

The second version incorporated the educator's feedback and redesigned visual elements to improve its usage experience for student teams.

4. Evaluation with student teams

The workbooks were evaluated in an actual classroom setting with educators and students. Student teams used the designed workbook during the two MbDM workshops. We evaluated the influences of workbook in two ways. First, the researcher noted live observations about the teams' interactions and usage of the different worksheets. Second, after the workshop the student teams provided their qualitative feedback about their experience in a semi-structured group interview.

5. Result

Based on the researcher's observations and direct feedback obtained from the student teams, we present the results of the study setup and consequent design knowledge generated consisting of possible improvements and techniques to introduce the workbooks for future use.

4.4 The Context of Study

In this section, we describe the educational context where the scaffolding approach was evaluated with relevant users. As each workbook is designed to help student teams achieve the goals of the particular workshop where it is being used, it makes the classroom setup and workshop goals important parameters to be considered in the design of the workbook. For this purpose, we first elaborate the classroom setting and then the workshops details.

4.4.1 Classroom Setup

The evaluations took place with educators and learners of Experience Design for Interaction (EDI) '22 at the University of Twente (UT). The course project was to build an interactive layer on the existing play-ground equipment to promote kids to play outside. The project focused on creating a multi-modal interactive experience that has a strong physicality component and goes beyond traditional methods of inputs(keyboard/mouse) and feedback(screens). The course was 11 weeks long with two MbDM practical workshops planned in Week 4 and Week 6.

The course involved students from predominantly master's program in Interaction Technology, Industrial Design Engineering and Computer Science at the UT. The cohort of approx. 50 students was divided in design teams of 4-5 students each. Out of 10, 2 teams consented to participate in this project. The evaluations took place in the month of May & June '22. Both the participating and non-participating teams were present in practical workshop at the time of evaluations. The curriculum and teaching activities remained same for the entire cohort, except that the participating teams made use of the workbooks during the MbDM practical workshops and were given brief instructions by the researcher about its usage.

Participants
Two student design teams that participated in this research, consisted of 3 (Team 1) and 5 (Team 2) students each.

It is noteworthy to mention the supervisor of this project also assumes the role of primary educator of the course (EDI'22), where the evaluations took place. As an educator and facilitator of courses employing one or multiple MbDMs, his feedback on the design of the worksheets stems from the years of accumulated knowledge and observations.

4.4.2 Details of Two MbDM workshops

The evaluations took place during the two MbDM workshops planned in the course. *First workshop's* goals were focused on ideation with emphasis on creating divergent ideas through first-person inquiry. The method employed in first workshop was an appropriated version of

Embodied Sketching (ES) as mentioned in [14]. The teams were asked to bring as well as had the opportunity to use the provided materials and objects that afforded to be used in unusual, unique ways. The workshop was not conducted in the physical context that was being designed for. However, two weeks prior to this workshop the teams visited the design context (a playground) as a group and made notes on various play experiences and activities they liked through a first-person reflection approach. In the workshop, the teams were encouraged to explore and ideate in a free-flowing and unscripted manner. They were instructed to explore their ideas through playful activities while employing a first-person felt experience. The main goal of the team was to explore and sift through a multitude of ideas to arrive at a bunch of ideas to bring forward in the design process.

Second workshop's goals were to make the teams explore and evaluate an intermediate prototype of their design experience with members outside of their team. The method employed in this workshop was an appropriated version of ***Experience Prototyping (EP)*** as in [19]. In this workshop setup, the teaching staff assumed the role of "users" who engaged with team's experience prototypes. The teaching staff consisted of the primary educator, a co-facilitator, and an external educator. They engaged with the teams' prototypes and provided subjective feedbacks as users and also provided additional expert insights to help the teams design better. The main goal for the team was to build an approximation of their envisioned experience such that the users could feel and engage with it. And then to carry out multiple EP rounds with the users and explore opportunities and flaws in their designs.

Chapter 5
Scaffolding Embodied Sketching

In previous chapters, we established the design space for this project and conceptualized the notion of workbook to act as a scaffold in order to help the design teams during physical implementation of MbDMs. In this chapter, we apply the scaffolding approach to design a workbook for MbDM - Embodied Sketching. We showcase our design process and rationale for the design choices while the workbook. Then we evaluate it in a real-world educational context with students and present the obtained results.

5.1   Introduction

The Embodied Sketching (ES) workbook presents a 2- step approach for novice teams to execute ES. The design of the workbook is achieved in two iterations. The knowledge gathered from literature and expert interview forms the core of the workbook which is then tailored to the needs of the classroom through a pre-liminary evaluation with the primary educator. In the upcoming sections, we elaborate our design process and showcase the state of the workbook at different stages of its creation. We conclude by presenting results from evaluation and highlight aspects that worked and did not work.

5.2   Design of Embodied Sketching (ES) Workbook

The content of the workbook was achieved by combining the classroom goals for the workshop with the insights from literature. Therefore, in this section we first present the goals of ES workshop and then brief explanation of embodied sketching and bodystorming.

5.2.1 Workshop Goals for ES

Before the week of ES workshop, the classroom went for a sensitizing field visit to a location similar to the context of design. In the field visit, teams were encouraged to employ a first-person reflection on the experience of being the context and associated activities. They were instructed to get to know the feelings and the sensations through movement, actions, space, and products. Through this exercise the teams prepared a list of liked experiences and seeds of ideas as well as core interactions.

The goal in the ES workshop was to provide the teams a chance to engage in a divergent ideation activity through a first-person inquiry. The teams were asked to bring as well as were provided with interesting objects, based on aesthetic, material, or functional qualities, that

afforded to be used in unusual, and inspiring ways. While teams engaged in the ES, workshop instructions placed great emphasis on getting to know their respective felt experiences, paying close attention to experiential qualities, and considering the physical context. The teams were supposed to generate and explore a breadth of ideas through bodystorming previous as well as new ideas, all while co-creating as a team and exploring material, space, and objects around them. By the end of the workshop the teams were expected to have gathered a wide range of interesting interactions, core experiential qualities and few ideas that forms the basis of further exploration towards their final designs.

5.2.2 Background of Embodied Sketching

Segura and colleagues [14], put forth a method to support ideation when designing for and with bodily movements. In this method the participants (designers and users) make use of contextual elements such as materials, objects, and arrangement of participants as well as layout of the physical space for coming up with design ideas through enactment. The authors accentuate the role of "*socio-spatial arrangement of players and artefacts in the space*" as useful design resource to ideate [14, p. 4]. The authors define ES as – "*a characterization of design practices in the domain of embodied interaction that foregrounds the somaesthetic experience for the exploration of, and design for particularly interesting physical activities.*" [14, pp. 4–5]. Two key characteristic features has been noted when employing ES – (1) activities and actions that are enacted are constituent or close to the physical activity that is designed for (2) trying and analysing how different design resources intertwine to generate interesting experiential phenomenon [14]. Authors also illustrate how the application of ES can be adapted to different design situations through three examples. Two examples that are particularly interesting and relevant for this project are example 1 and 3 [14, pp. 5–6, 9–10]. Example 1 illustrates the implementation of ES alongside bodystorming to explore new ways of moving in order to create *core mechanics.* Bodystorming is discussed briefly in the next section. Example 3 illustrates the implementation of ES in a design situation to deeply appreciate experiential qualities of a core-mechanic (hanging) through a first-person inquiry.

5.2.3 Background of Bodystorming

Bodystorming is a form of enactment based MbDM to deeper understand a context, and users' experience, actions and need states in that context [8], [20]. It is a prevalent MbDM amongst the ID researchers and practitioners, where the designers engage in a social and situated enactment to simulate users' actions (in a context that is original or recreated) in lieu of gaining better insights into the contextual, social, interactional elements of experience [18]. In this section, we revisit bodystorming and consider instances of various appropriations of bodystorming found in HCI an ID literature that inspired our designs.

Three variants of bodystorming are outlined in [20], before authors suggest their own adaptation called *Embodied Storming*. According to [20], first variant of bodystorming is to design and implement a product/artifact while being present in the context of its use. This way, "*just by being in the context*" a designer gets more attuned to the real-world contextual factors affecting their products' usage and thus is able to make informed choices. The second bodystorming method is called strong prototyping. The idea is to validate an early design prototype (product/artifact) in a "simulated" environment, which must include the most important aspect of the end environment. The designed prototype is tested and evaluated multiple times through introducing change to the different aspects of the "simulated" environment (like changing lighting, spatial arrangement etc.). The third way of bodystorming is called "use-case theatre". A prototype environment is created using actors and props to replicate a real-world experience, which is designed for. Actors assume different user roles and act in the prototype environment as per different variations of the prototype. These simulated experiences offer the opportunity for evaluation of a new product.

Bodystorming is employed as a way to brainstorm *in-the-wild* by authors in [18]. In this paper, instead of sitting around an office desk for ideation, the design teams act like users in a context (identical or recreated to be similar to context of interest) to produce new ideas for ubiquitous computing. By varying the degree of similarity between the bodystorming context and the original context, the authors highlight advantages and disadvantages of bodystorming.

5.2.4 First version of ES Workbook

ES Worksheet – I (Get started)
The schematic representation demarcates three important sections – ***context, target user and interactions.*** The concept of creating this pre-liminary step before teams engage in ES, was inspired by the bodystorming paper by Oulasvirta and colleagues [18]. Where a preliminary document is created prior to the bodystorming session containing user observations in the context and interesting phenomenon arising from it. By re-enacting previously noted interesting phenomenon, the design team was able to generate better empathy for the users and to gain access to "*psychological (e.g., user needs), social (e.g., interpersonal relationships) or interactional (e.g., turn-taking in conversations)*" aspects of a problem [18, p. 2]. For our design context, the ES workshop aimed to promote unscripted and free-flowing ideation and did not entail creating detailed user observations [20]. However, the notion of design teams generating a better empathy through a previously created documentation motivated us to design a worksheet that inculcates pre-liminary understanding of the context in the student design teams. In the literature surrounding bodystorming, it is discernible that a design context holds a tremendous importance for sensitizing the designer to user as well as contextual factors [18], [20]. Therefore, the first worksheet (figure 8) helps the teams to assemble and arrange their previously collected insights from the sensitizing field trip and become more attuned to the context being designing for.

Figure 8: First version of EP Worksheet-I

ES Worksheet – II

As mentioned previously the goal of the workshop was to encourage unscripted, free exploration. Thus, the ES Worksheet-II is designed to be minimal by displaying only ***instructions*** (the bodystorming card) and ***some tips*** to assist the teams during the physical execution. The bodystorming card is an *(in-progress)* artifact created by MeCaMInD. The tips (*things to be mindful of*) were comprised of recommendations from example 1 in [14]; like paying attention to spatial elements, building ideas on the fly; as well as insights from primary interviews with the Expert. Figure 9 shows worksheet 2.

ES Worksheet - III

In the example 3 in [14, pp. 9–10], a post-session discussion allowed the designers in abstracting their "experiences into aspects" useful for sharing and communication.
Taking from this, the third worksheet was created to help the teams ***understand and extract the insights*** from the entire workshop. This was intended to help teams dig out the key, notable information useful in the rest of their design process. To assist the reflection process, the worksheet contains 4 elements that can be used to review as well as converse about an experience idea/ iteration. This was to provide a kickstart to them uncovering various elements that comprise an experience and implicitly inform their designs. Additionally, since an

"experience" is dynamic result of many elements, the teams are prompted to define their own element that better characterizes their designed experience (Figure 10).

Figure 9: First version of EP Worksheet-II

Figure 10: First version of EP Worksheet-III

5.2.5 Second version of ES Workbook

The second version of ES workbook was arrived at after an evaluative discussion with the primary educator of the course. A significant change introduced in this iteration was merging the worksheet II and III together. The reason was to make the teams aware of the experiential qualities early on in their ideation process. We found in the primary student research that students uncovered the experiential aspects by themselves after undergoing several iterations of the method. By presenting this information early on, we intended to make the teams more aware of the factors composing an experience. Thus, supplementing and possibly expediting their ideation process. Figure 11 shows the A2 poster created from merging ES worksheet – II and III (See Appendix F for the final ES workbook).

Figure 11: A2 poster used by the teams during ES Workshop
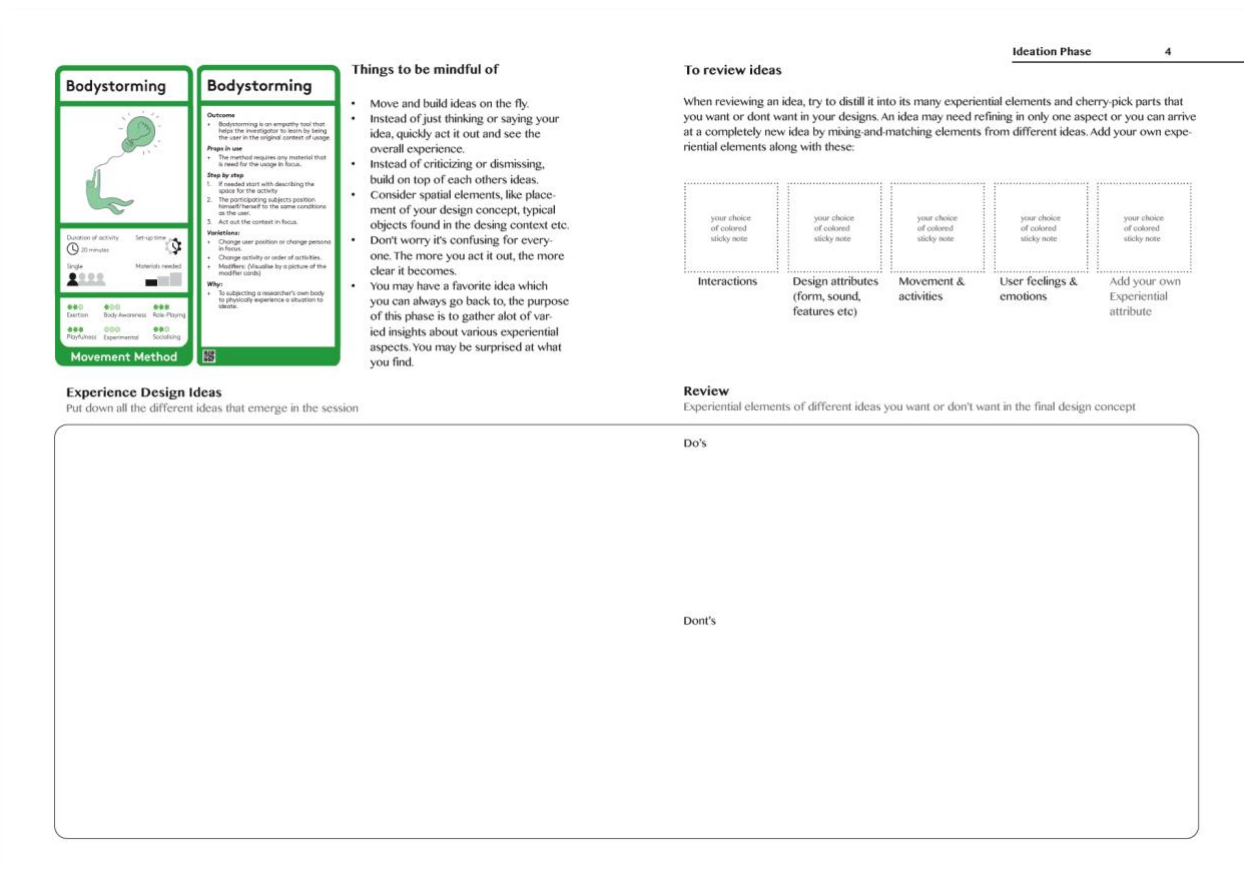
5.3   Evaluation

The evaluation was conducted in an open-ended manner where the participating teams were provided the workbook material and brief usage instructions at the beginning of the workshop. The impact of ES workbook was assessed in two ways. The researcher made observations during the workshop about a teams' distribution and practices. And post-workshop each team provided their qualitative feedback in a semi-structured group interview. The evaluations helped us understand the influences of the workbook on a student team's execution of MbDMs. We additionally also learned the pitfalls in our study setup.

5.3.1 Method

Setup
Both evaluations (in Ch.5 and 6) took place in the course setting of Experience Design for Interaction (EDI) '22 at the University of Twente. More details about the classroom setup can be found in section 4.4.

The first evaluation was conducted in the Embodied Sketching workshop of the EDfI course. A few days prior to the workshop, the *ES Worksheet – I (Understanding Context),* was emailed to the entire cohort as a preparatory exercise. Whereas *ES Worksheet – II (Embodied Ideation),* was introduced to the participant teams at the beginning of the workshop. They were provided the material - one A4 sized workbook (Appendix F) and an A2 sized poster (figure 11)- and were given a brief set of instructions to explain its usage. The teams were told to use the provided material freely as they deemed fit. No additional moderation was done for the rest of the workshop. However, the teams were informed to contact the researcher in case of any confusion or doubts. This was an intentional choice to check if and how much external help is required by the teams to use the worksheet. The teams followed the workshop instructions (similar for the entire cohort) and engaged in ES while making use of the provided material.

Participants
The invitation to participate in this project was communicated digitally via email to the entire cohort of EDfI '22. All team-members of two student teams consented to participate in this project. Team One (T1) comprised of three students - 2 males and 1 female, all Interaction Technology master's students. Team two (T2) comprised of five students – 3 females and 2 males. 3 team-members were Interaction Technology and 2 (one male and a female) were Industrial Design Engineering master's students.

An ethics approval with reference number RP 2022-24, was obtained from the EEMCS faculty of the UT to conduct this evaluation.

Data Collection

For assessment, the researcher collected observational data during the workshop (Appendix-H) using the technique of fly-on-the-wall. This was done to prevent leading or influencing a teams' execution. The observations focused on a team's interactions with each other, frequency and purpose of worksheet usage, and orientation of team-members in terms of responsibilities and spatial arrangement around the worksheets.

After the workshop, each teams provided their qualitative feedback in a semi-structured group interview afterwards. See Appendix G, for questions prepared in advance. The interview was conducted online on MS teams and was video-recorded and transcribed using the auto-transcription feature. The videorecording and transcription were later used to analyse the large amount of qualitative data gathered in the two interviews. Limited personal data was collected of the participants that included their names and master's programme.

Data Analysis

The qualitative responses of each team was analysed using thematic analysis separately. This was done as the two teams took completely different approaches during the evaluation. The broad categories emerging out of the thematic analysis are complemented with the observational data collected by the researcher to present the evaluation outcomes and discussions.

5.4   Results

The results of the evaluation consist of the post-workshop qualitative feedback of the student teams. Below we present the results of two teams separately in two sections.

5.4.1 Results of Team One

The reception of Team 1(T1) towards the notion of workbook was overall positive. This was reflected in their consistent engagement with it. They made use of both worksheets that are part of ES workbook.

ES Worksheet – I (Understanding Context)
Overall Experience: The interview began by asking the team to elaborate on their overall feelings to using the workbook. They responded having a positive experience overall and mentioned that the ES worksheet – I (*Define the Context)* was particularly useful. The team appreciated the first worksheet as it opened up discussions within their team and led to new ideation possibilities. The team was meticulous with it and made 3 versions corresponding to three main ideas that they wanted to explore in the workshop. T1 opened the interview with the following -

"I think it was very nice because we saw which idea was a little bit better than the other one, because you think about a lot of more things than just the general things immediately"

Approach to using: The team was asked to share their approach towards the worksheet that was emailed ahead of the workshop. The team replied that they conducted an online meeting with all team-members present. One team-member assumed the role of the facilitator and the note-taker. This person moderated the discussion by bringing up items from the worksheet and was responsible for writing down ideas/important points while also actively participating in discussion. After completing the worksheet, the team collectively reviewed it as a group. For next round of discussion, the role of facilitator was shifted to another team-member. T1 said –

"I think we just started at the top and then one person was writing down and then he stated, like the first words and then everyone was saying things that came up to their minds and then we made like a selection, and we wrote it down… we switched that around... I think he or she just said OK, now we're here…"

Function of ES Worksheet – I (*Define the Context)*: The team was further prompted to recall the topics of discussion from their meeting. Although the participants did not remember the nitty-gritty details (as it had been 2 weeks since their meeting), they mentioned the following functions:

o **Attention to context:** They mentioned the main purpose it served was to open up discussion about things that they hadn't considered before like the placement of other objects in (their) context, outdoor weather conditions and user behaviours. This effected their choice of material in their design. They said –

  ▪ *"For our experience lot of things, we have to think about, which we didn't think about before… like resistible against rain and it should be not easy to break…should be durable"*

o **Iterations of an idea:** The team also used this exercise to gain more insight into their existing ideas and as a chance to investigate different aspects of their imagined design itself. As they delved more into the context and more aspects were unravelled, like the suitability of their imagined ideas for the project brief. This led to variation of their original ideas. T1 said -

  "We just understood better what our ideas meant and how they could be applied in our project. And we came to the conclusion that like these ideas would be convenient to implement and more fitting to the project"

o **Thinking about user characteristics:** It also brought their attention to the different behavioural traits of the users that must be considered for a robust design that could appeal to more number of users. When asked about the kind of insights the team got from using the worksheet, following was mentioned -

  "How a adventurous kid using it or a shy kid using it"

Shortcomings: One of the shortcomings found during the interviews for ES worksheet-I was the unclear information of its function. T1 had made three separate versions of context corresponding to their three main ideas. As the context remained more or less the same for each idea, the teams found the repeated effort to be unnecessary. This oversight can be easily resolved by making the function of worksheet more explicit in the accompanying written description.

ES Worksheet – II (Embodied Ideation)

Approach to using: The team was asked to share their approach to using the worksheet during the workshop. They mentioned that they read the worksheet at the beginning and proceeded to continue as per the classroom instructions and schedule. They were busy in carrying out activities of ES, where after each exploration they stopped to write down the idea and its constituent design/experience elements. Sometimes this was right after a new idea was *bodystormed* and other times, it was after multiple iterations of single idea was *bodystormed.* The teams fixated on noting down the do's (things they liked) and don'ts (things they didn't like). T1 said –

> *"We did write down like dos and don'ts and mainly do's what we liked"*

Balancing MbDM and worksheets: When asked to share their thoughts on how it felt to use the worksheet (sitting activity) alongside doing ES (primarily physically activity). T1 mentioned that the writing time served the purpose of a break. This was particularly useful to recharge physically as ES demands a lot of energy, and for reflecting on the transpired events of that round. Reflecting right after a round prevented forgetting useful insights. It gave the team a chance to collectively discuss their way of execution, what the idea meant physically, individual experience, likes and dislikes etc, while they were still embodying the spirit of the idea. T1 made the following comment–

> *"Well, I think it's also good to. Like after you moved a lot and. Just sit down. OK? Think about what did we just do? How did it feel? Like? I think it's very nice to reflect on it. Because then otherwise, we forget the half of it… like what work. What did not work like. Then you're sort of still in the moments, but just out of the moments. But you still remember. Uh, so I think that is nice. And you also don't have energy to just keep moving around for forever. So, I think it worked nice for us."*

Possible Improvements: Team 1 mentioned that at times they struggled with coming up with new variations of an idea and suggested that it could be included in the worksheets. A reason mentioned behind this was the physical fatigue towards the end of the workshop and also lesser number (3) of team-members.

5.4.2 Non-Results of Team Two

Team two (T2) was less receptive of the ES workbook. Unlike T1, they had not completed the ES worksheet-I (Understanding context) which was emailed before the ES workshop. And were not keen on following the ES worksheet-II during the workshop. The reasons for it were uncovered during the interview and are presented below. The participants were asked to share what they instead did during the workshop and what changes can be made to make the adoption of workbook easier. At the end we present some miscellaneous remarks, that provide useful insights incorporated in the design of the next workbook aimed at Experience Prototyping.

Reasons for not using ES Workbook

No time to familiarize themselves: It was mentioned that sudden introduction of the second worksheet was unexpected and took them by surprise. They said –

> *"… we were trying to sit down and write stuff down and one of the worksheets just sort of appeared"*.

To which another team-mate added that it meddled with their formerly prepared strategy. –
"to think we already have our own tactics, so to switch that off, we put effort in that already"

Less integrated with the rest of the workshop: Another reason mentioned twice was that the positioning of the worksheet was unclear in the lecture. The regular classroom schedule had no dedicated time set aside for the worksheets and hence the teams were not motivated to go out of their way to do so. They said –

> *"For me, I think that we didn't really give the sheets an honest chance because it didn't have a clear position in the lecture. Like if it had like a space and now you're going to take a look at the sheets and looking on, that's using display for method I think then we would use the sheets, read it and give it a fair chance. But now it didn't."*

Although at the time of introducing the worksheet a brief set of usage instructions was provided to the teams but without emphasizing the utility of the worksheets. So the teams saw no value in investing their time in additional workload. They said -

> *"I also didn't see why it would greatly benefit us to invest time in reading the sheets when we could just do what the teacher said and start playing"*

Another important reason brought forth was that the classroom instructions were inconsistent with using the worksheets. One participant said that they felt more encouraged to play and do physical activities instead during the workshop.

> *"Yeah. Also, I had the feeling that whenever we were sitting and discussing and writing stuff down, one of the professors would come over and be like, why aren't you playing? Umm, so then it was very like, OK, we're not gonna write stuff down. We're just gonna go play. We're not gonna read stuff. We're just gonna go experiment and play with it. But because of that, we didn't really anchor ourselves in the worksheets. I know. I read them over. Probably some of it is somewhere in the back of my head."*

Less fun than playing: Another important reason which two team-members agreed upon was that the notion of reading and writing appealed less in comparison to simply playing and experimenting. They said –

> *"…there's also the option of just going and playing, which requires no parsing "*

Unapproachability: One participant mentioned that the ES worksheet-I did not provide a stepwise layout because of which they found it hard to get started and consequently did not pursue the worksheet any longer. The lack of examples was also an additional reason.

> *"I look at it and I'm like, oh, where do I begin? You know and that makes it harder to like … there's a lot of text and not a lot of examples."*

ES Workshop activities of Team 2

The movement of Team2 was observed during the evaluation. As the observations were carried out employing the technique a fly-on-the-wall. It was hard to comment on the actual content of the team's discussion. For this reason, teams were asked to specify their approach in the workshop and the nature and topic of team's discussion. They responded that their approach to the workshop was explorative where the aim was to try out a number of distinct design concepts which were prepared beforehand. The team arrived in the workshop with a few sketches of envisioned design concept and equipment, that served as the starting point and upon which new iterations were created. During the workshop they tried out individual concepts along with introducing variations to it to find new prospects. One team-member explains it as –

> *"just trying things out and experimenting with different ideas like when we had a concept and we wrote it down, we would make variations of the concept, and that way discover new possibilities"*

For each new concept the team created a new sketch on a different paper and noted down things like variations and possible gameplays they could build around it. After an ES round finished, the team collectively decided on the good and bad parts of design and experience elements, along with learning reasons behind it. The participant said -

> *"And then if we like this or not, then why we thought we liked this or what are the good and bad points?"*

Improvements: The team was asked to suggest changes for making the adoption process easier along with any additional improvements to the design of the workbook

1. Multiple team-members agreed on introducing the entire workbook in advance, such that the team gets enough time to collectively go over each worksheet. This removes the surprise element and lets the team situate themselves and their strategies accordingly. Or alternatively having a time set aside in the workshop for reflection and using the worksheet.
2. Clear stepwise instructions on the poster.

Miscellaneous: A participant said that poster should present a chronological order of steps to be followed so that it becomes more straight-forward to use it and demanding of their attention and efforts. They were asked if an interactive worksheet would be useful in such case that supplied timely prompts. To which the participant said that it is unnecessary and an ordered steps would have the same effect.

5.5   Discussion and Reflection

In this section we discuss the implications of results from the previous section. We formed broad categories by combining direct feedback of the teams with the researcher's observations (see Appendix H) to understand the influences of the ES workbook on a team's practices when working with a MbDM. Below we present the things that worked and did not work in the ES workbook as well as the flaws in our study setup.

5.5.1 The ES Workbook

Promising Aspects of ES Workbook

The objective of the ES workbook is to enhance the process of adoption and navigate the execution of Embodied Sketching for student teams. Since there is no comparative data (teams with workbook vs teams without workbook), it is difficult to say exactly to what extent workbook has been successful in fulfilling its objective. Moreover, we obtained qualitative feedback of only one team who used it. Without generalizing the results, we present some markers of the workbook's effectiveness.

- Team 1 was inspired to think about different variations of their ideas by *gaining a deeper insight into the context*. They also adapted the use of prompts (that draws team's attention to various experiential elements for reviewing purpose) as conversation starters and design considerations for coming up with new idea or iterations of existing idea. The direct impact of this on the quality of their concept is hard to assess. However, this indicates a way in which teams can be *nudged in a favourable direction* when presented with bite-sized knowledge early on.

- The workbook *was not deterrent to the team's collaboration*. During the primary interviews with the students, we learnt that team dynamics effected a team's receptivity towards the MbDMs and their ability to engage in the practical implementation (sec 3.3). The researcher observed that the use of workbook does not create a distributed arrangement of team members. The team carried out an ES round and only during break, huddled around the worksheet to capture important insights. Moreover, at multiple occasions the prompts in the workbook were helpful to bring team members together and kickstart discussions.

- It is also noteworthy to mention that the sitting-down and reflective engagement style with the worksheets *did not detract from the physical involvement that is characteristic of ES*. The team instead found it beneficial for recharging physically and discussing the events while they still held onto the physical experience of their *bodystormed* concept. This

enabled a way of capturing useful insights while most of the information was easily recollected.

Affordance of physical nature of the worksheet

Mobility: The physicality of the worksheets carried multiple affordances. In the ES workshop it was observed that the teams took the poster off the wall and instead placed it on the ground where they huddled around it. This could not have been possible with the digital format of the worksheet. This mobility in its placement allowed for a more relaxed and less physically restrictive way of use.

Information Storage: The poster served as a place to store the useful information for the team. In the beginning team started by putting down some pre-meditated design concepts on the poster. Throughout the workshop, the poster was used as an idea-bank out of which one idea was picked for exploration in an ES round. After exploring an idea, its iterations and generating new ideas, the capture-worthy information was noted down on the poster for future reference. Towards the end of the workshop, we observed the team using this previously stored information to discuss the final set of ideas to be taken forward.

Facilitation Needs for ES workbook

An important design consideration when creating the workbook was to make it self-explanatory. We wanted to minimize the facilitation load of the educator/facilitator and not increase it. To the best of our knowledge, the participant teams did not ask for help regarding the workbook before or during the workshop. Moreover, it was observed that the teams were incorporating the prompts in their ideation and were discussing experiential elements like sounds, usability, user's behaviour. This presents a novel way of nudging the teams that reduces the need of delivering repeated instruction for the facilitator/educator.

Improvements to the design of the Workbook

Detailed description about utility: One of the shortcomings uncovered during the interviews, was the unclear instructions on the utility of ES worksheet-I. T1 made three separate versions of context which remained more or less the same for each idea, the teams found the repeated effort to be unnecessary. A clear set of instructions about its utility and usage should be mentioned in the description accompanying a worksheet.

Stepwise instructions: One recurring suggestion was to include clear stepwise instructions that can be followed without having to decipher the execution order. T1 mentioned it in regard to the ES Worksheet- II.

Usability Improvement: T1 mentioned that they had to refer the description of a few words while working on ES worksheet-I. Although the description is specifically made for clarification purposes, using simpler terms, or embedding the description within the worksheet can improve the practice of using the worksheet tremendously and minimize friction in its adoptability.

5.5.2 The Experiment Design

Flaws in Experiment Design: The most notable shortcoming of the study setup was Team 2 skipping the use of the worksheet altogether. All reported reasons are mentioned in section 5.4.2. We believe this is caused by a flawed procedure of introducing the worksheets. The teams were emailed *ES Worksheet- I (Understanding Context)*, the week before the workshop and it was left up to the teams whether or not they used it. Also, the instructions were ambiguous and did not clearly indicate workbook's significance and role in the course, it was simply overlooked. Similarly, for *ES Worksheet- II (Embodied Ideation)* the verbal instructions did not emphasize its position with respect to the entire workshop, leaving the team unconvinced to use it. Also, the team reported that they were not expecting to use a workbook during the workshop. They came with a prepared strategy and did not appreciate or entertain the ad-hoc change. The team mentioned not getting enough time to *"familiarize and situate themselves in the worksheets"* and we did not enforce the use of the workbook or moderated the teams in any way.

Therefore, moving forward it is advisable to introduce the workbook during the preparation phase so that the teams get enough time to get familiar and incorporate the worksheet in their design process. Additionally, stressing on the workbook's utility and function must be included in the instructions.

5.6   Takeaways

We revisit some insights gathered during the design of ES workbook and its evaluation within a classroom setting.

- The workbook made for a good way to kickstart discussions amongst the teams. This can be particularly helpful for teams in which members are new to each other. Or to support those teams that are passive or might struggle to work as a team.

- Engaging with the worksheet alongside embodied sketching (ES) has no observable or reported side-effects that are deterrent to the physical involvement required in the method.

- The worksheet's description should clearly explain its utility (what are the possible benefits and why should one do it), and use (how to do it). This helps the students understand a worksheet's relevance in the overall design process.

- Worksheets acts as information storage device and is handy to store all the information in one place during the workshop for a quick look and for future design stages.

- The workshop should set a dedicated time aside for teams to work on worksheet. This can advance its usage and thus its influence on the teams' execution of the method.

- Providing prompts early on helps the team expedite their creative process and more aligned to the course goals. This also reduces the need for repeated instructions from the educator/facilitator.

- A clear stepwise demarcation of steps makes using the worksheet more straightforward and can significantly impact a team's receptivity of the workbook.

- Physical nature of the worksheet (A2 poster in our case) allows for flexible placement (on the ground or wall) as per team's demands, making its use more robust. However, the bulkiness of the poster (A2) had a downside that it was not mobile enough and was left behind when the team went outside of the workshop premise.

- Introduce the entire workbook during a team's preparation phase for a workshop. This allows them to become comfortable with the contents of workbook and better integrate it in their strategies.

Chapter 6
Scaffolding Experience Prototyping

In this chapter, we implement the scaffolding approach tailored to Experience Prototyping. The overarching design and evaluation process remains the same as described in Chapter 4 and followed in Chapter 5. During the evaluation in the previous chapter, we uncovered some improvement areas in the setup of our study and gathered direct feedback on the visual improvements of the workbook. These new findings were incorporated in the Experience Prototype workbook to better the student teams' experience.

6.1 Introduction

The Experience Prototyping (EP) workbook presents a broken-down, 3-step approach of performing the method for a novice team. In the design of the workbook, we put together knowledge gathered previously from different sources. The literature and primary research along with classroom goals determine the design and the visual design is informed by the direct feedback received during the evaluations in Chapter 5. In the upcoming sections we discuss the design details, iterations done at different stages along with the artifact's state and improvements in our study setup.

6.2 Design of the Experience Prototyping Workbook

Similar to previous chapter, the design of EP workbook is informed by combining workshop goals with relevant information from the literature.

6.2.1 EP Workshop Goals

By this moment, the participant teams were equipped with first-hand knowledge of the context they were designing for and had a collection of possible ideas. This week's workshop was aimed at teams exploring and fleshing out the details of their envisioned experience. The teams were to create a prototype of their design experience such that a person from outside their team is able to understand and experience their design and give feedback on it. By observing and engaging with outside participants, the teams were to further explore and finesse different experiential components of their designed experience.

6.2.2 Background of EP

Experience prototyping is a method put forward by Buchenau and Suri [19]. It is a MbDM that requires active participation of the design team in a real or simulated context with one of these goals - (1) understanding existing user experience in a context as well as the context, (2)

exploring and evaluating ideas in a context (original or a close approximation), and (3) sharing design/experience ideas with an audience. The authors define Experience Prototyping as "*any kind of representation, in any medium, that is designed to understand, explore or communicate what it might be like to engage with the product, space or system we are designing*" [19, p. 2]. While prototyping techniques like scenarios, storyboarding, sketches, and videos are acceptable mediums to carry out this method. The authors stress on physical participation of the design team where the team-members "*experience it themselves rather than witnessing a demonstration or someone else's experience*" [19, p. 2]. For this, they draw elements from role-play, improv-theatre, enactment and bodystorming and demonstrate the application of EP in several use-cases. They advocate that physical involvement instigates a deep sense of understanding (in design team, clients, users) that is useful in *identifying issues* and recognizing *design opportunities*. This is based on the *tenet* which they describe as "*experience is, by its nature, subjective and that the best way to understand the experiential qualities of an interaction is to experience it subjectively*" [19, p. 2].

6.2.3 First version of EP Workbook

The two goals of "*exploring and evaluating ideas*" and "*communicating ideas*" as listed in [19, pp. 5–7] resonate directly with the goals of the classroom (described in section 6.2.1). The first goal for the teams was to communicate their envisioned experience to a person outside their team (third goal in [19]) and then explore it with the user (second goal in [19]).

EP Worksheet-I: Define the Design Concept
As in the example "Digital Camera Interaction Experience" presented in [19], the design team had a vision of the final product and its user experience which was later turned into a prototype for effective communication with the client. The prototype contained a working system to demonstrate the functionalities (which was not representative of the looks of proposed designs) and an additional appearance model that displayed the look and feel of the product. With the combination of two, they were able to make the client better understand their envisioned user experience and product behaviour. Taking inspiration from this, the first worksheet is designed to make the student teams **develop a clear vision of their envisioned design concept**. They are instructed to decide on the details of the design concept, associated user experience and most importantly, the key features which create the core of their envisioned experience. Once the core experiences and its contributing features are recognized, the teams are better placed to build an effective experience prototype.

We also **embed brief description of items** directedly in the worksheets. We observed in previous evaluation that referring to the detailed description meant that the teams had to momentarily step-away from the activity at hand. Viewing all the relevant information allows for a more seamless experience of using the worksheet. Figure 12 presents the first version of EP worksheet - I.

Figure 12: First version of EP Worksheet-I

EP Worksheet- II: Trial the Design Concept

The first EP worksheet was intended as a pre-exercise that led to prototyping, that prompted the teams to establish a clear vision of their system in terms of its working, features, offered interactions and the core experiences for the user. The EP worksheet-II is to help teams during the execution of EP. A simple approach of implement-test-reiterate cycle is proposed.

First, the team *defines* what part of the experience or designed artifact is being checked and how it should be implemented in a prototype form so that an external user is able to grasp it. Then, after the external user engaged with their prototype, the team *gathers* feedback (1st person feedback from the user and 3rd person feedback from team-member who acted as observer). Based on the feedback, the team *discusses* what worked as well as what did not work in that iteration and *decides* if any changes required in the design concept or their way of execution. For the next round, the teams can reiterate the previous design setting with new changes or focus on a different aspect or a combination of both. In any case, the same cycle is repeated.

Additionally, for this worksheet we include *a set of variations* to encourage teams to subject their design system to varied test-conditions. The modification in scenarios, personas and roles allows a team to imagine and assess their designs from different angles, uncover new

possibilities, and also prevents from conforming and re-propagating their own preconceived ideas and expectations. These variations were inspired from the primary research in Chapter 3. For example, (in sec. 3.3) a student participant mentioned using different user quirks as a way to investigate the appeal of their offered experience for different users; and the Expert (sec. 3.2) often instructed students to think about different use-cases, scenarios and to switch roles in the team to gather a variety of data that informs their decisions.

Figure 13: First version of EP Worksheet-II

EP Worksheet- III: Moving forward

The EP worksheet-III helps the team summarize their learnings and findings at the end of EP workshop. We present three simple questions to prompt the teams to *revisit the obtained insights* from the session. This gives an opportunity to the team to extract the essence of the EP workshop, to collectively discuss and decide the changes needed in their envisioned design concept. The worksheet concludes by instigating the teams to think about the next steps needed to incorporate all the findings.

Figure 14: First version of EP Worksheet-III

6.2.4 Second version of EP Workbook

The second version was arrived at by incorporating the feedback from the primary educator of the course. In the **EP worksheet-I**, additional section was included to explicitly prompt the teams to think about different ways to create an approximation of their design experience. In **EP worksheet-II**, the key feedback was to include the perspective of the team-member(s) who acts or controls the (prototyped) system in the "observe" step. We term this as 2nd person feedback[2]. This team-member often has important insights about where the designed system was robust and where it lacked. Few visual changes were made to the layout for reducing visual clutter.

Figure 15 shows the A2 poster created from merging EP worksheet – I, II and III (See Appendix I for the final EP workbook.)

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[2] It is to be noted that our interpretation of 2nd person feedback is a combination of the "kinesthetic-empathy" eliciting 2nd person-perspective mentioned in [7] and the machine perspective mentioned in [15]. The team-member(s) who acts as a part or whole of (or controls) the system is situated closer to the user during an EP round, and thus is better positioned to kinesthetically empathize with the user's sensing and actions. And controlling the system allows the team-member to recognize the systems' interpretations and responses to user's activity that were appropriate or flawed.

Concept Name
Give it a descriptive name

Describe the concept
Write down the core idea of your concept

Key interactions for user
The ways in which user makes something happen in your designs eg: pressing buttons, voice interface, screen taps etc. How does the system respond to different inputs.

Key experiential features of the concept
Which features of your design concept delivers the key experiences to the users.

Ways to realize the key components of your design
In what ways can you create the most authentic experience of using your design concept for the test users. Think about using video, sound, lights, wizard of oz etc.

Describe your target user
Which user group you keep in mind while coming up with this design concept. Describe their demographic but also some of their quirks, values and behaviors etc.

Emotions and values of your user the concept targets
In what ways would the user relate to your design concept.. how can you promote product usage, improve their resonance with the product or create a more memorable experience.

STEP 1 : Define the concept
As a team describe the details of the concept you are trialing

Check
The parts of your design concept you would like to check with test-users. It could be the whole concept or smaller experiential components.
Decide WHAT would you like to check and HOW.

Observe
Write down the feedback from 1st , 2nd person perspective.
Add observations from 3rd person perspective.

Review
Reflect on what worked and didn't work.

Iterate
What needs to change for the next iteration?

Variations

- Scenarios: Imagine your design being used in the real-world. Come up with 3 different scenarios and validate your concept.
- Personas: Your users will have different quirks. Try to think of distinct characteristics in a user and validate your concept.
- Come up with 3 different ways that your concept will be used.
- Switch roles between the team members so you get variety in observations.

STEP 2 : Trial the design concept
Try-out your assumptions about the design concept

What were some things that were surprising?

What worked well in your concept?

What did not work well in your concept?

Which aspect of user, technology or design it brought to your attention? How can your design be improved to account for it?

How can you make the most out of these positive elements?

How can you avoid or completely remove these ?

What's next?
Think of concrete steps to take next so as to incorporate everything you observed today. What changes should you make to maximize the positive interactions and decrease the negative ones?

STEP 3 : Moving forward
Reflect, decide, and make changes with the team

Figure 15: A2 sized poster provided during the EP workshop

6.3   Evaluation

The overarching evaluation approach, the participant teams and the method of data collection as well as the analysis remained the same as the previous chapter, see section 5.3. There was however a small change in the procedure of introducing the worksheet to the students.

6.3.1 Method

Changed Procedure

For this evaluation, participant teams received a Miro board link consisting of the complete workbook a week prior to the workshop. And at the beginning of the workshop, teams were given a brief set of instructions describing its utility and a time indication to focus on a given step. Instruction however did not specify what each term meant or how to use or not use the worksheet. Teams were once again provided the material (one A4 sized workbook (Appendix I) and A2 sized poster (figure 15)). They were told to use the provided material freely as they deemed fit. Additionally, the teams were informed to contact the researcher in case of any confusion or doubts. No additional moderation was done for the rest of the workshop to check if and how much external help is required by the teams to use the worksheet. The teams followed the workshop instructions (similar for the entire cohort) and engaged in EP while making use of the provided material.

Data Collection and Analysis

The method of data collection and analysis remained the same. Alongside observational data during the workshop (Appendix-J), the teams provided their qualitative feedback in a group setting in a semi-structured interview (see Appendix G for prepared questions). The interviews were conducted online and within a week following the EP workshop.

6.4   Results

The experiment findings are informed by the qualitative feedback obtained from the teams. We analysed the interview responses using thematic analysis. The themes were labelled in four broad categories– (1) Functions of EP workbook, (2) Distinctive features, (3) Shortcoming, (4) Improvement suggestions.

Functions of EP Workbook

The teams were asked to share the moments when the worksheets were most used and its purpose. A wide range of themes were revealed as each participant shared their thoughts. Some common responses from both teams were:

Goal setting: A commonality in both team's responses was that it helped them gain clarity on what they wanted to achieve in the workshop. T1 said –

> "it helped us focus, OK, what? What do we want to achieve? Well, what do we want to test next time or? ... Like what part of our invention. Do we still want feedback on, and the sheet help more focus and Yeah, that's specific part."

Staying focused on the task and pacing: Along the same lines, T2 appreciated the overall structure to the workshop and mentioned it being particularly helpful in pacing their team's activities. It was also mentioned that it prevented them from getting too tunnelled on one aspect since they created a list of ideas consisting of experience and design element they intended to explore, early-on in the workshop. The externalized representation of goals supported their team to stay focused on the different tasks and keep track of their progress through the entire workshop. T2 said –

> "… it helps that you kind of have this reminder of doing the same steps for all the iterations basically. So you don't stay tunnel visions on one particular thing that stands out for 20 minutes. But then it was like oh, but we still have this thing to discuss. So, it's nice to fall back to that sheet and have a bit of structure I guess"

Vibe check in the team: Both teams mentioned that their respective teams were able to be on the same page about various decisions. This was enabled by the act of writing it on the worksheet. Before writing on the worksheets, the teams usually discussed it among themselves to arrive at an agreement. T1 and T2 respectively mentioned –

> "… little bit like, OK, we're all on the same page about this. We wrote it down and then we can test it, sure."

> "Vibe checks just like sitting down with everybody and being like, OK, So what? What did we decide that worked well... What did we like? What did we not like? … Why did we think that didn't work? Did we give that one option to solve it? Work, but why didn't it work? Or it did work? Why did it work just like a vibe check to all come back to the same sort of space and baseline?

Unpacking the remarks from T2, the various items that teams discussed were a combination of elements from the sheets (what worked, what did not) and also additional elements pertaining to the overall design (things they liked as a group, did not like, why did that work or did it work). Such discussions bring the team's attention to reasons and underlying phenomenon behind their designs and aid their design choices.

Cornerstone for decision: The teams were shared the kind of impact the worksheets had on their team's internal functioning. One participant from T2 stated that the worksheets acted as a cornerstone for the team to come together and collectively decide. At these moments, a shared understanding is generated about the reasons behind a certain decision and solidifies a decision with everyone's agreement. T2 said -

> "Cornerstone point that we could all come back to. I don't think this necessarily made any decisions for us, but it codified that we were all thinking the same thing when we

made that decision, and that a decision was actually the same decision. And then that decision was written down"

Prevents forgetting: A point brought forth by T2 was that writing down (different decisions, observations, points of interest) was particularly useful to prevent forgetting any important information. T2 said –

"Because if we didn't have the sheets, I think that we wouldn't have written down as much as we have now. And we might have forgotten a few things if we didn't write it down."

T1 also remarked along the same lines and stated the stored information being useful for future reference and external communication purposes. T1 said -

"Faced with steps that you have to take because it makes everything a bit clearer, and I think it's also gonna be useful in like the final report."

Smoother communication: Building on the previous point another participant in T2 stated that writing down their choices and decisions was useful as it served as a common reference point, visible to all members at all times. This reduced the need for redundant discussions which can often lead to time wastage and frustration in a team. T2 said -

"When you're working with a lot of people, like, you'll talk so much about a decision that I'll come back like week later and be like, what was the decision? … then you have the potential to rehash that issue and that can be frustrating if a team is continuously rehashing the same issues … when someone's like. Oh, what was that? They can go look it up again."

Distinctive features of EP Workbook

Thinking Prompts: The open-ended nature of the interview questions led to discovering of few distinct features of the workbook that teams valued. The teams valued the prompts in the workbook that made them think in-depth about their designs. T1 said –

"I think it did make us think more about just the design, like what is behind it and made us think a little bit further than just our first ideas…"

T2 particularly valued that thinking about different elements of an experience, like user values and emotion, was helpful and something that they did not do earlier. They examined their existing ideas regarding this aspect and mentioned that although it did not change their existing ideas, it instigated more design ideas where these experiential elements were considered. T2 noted –

"I think that triggered us to think about it in a bit of a different way than we would have if we didn't use the sheets… Especially the emotion. Which emotions user should have is not something we discussed earlier"

Tangible Outcomes: It was a shared comment from both teams that the sheets made for a tangible outcome that is useful to store information and for future referencing. A participant

said that it introduced a scientific feeling to the activity, and they returned with solid results from the workshop. T2 said –

> "Also think it makes it feel more scientific and... like you are recording the outcomes you have an outcome that you can refer back to"

T1 added that this kind of outcome recording also helped them see the evolution of their design with respect to the course brief.

> "We can use the sheets to have some kind of structure in our like story. So, for example, when this workshop we explore this and this, and we had these many iterations and we looked at I don't know whatever was on the worksheet."

Shortcomings

Form factors issues: T2 conducted some part of the EP workshop in an outdoor setting and due to the bulky size of the poster did not take it with them and instead used their own notebooks to make notes. Another issue related to form of A2 poster was pointed out by T1. They found the poster less handy for future reference because of its large size.

In such cases, teams could have been made aware of using the A4 sized workbook in outdoor setting or when being mobile and using the digital medium (Miro board) to store digital versions of their work for future referencing.

Space needed for other notes: T1 used additional paper to write down things that did not fit the contents of the worksheet, like their team's internal planning for the next week, task assignment etc. The participant who made this remark explained that it felt "stupid" to write outside the boxes and it was more natural to write a different thing on another piece of paper. This in our opinion leads to sub-optimal workflow and moving on, additional space should be provided on the worksheet for miscellaneous notes. Participant from T1 said –

> "It also kind of feels stupid to write out of the box … it feels like it's not meant for that"

T2 also wrote down items that did not fit into any poster section. They created a list that was written in the empty space along the edge of the poster. This list consisted of a few variations of ideas they wished to explored and different elements of design to be validated.

Suggested Improvements

Cater more towards exploration: T2 brought forth an important point that at times an iteration is not based a pre-meditated design choices or a feedback/observation, but rather is simply an exploration of the nature "*what-If*". They could not find an appropriate place in the worksheet to make notes of such explorative items.

> "When we came back, sometimes he would have observed something that wasn't necessarily based on that iteration, but that you wanted to explore further so it didn't have like an exploration slot"

They instead created their own list called a "think-about list" which contained any explorative ideas, variations of the ideas, or any interesting finding to be explored further. Moreover, they suggested on incorporating prompts to make a team think about different tools at their disposal, such as –

> *"What are some tools that you have in your basket for solving this problem, like with us and 3D space?"*

Explicit time set aside for worksheet: It was suggested that working with the sheets becomes easier if there is an explicit amount of time dedicated for it. Also, the team is able to get much more out of it. A participant in T2, on being asked about the improvement–

> *"...having more explicit time set aside... In step three, those are important things, but they kind of got smushed into random pockets of time that we carved out for them"*

6.5   Discussion and Reflection

In this section we discuss the implications of results from the interview feedback along with researcher's observations.

6.5.1 The EP workbook

EP workbook is designed to facilitate the adoption and execution of Experience Prototyping for novice teams. As the results in earlier chapter, the results presented here are not comparative but accounts of subjective experience of two student teams. Teams' post-workshop responses and researcher's observations indicate the following promising aspects of EP workbook.

Promising Aspects

Both teams appreciated the structured approach offered by the workbook for practically implementing EP. The teams found it useful to ***determine their respective goals and focus for the workshop***. The externalized goal representation facilitated the teams to determine the tasks needed in pursuit of the set goal and how to pace their efforts/activities accordingly. Additionally, both teams reported that parts of the workbook ***prompted them to think about their ideas/design concept in depth***. In post-workshop interview, T2 cited example of one such prompt to think about new aspects such as *user emotions* related to an experience.

During the interviews, the ***"vibe checks"*** within the teams (as mentioned by T2) were cited as one of the most helpful functions served by the workbook. The workbook enforced discussions that led the teams to create a shared understanding of their design choices and corresponding reasons and enabled a collective decision making.

The teams also liked the tangible outcomes at the end. Teams reported the act of recording was ***useful for future referencing and to prevent forgetting any useful information***. The

capturing of information allowed the poster to become a design artifact that was also useful for internal communication purposes. Revisiting a decision and its corresponding background is made easier as team members can access this poster-artifact to get informed at any time during the design process. This reduces redundant discussions and efforts. It also served as a tool to **view the evolution of their design concept** and convey it for external purposes. Like T1 said – *"We can use the sheets to have some kind of structure in our story. So, for example, when this workshop we explore this and this, and we had these many iterations and we looked at I don't know whatever was on the worksheet"*

Facilitation Needs for ES workbook

Similar to ES (embodied sketching) workbook, an important consideration in the design of EP workbook was to minimize the need of facilitation required from the educators/facilitators. For this purpose, the number of instructions given to the teams were limited. Instructions only conveyed workbook's utility for the particular workshop without delving into meaning of terms used or the kind of appropriate responses expected. The restrained instructions were a deliberate choice to observe if the workbook was understandable without any moderation during the workshop. Both teams **asked for no external help** regarding the workbook, despite the researchers present nearby.

In researcher's observation, a moment of inconvenience was noted for T2 when working on step-I (EP worksheet-I). T2 did not understand description of a term (*Key Experiences*) from the worksheet alone and looked up the related detailed description. After which they were able to proceed normally. This highlights the **significance of including a detailed description** with each worksheet. The detailed description of the workbook is intended to clarify the meaning of terms, how to approach filling it out and possible nudges to get the user thinking. Based on the evaluations in Ch.5, a brief explanation of terms was embedded within the EP Worksheets for enhancing its adoptability. This removes repeated back-and-forth and creates a continuous experience of use.

Improvement areas

In the evaluation, T2 mentioned that in step 2 of the poster, word "check" did not resonate with their notion of "explore". Although the team wanted to view the impact of changing a design element on the overall experience, they found it unfitting to put this under "check". They instead created their own adaptation of "check" and created a "think-about" list in its place. When prodded for reasons, T2 said that some iterations were a result of spontaneously including new insights stemming from observations, feedback, group or individual thinking. Such iterations were more aligned to their notion of "explore" as compared to "check". Using this list as a basis, T2 proceeded to follow the rest of the steps. We believe this issue is solvable by using **a more fitting nomenclature**.

Another thing we noticed during the interviews was the need to have extra space for additional thoughts and notes such as team management, ideas, task distribution etc. Both teams either

wrote notes on extra papers, notebooks or along the edge of the poster. ***Leaving dedicated empty space*** allows for a unified information storage.

6.5.2 The Experiment Design

Design changes that improved experience

Based on the evaluation of EP workbook (in Ch. 5), we introduced ***two major changes*** to the setup of our study. Firstly, the teams received the digital version of the workbook (in Miro) a week before the workshop. ***Introducing the workbook earlier*** during a time when teams were preparing for the workshop, lent itself to be better integrated into their design process. The teams used it as a dialog starter to arrange their focus and goals before the workshop. The early exposure to EP workbook offered an opportunity for the teams to orient themselves and thus have a smoother experience during the workshop.

Secondly, during EP workshop the teams were given ***more specific verbal instructions*** about the worksheet than the last time (in Ch 5). Similar to Ch. 5, the new set of instructions were also brief and did not dictate how the teams should or shouldn't use the worksheet. But unlike last iteration, the instructions were tailored to explain what purpose the worksheet resolves (***utility***) and the order and timing of working on a step (***approach***). This was further achieved through the design of the poster. The A2 poster contained all three worksheets sequentially. This was done to – (1) provide a comprehensive overview of the entire workshop's activities in one glance (2) convey the focus and order of each step. In doing so we attempted to reduce any barrier for the users. The teams appreciated this change and reported on having a clear approach to the workshop. The completion rate of the workbook was also higher (than last time) as both teams successfully finished all three steps.

Overall thoughts on EP Workbook

The teams were asked to share their overall experience of using the workbook. Both teams reacted positively to the EP workbook and mentioned that incorporating it in their respective strategies was easier as compared to Embodied Sketching workbook (discussed in chapter 5). Participants in Team 1(T1) and Team 2(T2) respectively said –

> *"The second sheet was quite useful"*
> *"We had a better experience than last time."*

The teams also mentioned that the stepwise breakdown made for clear instructions that were easy to follow. T1 said–

> *"Yeah, I mean, we just followed the instructions and yeah, it was pretty clear what we have to do"*

Teams were explicitly asked whether using the worksheet hindered with physical engagement that is required in EP. The teams recalled of no such instance and mentioned that team-members took turn to be the observer. The observer did not engage physically and was responsible to make notes while stood nearby. At the end of a round, the team collectively

worked more on the worksheet. This is similar to the example of "Role Playing a Train Journey Experience" in [19], where the teams captured their learnings during breaks and used the in-between time to reflect and ideate for the upcoming rounds.

This was also apparent in the researcher's observations. The teams huddled around the worksheet the most in the beginning and the end of the workshop. In between each EP round, one team member acted as the observer who was responsible for taking down notes of important information and at the end of each round, the team came together to discuss.

6.6 Takeaways

Following are the revisited key insights uncovered in the design and evaluation of EP workbook.

- Introducing the complete workbook in advance gives the team a chance to better integrate it in their design process.

- The scaffolding approach aids the process of goal setting, task determination and pacing of a team's collective efforts.

- The scaffolding approach acts as a catalyst in team collaboration. It creates more opportunities for the teams to engage in discussion.

- The structure acts as a cornerstone for teams decision-making. The teams form a shared understanding of their design rationale through dialog and thus can collectively take decisions.

- Various prompts included in the workbook acts as helpful nudges to get the teams thinking in new and favourable directions. This might reduce the need for recurrent instructions from the educators.

- The writing of decisions and findings, makes the worksheet a useful design-artifact that can be used for frequent referencing during and after the workshop. It also acts as a tool to view the evolution of a design in the broader design process.

- The worksheets should contain a space for miscellaneous notes to allow a continuous experience.

Chapter 7
Discussion

In this chapter, we first discuss the overall process followed in this project and highlight key decisions and limitations of the study. Then we discuss and reflect upon the implications of outcomes obtained in the evaluations of two Workbooks. Later we discuss the suitability of scaffolding for a separate use-case. And lastly, conclude by mentioning the future work.

7.1 The Overall Design Process

In this project our aim was to design a solution that enhances the facilitation/education of MbDMs for educators and/or learners in an educational setting. For this we employed a process similar to Double Diamond design process [5]. In the problem-finding stage, (in Ch. 3) we gathered information from three different sources - literature, an Expert and former students experienced with MbDMs. Through this we develop a comprehensive understanding of the challenges faced by learners and educators in an educational setting. We also mapped out all obtained findings (challenges, recommendations, tasks) in order to form a design space relevant for this project and guide our focus. This helped us answer ***Research Question 1.***

Then in Ch.4. we narrow down to an area with the most number of disruptions, which is during the initial phase of student teams physically implementing a MbDM. Hence, we decided to address the ***need of enhancing the facilitation of MbDMs during the practical implementation.*** For the solution-creating phase, we explored a few ideas, such as XR enabled learning experiences, multi-media note-creation, task blueprint etc., and assessed their suitability for the RQs. We then narrowed our solution to creating a scaffold in the form a workbook. The scaffold (workbook) aims to help student teams in practically executing a MbDM and to enhance the process of facilitation. This answered the ***Research Question 2*** of this thesis. In Ch.5 and 6, we create the actual designs of the workbook for two MbDMs – Embodied Sketching and Experience Prototyping. We evaluate the workbooks with students in real-world educational setting and learn the influences it had on their practices such as process of executing a MbDM, working within a team etc., which answers the ***Sub Research Question 1***.

7.1.1 Why a low-tech solution.

There were three main factors supporting the choice of a low-tech solution over a technical solution. ***One***, MbDMs requires practitioners to engage in rampant, co-creative, collaborative activities with each other and sometimes require tapping into their own somaesthetic experiences. Therefore, we were mindful of not introducing disruptions to the essential characteristics of first-person reflection and high-paced collaboration needed in many MbDMs. ***Two***, we did not encounter technical solution that was attainable for construction in terms of hardware and software within the scope of this project, that created value for educators and

learners while also providing a seamless user experience that is not detrimental to aforementioned MbDM characteristics. **Three**, we saw the possibility of addressing the challenges faced by teams (such as reluctance to leaving familiar ways of designing and not knowing how to execute a method) during the initial phases of getting involved with MbDM through using a low-tech scaffolding solution – The workbook. It could also accomplish the aim of not disturbing the essence of a method negatively.

This is in-line with the ideology put forth by Baumer and Silberman [36], urging designers to be **cautious of tech-based solution over a low-tech or no-tech solution**. As illustrated by the authors, that designing a computational technology in resolution of unsustainability often neglects the complexity of the entire context which includes other issues like environmental, political, social, historical and economic etc. Along similar lines, Sancho-Gil **criticizes the use of digital technology arising from "technological-solutionism"** to solve the difficulties in education [37]. She highlights that such solutions disregard the "*wickedness*" of issues existing in education paradigm and focus the solution on an *invented* or a minor part of the problem.

> *"Solutionism, results from disregarding the characteristics of "wicked" problems, by 'inventing' a problem, misrepresenting this fiction as a genuine and urgent dilemma and advocating the use of digital technology to fix it". – Sancho Gil* [37]

To a certain degree this project acknowledges the "*wickedness*" of an educational setting, particularly one that employs MbDM. The reported problems of students' inexperience and knowledge-gaps, along with movement-related and social awkwardness presents a complex challenge containing many aspects. For this, we employed an **activity-centric approach to design** closely in-line with Waern and Back [38]. The authors highlight that interaction design research must be more concerned with the way "*human interact with each other and through artefact*" than with just the design of an artefact (technological); and that an activity-centric design is "*inherently open to the option to not designing any technology intervention*" [38, pp. 1, 9].

The workbook represents the tasks related to a MbDM's execution that *serve as guidance* for team's activities and efforts during the execution. It indicates *what* activities should be done, and occasionally hints *how* one might approach it but does not dictate a detailed scripted performance. Therefore, offering a "*less-precise script*" that leaves plenty of space for adaptation and appropriation by the teams (as also found in the evaluations) [38, p. 6]. Moreover, in setting of a classroom there are many things competing for a student's attention and effort. Thus, the non-invasive and undemanding nature of a workbook offers more advantages than a technical solution. The workbooks require no learning effort on how to operate it and is non-interfering yet available when needed. After going through the design cycle, we learnt that it does not hamper the activities related to MbDM and indicates other advantages (in sec 7.2.2).

7.1.2 Process of Designing the Workbooks

We followed an iterative approach to design workbook for both workshops. This was done to ensure that workbooks were aligned to the classroom goals, where evaluations were conducted. Tailoring to the classroom's goals was crucial as MbDMs were appropriated, as is often the case, to the needs and learning goals of the classroom.

The first version of a workbook focused on attaining the functionality i.e., determining the goals and relevant tasks needed in for the particular MbDM workshop. This was derived by combining the workshop goals (sec 4.4.2) with the valuable insights gained from literature (sec 3.1). We incorporated recommendations gathered during primary research interviews with the Expert and experienced students in the form of practical tips wherever necessary. By incorporating previously tried-and-tested techniques from a real-world context into bite-sized information, we aimed to bring efficiency in a team's execution practices. The second version was designed after incorporating educator's feedback, gained in a pre-liminary evaluative discussion, to ensure that workbook catered to the classroom goals. After which, the final designs were presented to the student teams for use and consequently evaluation.

7.1.3 Limitations of the Study

The results of the study are based on the participant teams' qualitative feedback and researcher's observations. As the participant teams were using the MbDMs for the first time while making use of the workbook. Therefore, they could not offer comparative remarks on how their experience is affected because of the workbooks. The co-creative and situational nature of MbDMs makes it hard to assess the factors affecting the knowledge generation within a team while keeping all other parameters the same. Therefore, we did not focus on employing a mechanism to capture comparative results between teams, (those who used the workbook vs who did not) to objectively calculate the impact of the workbooks. In addition to practical limitations, the comparison was also not feasible due ethical limitations. Not all team-members agreed to participate in the study from the non-participating teams. In such cases including a team's results was not ethical. Additionally, evaluating in a real-world educational context posed time and context limitations which meant that each workbook was evaluated with two teams, T1 (3 students) and T2 (5 students), once per method in only one educational setting.

7.2 The Workbooks

In this project, we implement a scaffolding approach to facilitate the execution of MbDMs in a real-world educational setting. The scaffolding in the form of a workbook is made for two MbDM workshops, namely – Embodied Sketching (ES) and Experience Prototyping (EP). The method of creation and evaluation of the two workbook is similar and discussed below. We also touch upon what worked and what did not work.

7.2.1 Design of the Workbook

The underlying concept of the workbook resonates closely with Waern and Back's [38] notion of **activity-centric design** in *"that it aims to influence (and sometimes control) what people do"*. The workbook indicates a general overview of activities related to MbDM execution without presenting or stimulate creating a detailed script of performance.

The design of both workbooks is modelled on a 3-phase format. **The first phase** is for preparation. This phase builds on the existing knowledge of students, bringing key design aspects in their awareness early-on and allowing them to link their existing knowledge to practical execution. The students begin by first describing the essential information already known to them which also form the basis of the respective workshop, like describing the actual design context (in Embodied Sketching) or the details of their envisioned experience concept (in Experience Prototyping). **The second phase** is physically engaging with the MbDM. For this, the workbook presents the broken-down format of workshop goals in its constituent tasks and actions (relevant as per each task). This is intended to make the MbDM execution more approachable for teams by outlining clear actionable items. It also offers a broad view of the different execution activities which allows teams to organize their collective actions and efforts accordingly. **The third phase** is summarizing the findings at the end of the workshop. This is to ensure that the key insights are surfaced and can be used in later design stages by the team. For this, we present some prompts to trigger the teams to revisit prior steps and collect the main insights from the workshop.

7.2.2 Promising Aspects

In our study setup, as indicated in observations and from students' feedback, the workbooks as a form of scaffolding has shown promise in several aspects such as providing an easier landing into execution of unknown methods, helping teams determine relevant tasks for a goal and nudging the teams along the way, and steering team's internal dynamics.

Motivates Getting Started & Keeping the Momentum

The structural approach provides a **smoother, easier introduction** to executing a new design method. As reported by Team 1 *"… we just followed the instructions and yeah, it was pretty clear what we have to do"*. The workbook provides a peek into the tasks involved in executing a MbDM before actually doing it. Thereby alleviating confusion and anxiety (stemming from unfamiliarity) and making the idea of execution more accessible. This might lower the initial threshold of getting started with the methods (a key challenge noted by the Expert and experienced students). Additionally having a structure to rely upon helps strengthen one's motivation to step outside the familiar ways of designing, a challenge noted in the primary research with students where unfamiliarity resulted in team members resorting back to known ways of designing.

Aiding the teams in setting goals and determining relevant tasks is reported as one of the better benefits of using the workbook. Both teams appreciated the support offered by the structure in clearly understanding what is expected and what steps can be taken to achieve it. The sequential instructions enables the team's momentum towards the set goals. As reported by Team 2, it helped them direct and keep track of their collective efforts. The structure acted as a cornerstone for their team to collectively reflect, decide, and take actions. Not only it promoted cohesion in a team but also assured that the team advanced forward.

This becomes particularly ***beneficial where teams consist of individuals with different educational background***, which is usually the case in HCI and ID classrooms. In such teams, not all members are privy to basics of design thinking (DT), iterative design or interaction design and therefore may find it hard to relate to MbDMs (as also noted in the Expert remarks and the literature). Even for the members with a design background, having an execution structure lowers the barrier of changing their mental models (which is based on prevalent methods of DT, user centred design etc.). The challenge of teaching a heterogenous classroom is mentioned in the literature ([22], [28]) as well. The workbooks can be used as a supplementary tool alongside regular teaching activities so as to help teams envision working with a MbDM.

Nudging Teams Towards the Goal

The content of the workbook activates constructive discussion, within the team, pertaining to design and problem space. For example, Team 1 was able to consider environmental elements like rain and user elements like different behavioural traits through the use of ES worksheet-I, which led to modification in their designs so as to account for these elements. Through focused discussions, the teams ***generate a shared understanding*** of many facets of their design context and design solution. Often the focused discussions led to other conversations where a team learnt more about their own design choices and corresponding rationale. This ensured that all team-members were aligned with the generated knowledge, which in turn ***facilitated a collective decision-making.***

The prompts also nudge the teams towards a ***favourable direction more in line with the course (or workshop) goals.*** Like in the EP workshop, the goal was to further a team's understanding of experiential and interaction qualities of their envisioned experience. A constituent part of an experience is user's subjective *mood* [19]. Team 2 was able to consider the aspect of *User Feelings and Emotions* associated with their envisioned designs through the use of EP workbook. By making important aspects known to the teams early on shows a potential technique that enriches their execution process. We speculate that this might increase the execution efficiency of a team and might also possibly boost their design capabilities as important aspects are now brought to their attention. Including practical tips in the workbook is another beneficial way for promoting a team's efficiency. In our case the practical tips were derived from recommendations received from the Expert and previously experienced students (in sec. 3.2 and 3.3). The shared recommendations were based on tried-and-tested techniques from respective real-world design projects. Hence it made sense to offer these as practical tips relevant to the classroom goals and setting. For example, the variation of changing user

personas based on users' behavioural quirks in an EP session already gets the team thinking about the versatility and appeal of their designs to a wide range of users. Such practical tips provides assistance in teams' execution and may result in enriching their designs.

Enhances Team Dynamics

We found in our observations and directly from the teams that workbook seems to positively enhance a team's collaboration. The very act of doing the workbook requires the team to come together. This can be particularly useful for teams where team-members are new to each other or are passive. In primary interviews with students (section 3.3), initial awkwardness with strangers was found to be a significant hurdle for many participants. Although it might not take away the physical awkwardness of performing the MbDM, the set of pre-determined topics in the workbook offer a way to spur design related conversations in a team and to reduce the initial social barrier. The pre-determined topics enforces the team-members to engage in dialog about several design related aspects. Thus, manufacturing additional opportunities for team to collaborate. Like in the evaluation of Experience Prototyping workbook, Team 2 reported that one of the key functions served by the workbook was to **enforce "vibe checks"** in their team. The team discussed themes mentioned in the workbook as well as additional themes uncovered in their team discussions. Engaging in dialog ensured that all team-members were on the same page regarding the design choices made as well as the rationale behind it. This facilitated the process of collective decision-making and promoted unanimity in the team.

Although it was not assessed in our evaluation, we argue that **relieving the team of meta-activities**, such as managing team dynamics, initiating discussion, creating a shared understanding, and taking collective decision; leaves more cognitive resources for MbDM related actions and thoughts. Therefore, increases opportunity for the team to focus more on their creative and design endeavours.

7.2.3 Faciliation Needs from Educator/ Facilitator

A key consideration in the design of workbook was to not increase efforts needed from an educator/ facilitator. For this purpose, we provided only necessary instructions and did not moderate how the teams used a worksheet in our study setup. In both sessions teams did not ask for additional help from the researcher or educators regarding the use of workbook despite having the option to do so. This testifies that workbook **indeed did not add to educators efforts.** When designed carefully, it in fact can reduce the need for redundant instructions needed from the educator/ facilitator in practical workshops. For example, in the Embodied Sketching workbook specifying that spatial and environmental elements (like weather) must be considered when developing an experience idea, make the teams aware of the vital aspects without the educator needing to do so. It also minimizes the chance of student efforts being wasted as they operate from the complete knowledge early on. This promotes self-regulation and self-efficacy in a team.

7.2.4 Effect on the MbDM's Charachteristic

We observed that the workbooks *introduced no disruptions* in the co-creative, physical aspect essential in many MbDM (in our case ES and EP). The teams also reported that they experienced no interference in being physically active or during self-reflection activities related to MbDM while using the workbook. In Embodied Sketching workshop, Team 1 in fact appreciated the balance between the physically demanding activities of bodystorming and the more reflective and stationary activities of the workbook. It served as a break to recuperate and think in between rounds of ES. It is also noteworthy to mention that teams took the provided poster off the wall and places it on the floor. The team huddled around it during discussions while sitting/ half-laying in comfortable positions. We assume it reduced physical strain and promotes a positive association with the workbook.

Additionally, we observed in both workshops, that workbook *did not lead to a distributed arrangement amongst the team-members* where one or multiple members become more busy with the workbook than engaging in the method. All team members participated equally in the MbDM rounds, as is necessary. The teams elaborated that after each round they first collectively discussed the transpired events and then noted the important items on the worksheet as a team. In the case of a team-member becoming an observer, they were responsible for noting important items on the worksheet and the role was rotated to other team members for the next round. In upcoming sections, we elaborate how the workbook seemed to enhance team collaboration.

7.2.5 Information Storing Design Artifact

The teams used the workbooks as an information storage device useful for future referencing and internal as well as external communication purposes. Thus, transforming it into a design artifact by itself. In the Embodied Sketching (ES) evaluations, the worksheet was reported to be *useful for quickly capturing insights* while team-members still retained the most amount of experiential information from a *bodystormed* idea. Similarly, in the evaluation of Experience Prototyping workbook, the teams mentioned that the act of storing information in the workbook *prevented them from forgetting useful information* and provided a sense of returning with concrete outcomes. The need of helping students *"extract and abstract insights"* is highlighted by Tsaknaki and colleagues [28, p. 10]. The workbook provides a solution to a certain degree. It encourages teams to capture information at different intervals and assists in extracting insights periodically as well as from the overall execution in the final step. In this way teams are assisted in the process of drawing out the key insights which are useful for next design stages after the workshop. But workbooks do not dictate or account for which insights end up in the team's actual designs.

The challenge of recording and reporting a MbDM has been mentioned in the literature [31]. While the authors in [31], aim to capture the *ephemeral bodily experiences* and *elusive* nature of embodied ideation activities. The workbook explores a way of *capturing intermediate*

findings during a MbDM's execution of a team. In our project, the captured information[3] highlights the journey of a team and several uncovered, noteworthy points found along the way. The teams reported that this type of information storage becomes useful for future referencing and internal as well external communication purposes. Team 1 mentioned that sequential capturing of information brought clarity on the evolution of their designed concept, which they found useful for external communication purposes to showcase their progress. Team 2 said that stored information makes all the past insights and design decisions available in one place and therefore reduces confusion and repeated discussion/ efforts within a team.

This is a desirable effect which was somewhat unanticipated. The workbook was not made primarily for the purpose of capturing information but to simply indicate how to begin and carryout a MbDM. Moreover, the value of the design artifact is based on the knowledge contained in it which is completely dependent on a team's due diligence. Workbooks show a promising way of capturing information, but its use should not only be limited for this purpose. The benefits offered by providing a structured approach to carry out tasks still remains even if capturing the intermediate information is unrequired, unwanted, or infeasible due to time or resource limitations.

7.2.6 Learnings & Limitations related to Workbook

In the first evaluation we learnt that introducing a new part of the workbook in the practical workshop adds to the existing unfamiliarity and hampers its adoption. Team 2 could not integrate the new part of workbook in their design process without it being one of the workshop's activities or explicitly instructed to so. Additionally, the team reported that they were not convinced of the utility of the workbook. Hence, stuck to the prescribed activities of the workshop instead of investing time in something unknown. Team 1 on the other hand was able to use the new part of the workbook and did not face same issues. We speculate this difference could be because of the fact that Team 1 did the first part of the workbook (whereas team 2 did not) that was emailed prior to the workshop during their preparatory phase and hence were more convinced of its utility and function. It highlighted flaws in the setup of our study and also showcased *the importance of providing clear instructions about utility and function of a worksheet.* Therefore, in second iteration we introduced the entire workbook a week before the workshop during the team's preparation phase and found that it was positively received by the teams. The early introduction provided the teams a chance to get to know the material of the workbook and incorporate it in their preparation for the workshop. This also removed the surprise and unfamiliar element during the workshop, as found in first evaluation, and thus promoted the completion rate of the workbook to 100% for both teams.

Another shortcoming found in the first evaluation was that the teams *expected clear step-wise instructions* that required no deciphering and be easily followed. Due to missing steps in ES

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[3] The captured information in the workbook is mixture of many things such as a design ideas and variations, outcomes of a movement round, observations, educators' feedback, qualities liked or not liked by a team, and at times a team's future project planning.

worksheet, team 1 did not formally "review" the ideas generated at the end of Embodied Sketching workshop as intended. The factors for reviewing were still used by the teams to think and discuss about the different ideas as they were bodystorming. Therefore, the visual layout of EP workbook contains a step-wise design, which was appreciated by the teams as it provided more clarity.

The **bulky form of the poster** also posed mobility challenges. For instance, when a team moved to an open-air premise the poster was too cumbersome to be move around with them and teams instead made opted to make notes on their notebook. Although the practice of noting observations and feedbacks remained the same, the distributed knowledge was not intended in our original design concept. Additionally, it was uncovered in the post-workshop interviews that teams often needed to write things not related to the content of the workbook (like list of ideas uncovered, or team' task planning for upcoming week). The worksheets did not offer extra space for miscellaneous items and hence the knowledge was distributed unintentionally.

Lastly, the design of the **workbook might be idiosyncratic** as it is closely aligned to the classroom goals. Since one MbDMs can be adapted differently based on the phase of design it is used in, or the purpose it serves. Other classroom may not find the workbooks being directly applicable to their setting. It may require small or big tweaks depending on the difference in the classroom goals. However, we believe that the principle of structuring the activities can still be abstracted and made use of, and the individual worksheets may be reused and repurposed.

7.2.7 Limitations related to MbDMs

We found a significant change in the teams' reception towards the workbook in second week. In the first workshop, the workbook received a mixed reaction where one team adopted it and the other did not. We believe it to be caused by a combination of not introducing the entire workbook beforehand, unclear instructions without emphasizing its utility and the visual design of the workbook (as explained in section 5.5.2). Whereas in second week, both teams' attitude towards the workbook was more positive and the completion rate of the workbook was 100%. This might have been the result of readjusted method of introducing the workbook and improved visual design. We still speculate additional contributing factors such as the teams were more aware of the workshop routine, physical requirement of MbDMs and the kind of expected outcomes in the second workshop. Moreover, the teams had arrived with an approximate vision of their own design experience. The familiarity to the workshop activities and certainty about their design concept may have left more time and mental resources to the use of workbook, thus improving its reception.

This still draws our attention to the **suitability of workbooks** for a divergent method (Embodied sketching) vs a convergent method (Experience prototyping). The team that made use of ES workbook (divergent) was able to find value by learning more about the impact of contextual factors on their design choice and using the experiential elements mentioned in the workbook for discussing and thinking about ideas. This notion still needs to be fully examined in further studies.

An improvement was suggested to the design of EP workbook to make it also **cater to more exploratory** iterations. The team commented that sometimes iterations originates from the nature of "what-if" and are a result of spontaneously including new observational insights. In such cases the terminology of "check" did not reflect the teams intention of "exploring". It can indeed be the case that accurate elements being validated in an EP session are not known to the teams beforehand. Therefore, a better terminology is needed to depict the starting state of an iteration and evaluated.

Although the workbook specifies a breakdown of tasks related to a MbDM's execution, it **does not help the students in actually becoming comfortable with physical involvement** needed in the MbDM. The task of building physical skills of a students is a tricky challenge currently outside the scope of the workbook. It is a major challenge noted in the expert interview as well as primary student interview and remains open for investigation.

7.3   Suitability for other MbDMs

In this section, we discuss the suitability of scaffolding approach for one other MbDM in a classroom setting. We requested an educator at the UT to fill out the same survey as shared with the Expert in Section 3.2. The motivation was to learn about the challenges of an educator and a student in a different educational setting employing a different MbDM than the ones reviewed so far and assess if the scaffolding approach is still applicable. The classroom includes students with educational background in computer science, psychology, interaction design and industrial design.

This latter classroom employed a MbDM called Improv Theatre Simulation. As described in [7], this new MbDM is a 3^{rd} *person perspective* method which is in sharp contrast with the expert's ones that focused mostly on 1^{st} *person perspective*. In this latter classroom, students assumed a 3^{rd} person perspective while professional improv actors enact a version of a reality with making use of student's designed artifact. The students work with a professional director and the course educator to set the scene by describing the situation, designed artifacts' interactions and behaviour, personas involved, and related hypothesis being investigated. During the enactment the teams get a chance to witness the use and effect of their designed artefact in a simulated environment in order to learn new insights, validate hypothesis, and open up new direction of thinking. This MbDM workshop is carried out midway through the course to provide a sanity check as well as to expand the student teams' view on their designs. For this session student teams fill out a form describing the situation, personas, and the hypothesis to

be tested, at the beginning of the session. This information is used by the director along with the educators to translate the student question into instruction for the improv actors. Students also choose the improv-format based on their specific design needs related to investigating embodiment, interaction, expression etc. Additionally, the form contains section for noting *observations* and *new insights*. In this way, the existing form already functions as a scaffold to some degree by laying out the tasks for a team.

In the survey, the pedagogical challenge mentioned for the educator is "*preparing students and managing expectations*". To combat this, **students are provided with previously worked out examples and video recording of past Improv Theatre sessions**. This aligns to a response received in primary interviews from a student (in section 3.3), that in order to be mentally prepared example videos could set better expectations and provide an idea about the practicalities of a workshop. Another educator's challenge mentioned is making students *"understand the difference between good observations and interpretations".* The scaffolding approach of the form already offers resolve in this regard by creating a demarcation between *observation* and *new insights.* This distinction can be further made more evident by embedding a small example with or without an explanatory definition in the form itself. The definitions serve as a guideline for shaping the conceptual understanding of the student while the examples serve as a criterion for a suitable input. In our study, we found that using definitions along with some prompts were able to get students thinking in the favorable direction. Moreover, the student challenges mentioned in the survey also pertains to similar lines of "*teasing out insights"* and *"understanding how to process the results so they can be validated/valued, compared and reproduced*". The process of result-formation can be aided by introducing a new set of information in the existing form. The new information could explicitly highlight various elements of a scene that one should pay attention to. Educator can define elements as seen appropriate for their use-case, some examples can be artifact's interactions, its physical form, user's perception of the artifact's behaviour, effects of the surrounding etc. It can be presented in many formats like a pictorial visualization or simply as 'things to consider' in a written format. In doing so, such elements become more recognizable and available for students, and it might encourage a more apt association of an insight. Thus, enabling the process of extracting useful insights for their designs. For example, after executing an Experience Prototyping round, we guide the teams' attention to collecting feedback from different point of views – 1st, 2nd, and 3rd person perspective (1st pp – user trying their prototype, 2nd pp – student acting or controlling the prototyped design system, 3rd pp – team member acting as observer). This ensured that all perspectives were being accounted for in their designs.

Another shortcoming mentioned by the educator is the logistical issues of arranging the improv-theatre with professional actors. The educator also mentioned that previously students would perform the improv-theatre by themselves, but it took considerable time and effort before students acquired the skills and were competent to carry-out a valuable improv on their own. Since it was not the objective of the course to upskill students in this regard, professional actors were involved. This highlights a potential opportunity area where scaffolding might or might not work. Improv is an acquired skill requiring the actors to be spontaneously reactive in

unplanned situation. We can only imagine that it requires experience before one is a *decently good* improv actor. Moreover, the actors need to be in spotlight which might be very uncomfortable or simply just not right for some students, as also noted in the Expert interview. We speculate that it would require a different format of scaffolding, such as physical exercises or pre-determined scenario scripts. The degree to which scaffolding can actually help in this regard, is unexplored in this project and still remains open for investigation.

As the students are not juggling performance and analytical tasks simultaneously, they might find it easier to anchor themselves in the form. Alongside existing practices of sharing a form beforehand, using example videos and previous student work, we believe that the current state of form has potential to increase the level of scaffolding to account for observation and interpretation and thus, expanding its utility.

7.4   Future Work

In this project, a workbook is designed to simplify the practical implementation of MbDM into smaller manageable tasks so that physical execution may occur, but it does not help students build the actual physical skills such as somaesthetic reflection or improvisation. This remains open for investigation that how can students be helped in building their physical skills required in MbDMs through the use of a workbook or other means. And, although we were able to evaluate the workbook in a real-world educational context, more research is needed to investigate its use and impact by employing it in different educational contexts with different learning goals.

The concept of a workbook is yet to be extended to serve non-educational settings. A similar template can be created for not just student teams but any designer(s) (professional or academic) trying to engage with the MbDMs for the first time. Thus, helping to bridge the gap in theoretical knowledge and practical implementation. Learning and reading about the MbDMs does not necessarily grants its reader the ability to physically implement it. More research work is needed to come up with a generalized implementation approach of a MbDM so that it can be applied in varied design contexts. We present a novel, low-tech approach for facilitating MbDMs that attempts to enhances student teams' experience and consequently the educators'. It opens up an avenue for further research in this domain of making MbDM more adoptable and easy to use in educational settings and beyond. Additionally, in the limited time of this project we ventured in only a few technical explorations. It leaves an interesting opportunity for other designers to create technical solutions that does not interfere with the core properties of situated and collaborative nature of MbDMs and can enhance working with MbDM or the method itself.

Chapter 8
Conclusion

In this chapter, we summarize our findings obtained during different phases of design and evaluation of our proposed design solution and use it to answer the research questions set at the beginning of this thesis.

8.1 Answering Research Questions

8.1.1 Research Question 1 : What are some difficult areas for learners and educators related to MbDM in an educational setting?

We conducted a secondary (literature review) as well as primary research (interview with educators and learners) to formulate a thorough understanding of the classroom setting that employs MbDMs. During this phase the focus was on learning about the challenges but also finding possible improvement opportunities and building an overall comprehensive view of an educational setting including the common implementation practices, teaching approaches etc. Below we present the challenges that we identified in our research. As this information is pooled from three sources, we specify the source as L (literature, sec 3.1), E (expert interview, sec 3.2) and S (student interview, sec 3.3)

Difficult areas for Educators:
- (L) The heterogenous nature of classroom (usual in ID and HCI) demands that educators cater to a wide range of audience where members have different creative and comprehension skills related to design overall. This makes teaching MbDM a complex activity.
- (L) Coming up with a fair rubric can be challenging in a heterogenous classroom as some students have expectations of an engineering course grading where goals are clear, and assessment is objective as opposed to assessment in a design course that is assessed through critique, dialog, and considers the *rigor of process* in addition to success of the result.
- (L) Educators often need to introduce small exercises in the classroom to help spur student's creativity. This adds logistical and time overheads.
- (E) The expert mentioned that communicating how to perform a method and help students become a facilitator themselves is one of the major difficult areas.
- (E) Making student think about different material and experiential qualities by themselves is not always easy.
- (E) Tweaking one's involvement as per the need of a particular student team. This ranges from helping them prepare for the execution to actually helping in facilitation of the execution.

- (E) Making students think about the felt-qualities of material and continuously drawing their attention towards it throughout the design process.
- (E) Constantly prompting different teams to think of different novel use-cases, to change roles, adopt new perspectives etc.

Difficult areas for Students:
- (L) Educators in literature mention that sometimes students' practices of first understanding the problem, ideating, and then creating a solution, clashes with movement-based design practices of like soma design, which focuses first on experiencing, feeling, and employing a first-person perspective to enquire the design space.
- (L) Literature also mentions that the open problems (typical in interaction design) tends to frustrate the students mostly with engineering backgrounds, as they are used to set boundaries of right and wrong.
- (L) In some literature it was mentioned that students also find it difficult to extract and abstract insights from the experiential learnings.
- (L, S) Students also find it difficult integrate the gathered insights in their overall design concept. Few students in the interview also agreed that at time they did not know how to make use of what they saw when performing the method.
- (L, E) The student's ability to relate and perform a MbDM depends also on their educational as well as extra-curricular background.
- (E, S) The expert mentioned that the students usually do not know how to practically execute a method. Due to which there exists a considerable threshold in getting stared with the methods. It was also reported in the student interviews, that they did not have clear expectations from the session in terms of how to perform the methods and what sort of outcomes can be expected.
- (S) Students reported that there was resistance to trying a new way of designing as it was completely unusual, and strange as compared to their previous known ways of designing. It was hard for them to relate to movement as a way of tool to design in the beginning.
- (S) Students also experienced social barrier of working with unknown team-members and reported that it added counter-productive weights to an already uncomfortable situation.
- (S) The physical awkwardness of being involved in a MbDM was also a notable point for many. This was further enhanced by the team-members not being comfortable with each other yet.
- (S) Few students also mentioned that the introspective nature of some MbDM practices, like somaesthetic reflection, was not something they were used to before and hence found it difficult to adopt.

We also learnt other valuable information from the Expert about student skills that make working with MbDM easier for some. We re-iterate the skills here, as these indicate difficulties for at least some students. The mentioned skills were –

- The expert mentioned that despite best efforts, not all students respond well to working with MbDMs. Students with shy or reserved personalities will always find it hard to be in the spotlight and express themselves physically. For such students discomfort leads to disengagement.

- Students who were already skilled in paying attention to their bodily movements, because of doing activities like stage performance, dancing, or theatre outside class, were able to tap into that tacit knowledge and apply it to understand/work with these methods. This was mentioned in literature too that the final design outcomes are not just influenced by movement skills they learn in the course but also by their own experiences with movement activities. The design concepts that had frequent references to nuanced qualities of movement were made by students who had a prior background in movement activities like dance, tai-chi, and mixed martial arts.

- Prior skills in iterative design, interaction design and even participatory design were mentioned as very important. It sets up the students for successes as they are familiar with some parts of MbDM design process. This results in a more independent, self-regulated execution of these methods.

- Student knowing each other in a team was also said to be helpful factor. It reduces one less obstacle in adoption of the method.

- Student's ability to reflect was also mentioned to be one of the important factors. For example, if they have the ability to critically reflect on their design choices, ability to reflect on different aspects of a MbDMs (soma aesthetical part, on physicality of movement, on bodily feelings etc.). Or if they can self-reflect on a more personal level, like how can I make this better.

8.1.2 Research Question 2: What might we create to enhance the facilitation or education of MbDMs for learners and/or educators in an educational setting?

We tackled this research question through first formulating an understanding of the subtle intricacies in an educational setting. We gathered insights, recommendations, and challenges from the literature (on the use of MbDMs in an educational setting), directly from an Expert who regularly practices and teaches MbDMs at a master's level and students who had prior experience of working with MbDMs. Combining all findings, we created a comprehensive view on the relevant challenges and opportunities for the two set of users – educators and learners and used it to determine the appropriate problem-areas and direction of possible solutions.

In the primary student interviews, we found that a student's experience of engaging with the MbDMs improved exponentially once he/she got comfortable in their teams and knew how to

physically execute the method. This highlighted ***the need to lower the initial threshold faced by students*** and to focus on ***tackling the challenges in early phase of getting started with practical implementation of MbDM***. Some of the related challenges identified in our research were – students' knowledge gap in the practical know-how of a MbDM, reported reluctance in leaving their previously known ways of designing and social awkwardness when working with unknown team-members etc. By alleviating these challenges, we could potentially ***facilitate a faster way for students*** to reach the level of easy engagement with MbDM. Thus, improving their experience with the method itself.

In this project we address some of these challenges through a ***low-tech scaffolding solution - The Workbook***. It is a tangible workbook intended to be primarily used in its physical format. There is also a digital version for teams that work online or teams that want to store digital copies of their work. The Workbook is designed to be used alongside regular teaching activities of a classroom, to help novice design teams during the practical execution of MbDMs. It is designed to ***help student teams manage their activities and effort*** by providing a scaffold around the many tasks needed to practically implement a MbDM. The workbook presents a schematic layout of tasks corresponding to the goal of a MbDM workshop. The tasks are further outlined as a sequence of actionable items. Each individual worksheet has an associated detailed description that clarifies the purpose of a task, provides definition of the actionable items, and wherever necessary provides practical tips and prompts to stir the team's thinking.

In this way the workbook ***aims to bridge the knowledge-gap*** in practical know-how of teams, by providing an idea of how to execute a method before actually doing it. Getting a preview into the workshop (as layout of tasks) reduces confusion and helps team collectively envision how a method might be executed. This uniformity in thought lets teams develop a shared approach to designing and allows them to direct their actions and efforts accordingly as a group. The actionable items corresponding a task presents smaller, manageable chunk of work that teams can easily act upon. Thus, enabling them to build momentum and ensuring that teams advance in the direction of the set workshop goals.

The overall structure offered by the workbook ***lowers the initial threshold*** in getting started and serves as a continuous guide useful for teams to organize their approach during execution of the MbDM. Thereby, empowering them to self-regulate their teams and consequentially reducing the need for constant involvement from the educator. The actionable items simplifies the nuances of MbDM making it more approachable and available for a novice designer. Also, having a structure to refer and fall back on ***encourage the team-member to try a new way of designing*** who otherwise were reluctant in leaving previous known ways. Thus, by addressing aforementioned challenges the workbook supports the facilitation needs of a team during the practical implementation of the MbDM.

8.1.3 Sub Research Question 1: What are the influences of the designed intervention on the practices of learners and/or educators when executing the MbDM?

In our study, ***educator's practices*** remained more or less the same during the execution of the MbDMs. We did not encounter additional efforts being needed from the educator. During both workshops student teams did not ask for help from educator or researcher regarding the workbook despite having the option to. We believe that the workbook in fact shows potential to benefit educators. Educators can embed the more straight-forward instructions (e.g., the importance of thinking about elements of actual design context while Embodied Sketching) and important theoretical aspects one should consider while designing, in the workbook itself. This benefits students visualize the complete picture and leaves educators with more time to help teams in other needed ways.

The influence of the workbook on ***learners' practices*** are understood by the direct feedback of the participant teams and observations made during the two workshops. The influences presented below does not report a comparative analysis (i.e., practices of the teams that used workbook vs who did not) due to practical and ethical limitations. Teams reported the following influences –

- **Early accounting of important aspects**: The prompts in the workbook helped bring many important elements pertaining to design context and elements to the teams' awareness. This resulted in rethinking, reiterating, and reimagining their ideas. This is illustrated in teams' responses from both workshops.
    - ES worksheet-I helped draw Team 1's attention to the contextual factors like environment and user characteristic which made them re-iterate and re-think their initial ideas to account for these. It also served as a chance where teams assessed suitability of several other ideas for the project brief.
    - In EP workshop, Team 2 mentioned that they began to account for elements like 'user emotion and feelings' through using the workbook.
    - In ES workshop, team 1 used the factors meant for reviewing an idea to not just review but also to come up with more ideas and as discussion points in the team. This indicates a potential way to shape a team's knowledge early-on in the design process.

- **Performing and pacing tasks**: The scaffolding approach aids in the process of goal setting, task determination and pacing of activities. This helped teams in clearly understanding what was expected from them and how to achieve it and keep on track with it.
    - In EP workshop, Team 2 created a list of ideas and variations on the workbook that they intended to investigate in that session. The list prevented them from getting too tunnelled in one direction and helped team to in pace their activities accordingly.

- **Collecting valuable information:** The act of capturing information was useful for gathering key insights/ideas uncovered during the workshop which might otherwise be forgotten. The teams mentioned that stored information was also useful for internal as well as external communication purposes and to view the evolution of their ideas.
  - In ES workshop, Team 1 mentioned that the act of writing helped them to capture important insights and ideas while they still retained the most amount of embodied experience from an ES round. This ensured that useful information from the session was not being forgotten or missed. Team 2 noted the same in EP workshop.
  - In EP workshop, Team 2 mentioned that the workbook stored shared design decisions and reasons in one place. This allowed team-members to refer it at a later time and prevented re-hashing of the same issues and repeated discussions.

- **Building team cohesion:** The workbook made for a good way to kickstart discussions amongst the teams and is reported to be helpful in generating shared understanding and enabling collective decision-making in the teams.
  - During EP workshop, team 2 mentioned that workbook allowed for "vibe-checks" in their team where they collectively discussed what worked, or did not work, what they liked about an idea etc. The team arrived at an understanding and then writing down on the workbook helped solidify their collective thinking and that all members were on the same page. This enabled collective decision-making where workbook served as a cornerstone to take decisions.
  - The physical nature of the worksheets (A2 poster) allowed for a flexible placement as per the teams demands. Both teams placed the poster on the floor and gathered around it to discuss and work on it. We believe this enhances the chance for team cohesion as team-members coordinated and discussed in close vicinity. However, due to its bulky size, the poster was not suitable to be used outside and team resorted to using a notebook for recording all information.

- **Balancing with MbDMs:** In our study, the use of workbook (involving mostly stationary and reflective activities) had no side-effects detrimental to physical execution of both MbDMs which involves mostly active and co-creative activities, in any way observable or reported by the teams.
  - During the ES workshop, team 1 actually appreciated the more stationary and reflecting type of activities of the workbook as it provided a break in otherwise high-energy, intense sessions of embodied storming. They used this time to recuperate physically and think about more ideas.
  - We observed that the workbook also did not lead to a distributed arrangement of team-members where some were more busy with the workbook than engaging in the MbDM. All members were able to participate in the MbDM equally.

8.2   Closing Thoughts

At this point, perhaps a palpable question is – What can the scaffolding workbook truly help with, and what it can't - or better yet, should not promise to?

Regardless of whether the workbook can in fact enhance working with MbDM – it is difficult to imagine student teams developing movement skills and a well-rounded knowledge of MbDMs without being complemented with other theoretical and practical activities of a classroom as well as educator's insights. The workbook still offers a way to communicate approachable, accessible and a shared methodology for adopting MbDM to novice designer(s). Educators still remain responsible for guiding students; however, off-loading fundamental tasks to the workbook, could free space to accomplish more. Of course, we hope that the workbook can later become a wholistic tool useful for disseminating knowledge, developing one's movement skills and increasing the integration of MbDMs. Like with all design-led solutions, it is however useful to regard it in its current context and consider how it assists in existing practices of novice teams – Does it help them orient their actions and expectations when starting with MbDMs and does it assist in developing a shared process, navigating the execution and collect learnings from a MbDM session. We hope this work inspires future researchers to develop more approachable ways of making use of MbDMs for novice designers in educational settings and beyond.

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Appendix A: Survey Questionnaire for Educators

General Information	
Name	
Institute	

Survey Questions	
How long have you been involved with movement-based design methods? (This includes teaching, co-teaching, facilitating or using these methods in	
What domain does your work falls under? (for example - rehabilitation, leisure, sport, education etc)	
What is it that you design? (including technology direction e.g. motion-based games, VR-experiences, sports exercises, playground equipment/toys etc)	
To what extent is this different to the projects you engage in with students during courses where you use movement-based design methods?	
Mention what you find your three most important movement-based design methods that you used in an educational setting (focusing on those applied	
You are welcome to leave more than 3 methods, but are there other methods that you do not describe or tech in detail but would want to mention as	
How are the methods introduced to the students? What kind of preparatory materials do you provide (e.g. papers about methods, links, infographics, videos, or homework activities to familiarize them with methods in general)?	
We would greatly appreciate if you would want to share readers, videos, or infographics that is shared with them (e.g. examples/microlectures/keynotes), specific papers/links can be described per method)	

General Questions	
In general, so not method specific, what were the most challenging parts in adopting/employing these methods yourself towards your educational setting, when you first started in this area?	
How has your experience influenced the way you approach teaching the movement-based design methods now?	
According to you, what are the areas where your colleagues will struggle with the most in teaching and facilitating movement-based design in an educational setting? Why?	
In general, what keeps you or your colleagues from applying movement-based design methods in education (more often)?	
For instance, do you plan your movement-based design sessions together, do you teach your staff before the course (e.g. TAs), do you instruct your technical department/roster team, do experts give separate guest or micro-lectures, do you alternate giving instructions to students, or do they join (only) in facilitation sessions etc.)	
According to you, what are some key publications related to the overall theme of movement-based design methods that students should learn about? *Mention if the list follows a order of importance. These publications can be more wide-ranging in nature and need not be confined to only educational settings.*	
Feel free to share any existing documents containing your observations, experiences while teaching/facilitating such methods. (As complementary	
PLEASE PROCEED TO THE FOLLOWING TAB DETAILS OF METHOD 1	

Questions on the details of method

How would you describe the method?	
Is this method based on another method? If so which one (i.e., if you know the name please include it)?	
Also, if they have been published, what is their reference(s) or a (doi) link?	
If any, what other related research papers that you shared with students to familiarize them with this specific (kind of) methods before/between or after sessions?	
If this method is also part of the Mecamind project IO3 gathering of methods you might be able to reuse parts here.	
Which kind of embodied (movement, and physical, social, and situated) engagement does this method entail (i.e. via what category(s) of embodied engagement does the movement-based method add)?	
If you are aware, what is the rationale for the choice of specific movements and physical and situated engagement in this method?	
If any, in what ways are the types of engagement characterizing the method aligned with the design under investigation (i.e. still in your educational setting)?	
What do the student participants do?	
What is the targeted outcome of how you use this method (e.g., inspiration for design, design concepts, improved prototype, feedback on a prototype, validation of a prototype...)?	
Have you appropriated/adapted those original methods? If so, how? Also, why?	
What is the specific reason you include this method in your educational setting?	
Why do you pick this method as important to mention in this survey?	

Logistics and facilitation:

In what type of setting are you using the methods (e.g, the (kind of) classes/projects/workshops, educational background is discussed below)?	
To what extent do you actively execute and facilitate parts in the educational setting with students (e.g., do they actually perform movements and if so how many hours of in-class workshops/number of sessions per course, is this extended with unfacilitated project/self-study assignments)?	
What are the logistics involved in preparing and conducting the method (e.g. tools used, space selection/arrangement, etc.)?"	
Specifically, if not yet included above, in what kind of space do you typically apply the methods in your educational setting (e.g. size, in-context/normal lecture hall (putting tables to the side)/more dedicated open spaces/ labs etc)?	
Specifically, if not yet included above, what kind of preparatory work does it require from you, your colleagues, or your students (e.g. making prototypes, recreating (virtual) user environment, bringing props, preparing scenarios, indicating elements of the idea to investigate etc.)?	
If anything comes to mind, what else forms an important element of how your preparation process of teaching and facilitating movement-based design method is like?	
With how many other staff members/TAs do you facilitate/teach the methods in a course? How are they involved?	
How are roles divided within the student groups when applying this method in your educational setting? In what ways do you (let them self-)assign a role? *For instance, you might assign a guiding role (facilitator or more director-like) or a `pretend user' role, and decide who takes an observer role, and who keeps track of time.*	
In what group sizes are students divided during workshop sessions? If different, what is the size of their project groups?	
Who besides the students and staff participate in executing those methods when using these in your educational setting (e.g. invited designers, actors, users, other stakeholders...)?	

Background of the students and course:	
What is the educational level of the program (e.g. bachelor/undergraduate, master/graduate, phds etc)?	
In what year (out of how many) of this programme do you teach this method? (e.g. 2nd out of 3 year bsc)	
In what study program(s) are the participating students involved (e.g. Computer Science, Human-Computer Interaction, Sports Science and Health, Industrial Design, Interaction Technology, Movement Sciences..)?	
What relevant specifics do you encounter about the (variety in) educational background of the students (e.g. design/performance background/movement sciences/engineering, when it is different from the current program)?	
If any, what kind of impacts of different cultural background/related to where they took their previous level of study, did you encounter in your experience?	
If there is an overarching course, what is the the name?	
How long does the overarching course take in ECs (25-30h) does the course take for the students?	
In what week(s) of the total duration of the project do you `typically' teach these methods (e.g. in our ten week course, in week 2 of 10 we provide a lecture and in week 3 we facilitate a practical on this method)?	
What is the size of the student cohort participating in this course?	
If there is a design project involved, in what way does that technology/interactive experience under design require of, or support movement, and physical engagement of users?	
Experienced Challenges:	
What are your key challenges as a teacher in teaching/co-teaching/facilitating these methods?	
How do you try to overcome these?	
With which aspects of these methods do you see or know your students struggle?	
If so, please mention the struggles they reported and the stage of the design process the method was being used.	
If not, please elaborate, why do you think your student population does not struggle with certain parts of this method that other students might?	
What do students seem to dislike about this method? Why do you think this (e.g. can you share some anecdotes or experience about this)?	
project, teachers, familiarity with others/methods duration of sessions/course, etc)	
What are key pitfalls to avoid when teaching/facilitating this method?	
Experienced Benefits:	
What do students seem to like about this method? Why do you think this (e.g. can you share some anecdotes or experience about this)?	
What do you think is the main benefit on the resulting outcomes (if any) of working with this method in your educational setting?	
Alternating and changing the method:	
What are your main learnings (things you learned to do differently) about working with this method?	
What kind of adjustments do you typically make between years of teaching this method (e.g. add materials, change project context, change teaching staff or teaching	
When applying a method with students during education, what (ad-hoc) instructions do you typically give to change the method between rounds during the session (e.g. add materials, change perspective, assign roles)?	
If any, what are other relevant insights or methodological considerations that you would like to share with others teaching or facilitating this method?	
PLEASE PROCEED TO THE FOLLOWING TAB DETAILS OF METHOD 2	

… similar list of question followed for Method 2 and 3.

Appendix B: Interview questions for the Expert

1. As mentioned in the survey students learn by reading papers, do you also teach about the method in any other way like lecture format, micro lectures or videos?
   - if so, what aspect is more focused in lecture
   - Have you found this way effective? Do you suggest other effective ways?
   - Any shortcomings you noticed in this way?
2. Do the students undergo any sort of pre-exercise before the start MbDM session? Why or why not?
   - What is the observed effect on students?
   - Do the students like this exercise, do they find it useful?
   - Any at-home exercises for the students?
3. Do they receive written or verbal instructions for doing the session? Frequency and duration?
   - Do they receive any form of assistance to help them do the session like written instructions? Why or why not?
4. What is normally included in the instruction (verbal or written)
   - Are they told what to focus on and what to observe during the session?
   - To what extent do you see students get to go over the instructions again before or during engaging in the activity?
   - Is there any instructional materials you didn't yet use but would you like to? or see the need for?
5. Regarding the structure of the session, can you give examples of tips to prevent things you have seen going not so well in previous session?
6. When you provide your assistance in practical sessions, is it more in preparation phase or execution or analysis phase?
   - And what is the nature of questions/doubts are you mostly dealing with at that time
7. How do students proceed after doing the session?
   - How do they integrate the session insights in the next stage of design? do you observe any friction in this part
   - Do you provide any assistance or practical material to help them in this stage?
8. In what way do you (explicitly) try to get the students to use the methods after the actual sessions themselves?
   - To what extent do you see this happening?
   - How do you approach this?
   - In the course/project case? How do you influence this on curriculum level?
9. Have you made revisions in your curriculum based on your previous experience?
   - What are they and what made you change it?
   - Specifics in terms of teaching activities and student activities
10. What do you consider as key skills in students that is useful to working with MbDMs?

Appendix C: Call for participation for students

Call for Participation
Student interviewees needed in a research

RESEARCH
We are looking for ways to improve the education of movement-based design methods(e.g., bodystorming, experience prototyping, enactment and many more) for future students and/or teachers. These methods play a big role especially when designing for sports, movement, play, tangible devices or any other system requiring bodily movements as a means of interaction.

STUDENT INTERVIEWS
In students interviews, I look into individual experiences of a student who has previously worked with movement-based design methods in an education setting. The idea is to gain insights from a student's perspective to locate any improvement areas in education of these methods. The goal of the interview is not to get feedback on the course/project/teachers but to simply gain insights about the design method used within the course.

WHY PARTICIPATE
One-to-one short interview with a fellow student. Chance to contribute in shaping future design education.

What: 30-45 min interview
When: 11-25 April, Online
Why: bol.com gift card worth €10

If interested or
for any queries, email:
n.sihmar@student.utwente.nl

Appendix D: Information Brochure for students

Information Brochure

Purpose: Movement-based design methods have been used for many decades in the field of HCI and Interaction design. These methods are reported to play an immense role especially when designing for play, persuasive technology, tangible media devices or any other system requiring bodily movements as a means of interaction.

We are looking to improve the education/facilitation of movement-based design methods for students and/or instructors. By gaining insights from the past experiences of both students as well instructors, we hope to find possible ways that might improve understanding/adopting/executing these methods better for future designers.

In the student interviews, we dig deeper into the individual experiences of a student who has worked with movement-based design methods (e.g., bodystorming, wizard of oz, experience prototyping etc). The idea is to gain insights from a student's perspective, to locate the areas in the education of such methods that need improvements.

Procedure:
The volunteering participants first verbally provide their informed consent in the beginning of the interview. You have the option to remain anonymous in the research output. You can stop and opt-out from the interview at any point. Additionally, you can retract your provided responses up to 48h after the interview. Remuneration is given at the end of a complete interview session. This remains unaffected by your choice to retract your responses in the aforementioned duration.

Interview should last up to 45 minutes. Interview consists of open-ended questions about your experiences with the design methods that involved bodily movements in a course at the university. The goal of the interview is not to do a review or get feedback on the course/ project/ teacher/student group but to gain insights from an individual take on the design methodology used within the course.

Data handling & Privacy: Interview data is handled according to the standards set by the Ethics Committee Information & Computer Science at the University of Twente. All the data provided - participants' details and interview responses and corresponding transcribed text- is stored on the university provided drive storage. The data is only shared within the research team. All the stored data – participant provided details, recordings and transcribed texts of the interview - is kept for the foreseen future by one of the researchers following GDPR safety measures set out by the University of Twente.

Participants are asked their informed consent before the interview. They have the option to remain anonymous in the research output and the option to stop and opt-out from the interview at any point. Additionally, they can retract their provided responses up to 48h after the interview.

Exclusion Criteria: A student who has not used movement-based design methods themselves in a course setting at university level.

Remuneration: Gift-card worth €10 (approximately).

Study team consists of researchers involved in the MeCaMInD project. For any further information contact the following responsible researchers:

Researcher – Nancy Sihmar, n.sihmar@student.utwente.nl

Supervisor – Dr. ir. R.W. van Delden, r.w.vandelden@utwente.nl

Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee Information & Computer Science: ethicscommittee-CIS@utwente.nl

Appendix E: Interview Questions for students

1. Could you explain very briefly what was the project brief you used MbDMs in and what was the deliverable at the end?
2. The MbDM details
   - What was the overall design process like for the course?
   - At which stage did you use a (or multiple) movement-based method?
     - Which MbDMs, at which design stage? For which purpose?
   - How did you learn about the method? How was your preparation like before you executed the method.
     - Were you well prepared for conducting the session?
       - Why, why not?
       - How did being prepared/unprepared affect the actual MbDM session?
     - Did you find preparation useful? Why?
     - Was there something you were unsure about during the preparation? What could've helped you with that.
     - Would you recommend something other than what you did for preparation and why?
   - Describe execution of the MbDM session-
     - what did you do and what was the setup like in terms of tools, environment, different activities etc.?
     - Was there a warm-up done before the session? Was this useful?
     - How many participants were included in MbDM session - team / users/ test participants
     - What kind of instructions were given and how (verbal/written) and its frequency (after each activity, round, only at the beginning – was the session moderated stepwise or instructions were given only in the beginning – Group activities vs solo.)
     - Run me through your team's internal discussion or processes as you were executing the method
3. What did you learn afterwards that you think could've been included in the preparation/execution. Would it have made a difference to the outcome? how?
4. Retrospective Feelings
   - How was your experience/ of the actual session?
   - What aspect of the entire MbDM experience did you find most enjoyable-likable
   - What were some difficulties in executing the MbDM session
     - Why do you think that was difficult

- ■ What could've made it easier. How would it have resulted in a different experience.
  - ○ Now that you think about it in retrospect, would you change something about the execution? Why?
  - ○ Would you like to change or do anything differently regarding the method
  - ○ Did you notice any improvement areas in the whole MbDM process
  - ○ Have you used these method(s) outside of this project?
5. Elaborate a bit on the style of teaching.
  - ○ How was the teaching /practice structured in the course?
  - ○ What would you like to change in the current way of teaching?
  - ○ Lastly, what would you say worked well in the current way of teaching?

—----------------------

Appendix F: Embodied Sketching Workbook

Overview

These worksheets are made to be a comprehensive checklist for designers while they engage with embodied designing methods. The worksheets gently nudges designers to think about various aspects that contribute to creating an experience. It is meant not as a exhaustive method that can yield results only by filling it out but as a thinking tool, as a starting point for the design teams.

What are these worksheets

These worksheets are to help as you begin designing with embodied methods. It presents a broken-down version of approaching an embodied designing method into simple actionable steps. These will spark conversations and bring aspects to light that the design team can use to dig deeper, discuss and create.

How to use it

The worksheets should ideally be done with the entire design team present. This helps keep everyone on the same page and builds a unanimous coherent view of the project.

Adapt & improvise. The worksheets lay down different aspects that should be considered. In most cases these should be sufficient however you can always adapt as per your own use-case. Add, amend on top of it or skip parts that doesn't fit your design problem.

Lastly an open, creative and collaborative mindset will go a long way.

1. Understanding Context

What influences does your designs have? What experiences is it creating or disrupting? Which behaviors is it driving?

To efficiently design an interactive experience it is vital to first understand the context it will be used in. So spend some time with your team unravelling and analyzing different stimuli-response relationships between physical spaces and users. This will help create a solid foundation for the rest of your project.

Context

Start with this. Context is the physical space where your designed artifact will be used in. Understanding the context brings clarity and useful information which can help you to design. Look closely at all the small and big details that make up that space.

Spatial setting (objects, layout, lighting, people etc)
Write down a short description of the physical space. Pay attention at physical attributes like objects, people, space layout and also atmospheric elements lighting, sounds, smells, surroundings etc.

Things to be mindful of
Noteworthy things in the context that the team would like to be aware of during designing.

Surrounding affordances
Keep a note of things that you think have the potential to be reused, repurposed, reinvented or simply incorporated in your designs.

Surrounding limitations
Does the physical space has some limitations.. It's better to be aware of it beforehand so that you can design to circumvent it or be creative and make it a part of your design.

Target User

Your designs can appeal to various user groups, but designing for all of them simultaneously is tricky. So decide one as a primary target user group. Write down the details of a person that most likely fits your target group. Go beyond the demographic information and, think what matters most to them.. what drives them and why. Feel free to define the target group by introducing your own features along with the ones presented here.

Characteristic features (personality traits, values etc)
What would be some distinct features that helps you figure out if a person belongs to your target group or not.. Think of their quirks, unique habits, patterns of behaviors etc.

Physical, emotional & mental capabilities
Think of your target users as people. What sort of internal capabilities lets them interpret the meaning of various experiences.

Wishes and needs
Unless you have the data, this is guesswork but done as a team removes individual assumptions. List down some wishes and needs of this target group. Rate them in order of importance if you like.

Interactions with the context

Focus on how a target user interacts with different elements of this context. What factors contribute to creating their experience.

Stimuli: things user sees, hears, smells etc
All things that act as inputs to the users' senses and demands their sustained or unsustained attention.

Movements, actions and activities user does
The way users moves to interact with elements around them.

Usual behaviours in this context
List down different sorts of commonly exhibited user reactions and responses.

Typical user feelings and emotions
Try to gauze how the user feels in this context currently. It becomes easier to understand later how your designs influence this.

Getting started
Look into and describe the design space that you are working with

Context

Spatial setting (objects, lighting etc) _____

Things to be mindful of _____

Surrounding affordances _____

Surrounding limitations _____

Interactions with the context

Stimuli: things user sees, hears, smells etc _____

User movements, actions and activities _____

Usual behaviours in this context _____

Typical user feelings and emotions _____

Target User

Characteristic features
(personality traits,
values etc) _____

Physical capabilities _____

Wishes and needs _____

2. Embodied Ideation

After doing a deep-dive in the context you are designing for, its time to venture out and explore different ideas you can bring in it.

Looking closely at the context and understanding its boundaries was an important first step, as now you are more aware of the interplay between different elements. In the ideation phase, its all about amending and manipulating these boundaries favorably to create an experience that is appreciated.

Embodied Ideation

Instead of thinking about an idea in your head, in embodied ideation you also use your bodily movements and knowledge to ideate and create. Along with relying on your cognitive skills of imagination and critical thinking to design or understand something, you also employ your bodily skills to act, move, feel and react in a design space so as to bring you feedback on the overarching experience.

As you begin embodied way of ideation, its good to ask yourselves what's the design goal and how to get there while the end-user has an enjoyble experience. Step into users' frame of mind and interact within the design context. Think what would they like to do, see and feel.. if you were them what would you like.. think not just about your design artifact but also the experience it will offer to the end-user.

Any ideation method requires constant iteration and discussion within a team. So, do not fall in love with an idea at this stage and try to create a varierty and volume in your idea-set. Combining prespectives of different team member's previous knowledge and experience may uncover new insights, so collaborate and communicate as much as you can.

Reviewing your ideas

While embodied ideation is a free-flowing divergent activitiy, at some stage you will want to critically look at an idea and analyze it from all angles to see if it can deliver the experience you strive for.

As a team you could analyze an idea after each one, in between iterations, after collecting a few, or altogether at the end, and see what worked and didn't work. Team members should make note of their own observations/ experiences/ elements etc only when its not disrupting the team's activity and the flow of

coming up with ideas on their own. Rememeber that you see different things if you observed your fellow team mate than what they actually experienced. Both perspectives(3rd & 1st person) provide valuable insights and should be taken into account by the team.

The following break-down is to help you get started on thinking about different elements of an experience. When analyzing your experience ideas, consider what a user does, sees and feels as they come in contact with your designed artifact. Feel free to add your own elements.

Interactions
How does a user make something happen in your design. Are they pressing button, are they controlling it by voice.. what kind of system actions are at their disposal.. is it intuitive for them... think of usability and factors that can affect it. What do the system responses look like to a user action. Also, is this interaction style in-line with the goal and the overall experience you envisioned.

Design attributes
The features, functions and qualities of your designed artifact. How and what does it do.

Movement & activities
Consider the kind of physical movements for the user. Is it promoting the right kind of user feelings, it is spatially feasible, what behaviors is it driving, whats the motivation for user etc.

User feelings & emotions
As a consequence of interacting with your designed artifact, its functions and physical movements the user goes through, what is their emotional response and resultant mindset during and right after. Also consider more physical feelings like hot/warm, soft/harsh, rushed/paced and more spine-tingling, stomach turning like in roller coasters etc.

Bodystorming

Bodystorming

Outcome
- Bodystorming is an empathy tool that helps the investigator to learn by being the user in the original context of usage

Props in use
- The method requires any material that is need for the usage in focus.

Step by step
1. If needed start with describing the space for the activity
2. The participating subjects position himself/herself to the same conditions as the user.
3. Act out the context in focus.

Variations:
- Change user position or change persons in focus.
- Change activity or order of activities.
- Modifiers: (Visualise by a picture of the modifier cards)

Why:
- To subjecting a researcher's own body to physically experience a situation to ideate.

Duration of activity: 20 minutes
Set-up time:
Single
Materials needed:

Exertion • Body Awareness • Role-Playing
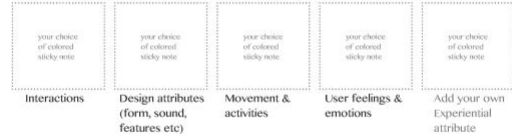Playfulness • Experimental • Socialising

Movement Method

Things to be mindful of

- Move and build ideas on the fly.
- Instead of just thinking or saying your idea, quickly act it out and see the overall experience.
- Instead of criticizing or dismissing, build on top of each others ideas.
- Consider spatial elements, like placement of your design concept, typical objects found in the desing context etc.
- Don't worry it's confusing for everyone. The more you act it out, the more clear it becomes.
- You may have a favorite idea which you can always go back to, the purpose of this phase is to gather alot of varied insights about various experiential aspects. You may be surprised at what you find.

Ideation Phase   4

To review ideas

When reviewing an idea, try to distill it into its many experiential elements and cherry-pick parts that you want or dont want in your designs. An idea may need refining in only one aspect or you can arrive at a completely new idea by mixing-and-matching elements from different ideas. Add your own experiential elements along with these:

your choice of colored sticky note	your choice of colored sticky note	your choice of colored sticky note	your choice of colored sticky note	your choice of colored sticky note
Interactions	Design attributes (form, sound, features etc)	Movement & activities	User feelings & emotions	Add your own Experiential attribute

Experience Design Ideas
Put down all the different ideas that emerge in the session

Review
Experiential elements of different ideas you want or don't want in the final design concept

Do's

Dont's

Appendix G: Post-workshop Interview Questions for students

1. How was it using the workbook?
2. Run me through your approach to using it?
   a. What were the first things you did as a group?
   b. What were your first thoughts in that session. Why?
   c. What next steps did you take as a team towards using the workbook?
   d. Was it clear what you had to do and how?
   e. When was it unclear?
   f. Did you guys assign roles within the team? did someone assume "facilitator" role? how did that come about.
   g. What kind of conversations were you having in the team
      i. What kind of results did this lead to
3. How did the group interact with the worksheets?
   a. How was it using worksheets and doing bodystorming simultaneously?
   b. In what ways did it affect participation in the bodystorming.
   c. How focused were you on the worksheets vs the bodystorming
   d. How was the interaction within the group when working with the sheets
   e. Were there any kind of effects in the teams' internal dynamics because of using the worksheet
4. How did it feel using the worksheets?
5. What would you change about the worksheets?
6. What worked nicely in the worksheets?

Appendix H: Researcher's Observation during ES workshop

Team One
o Physically carrying out ideas, stopping to discuss, then writing what worked out and what did not. Also making note of the version of an idea that made sense.
o Tried out bunch of ideas and ran out iterations for an idea. During this time one participant was reading how to review based on different experiential elements. They discussed an idea and its many iterations before jumping into the reviewing.
o The team took the poster off the wall and instead placed it on the ground where they huddled around it. They used the poster to place all their sticky notes on top of it.
o Many times, they revisited an older idea based on the previously placed post-its.
o The team played a lot with different kind of animal sounds at the beginning of the workshop
o After the first ES round, the team began by conducting a small ideation workshop first on the paper and then moved onto practical implementation of it. During this ideation they were mostly focused on thinking about different variations to their original idea
o The group was already thinking about the different experiential elements at the beginning of second ES round along with ideation.
o The teams also used the previously placed post-its as an idea-bank and picked which idea they wanted to work with during the third round of ES.
o One of the team-members said, "lets write it down".

Team Two
o Started off with trying their already prepared ideas
o More focused on playing and iterating
o Uses the stationary material for making more games, writing ideas outside the sheet on the flipboard
o Discussing around the board then talking and noting things on additional paper
o Uses the post-its to create games instead of using it as a writing material
o more ideating and less reviewing until the beginning of round two.
o Round 2 is more spent around their own papers and the workbook, brought their own drawings of games and playground
o Put down many drawings of their ideas on paper and in a circle discuss gameplay, equipment, execution.
o All members of the teams involved in discussion and ideation
o All members participate in playing part of the system, taking turns to become the "user"
o went outdoors to play without writing materials

Appendix I: Experience Prototyping Workbook

3. Define the Design Concept

Describe the design concept that you like to present to the test users.

Your design concept could be a work in progress but before you present it to someone outside the design team, its beneficial to lay-out its details. Recording this starting state of your design concept is beneficial in understanding how your concept changes as multiple users try it out and why.

Name & describe the concept

Give your concept a name. Write down the core of the concept. Briefly describe how it works in practice.

Key interactions for user

How does a user make something happen in your design. Are they pressing button, are they controlling it by voice.. what kind of system actions are at their disposal.. is it intuitive for them... think of usability and factors that can affect it. What do the system responses look like to a user action. Also, is this interaction style in-line with the goal and the overall experience you envisioned.

Key experiential features of the concept

Think of the overall experience you want to deliver to your target user. Now think of which aspects of your concept are responsible for creating those key experiences. These are the features that you want to recreate for your test-users and their early feedback on the most important parts of your concept.

Ways to realize the key components of your design

Make your test-users imagine less and experience more. Try to create the best approximation of your design concept that can deliver an experience as close to the actual concept. Get creative and substitute components of your design concept by using video, sounds, lights, wizard of oz etc.

Describe your target user

Write down the details of a person that most likely fits your target group. Go beyond the demographic information and, think what matters most to them.. what drives them and why. What would be some distinct features that helps you figure out if a person belongs to your target group or not.. Think of their quirks, unique habits, patterns of behaviors etc.

Emotions and values of your user the concept targets

The emotions and values driving the users' actions when they interact with your design concept. How do they relate to your designs, can you improve it favorably.

Define the design concept

As a team describe the details of the concept you are trialing

Concept Name

Give it a descriptive name

Describe the concept

Write down the core idea of your concept

Key interactions for user

The ways in which user makes something happen in your designs eg: pressing buttons, voice interface, screen taps etc. How does the system respond to different inputs.

Key experiential features of the concept

Which features of your design concept delivers the key experiences to the users.

Ways to realize the key components of your design

In what ways can you create the most authentic experience of using your design concept for the test users. Think about using video, sound, lights, wizard of oz etc.

Describe your target user

Which user group you keep in mind while coming up with this design concept. Describe their demographic but also some of their quirks, values and behaviors etc.

Emotions and values of your user the concept targets

In what ways would the user relate to your design concept... how can you promote product usage, improve their resonance with the product or create a more memorable experience.

4. Trial the design concept

Decide which aspects of your design concept you like to present to the test-users and get feedback on.

You may want to trial the whole concept or its smaller experiential components. Decide with the team which aspects to try-out that brings the most value.. what can help you make the right decisions in the next phase.. which areas would you like feedback on.

Check

The parts of your design concept you would like to try-out and gather feedback from test users. It could be the whole concept or smaller experiential components.

What
Define what is it that you are checking. Be specific.

How
Devise an implementation plan of previously mentioned "what". Also think of how will you gather feedback, will you ask users after each step or at the end, do you have specific questions to ask them etc.

Observe

Feedback coming directly from the test users is gold. Additionally it's also advised that the team documents their observations too.

1st person perspective
Feedback given by the user testing your design concept.

2nd person perspective
Feedback from the perspective of your design system, its usually someone who controls the system responses to user actions. This highlights the strong and weak system actions/feedback as different kinds of users interact with it.

3rd person perspective
This is typically the person from the desing team observing the whole encounter and possibly making notes alongside.

Review

Reflect on the observations you made and the feedbacks you get. Try to assess what worked and didn't work in your design concept.

Iterate

Based on the review you did previously, decide what will you change for the next iteration.

Feel free to add, ammend, or flip around your design concept.

You can also try changing the usage scenario of your design concept, or different personas of the users and see what kind of aspects/experiences gets highlighted in your design.

Trial the design concept - Part 1

Try-out your assumptions about the design concept

Check

The parts of your design concept you would like to check with test-users. It could be the whole concept or smaller experiential components.

Decide WHAT would you like to check and HOW.

Observe

Write down the feedback from 1st , 2nd person perspective. Add observations from 3rd person perspective.

Review

Reflect on what worked and didn't work.

Iterate

What needs to change for the next iteration?

Variations

- Scenarios: Imagine your design being used in the real-world. Come up with 3 different scenarios and validate your concept.
- Personas: Your users will have different quirks. Try to think of distinct characteristics in a user and validate your concept.
- Come up with 3 different ways that your concept will be used.
- Switch roles between the team members so you get variety in observations.

Trial the design concept - Part 2 : Moving forward

Reflect, decide, and make changes with the team

What were some things that were surprising?

▼

Which aspect of user, technology or design it brought to your attention? How can your design be improved to account for it?

What worked well in your concept?

▼

How can you make the most out of these positive elements?

What did not work well in your concept?

▼

How can you avoid or completely remove these ?

What's next?

Think of concrete steps to take next so as to incorporate everything you observed today. What changes should you make to maximize the positive interactions and decrease the negative ones?

Appendix J: Researcher's Observation during EP workshop

Our observations and *interpretations* (*in italics*) of two teams are presented below –

Team 1
o Structures the group discussion - *useful for groups with shy, introverted, or aloof members.*
o More discussion about gameplay, adding time pressure, introducing new sounds.
o Things discussed - different gameplays game dynamics (cooperative vs competitive), focus on the story (single player, multi-player), technical implementation details for building their upcoming demo, division of responsibility for implementation, system feedback changes.
o Also discusses about increasing engagement with the prototype.
o Keen about doing the sheets – *perhaps because of team-members' personalities.*
o Uses the sheets to brainstorm new idea, draw on it, map of the playground.
o Writing feedback and asking questions simultaneously by the same person.
o Slight awkwardness within the group - *the members did not know each other before and perhaps were still getting used to working together.*
o Uses sheets to note all their existing ideas, reading the different modes of play of their designed games from the worksheet – *a place of dumping details and quick and easy recovering.*

Team 2
o Team discussing what are the different ways they can execute their designs.
o "Key-experiences" was hard to understand, and description was looked up.
o One team-member making notes while the rest of them become a part of the implemented design and ask user feedback. Uses the smaller notebook to note observations outside and not the poster. one observer writing everything but still participating in the discussion afterwards.
o A lot of discussion on why they should stick to a particular design element.
o They decided to check the utility and if the game is engaging and checking if interactions can deliver what they planned.
o Team accounts for 2nd person perspective feedback. One team-member asks feedback from another team-member who was responsible for changing the system state (changing the light colour in response to user action). Replies with "that's interesting and we can play around with that"
o Review stage is mostly verbal – *could be merged with "iterate" step in the next re-design of the workbook.*
o Discussion on - technical feasibility considered for changing or coming up with a gameplay, physical implementation details, division of practicalities (figuring out the next meeting content, what each person will do, what they will try to achieve in next meeting), thinking about more options for making different type of prototypes, ways buttons would change etc.

Appendix K: The design space

see next page..

Recommendations or Things that worked

Challenges

Task Breakdown

MbDM theoretical knowledge

- emphasis on 1st p reflection
- repeated return to the soma experience
- art studio culture / more student regulated

- communicating methods significance and use
- helping students become facilitators themselves
- grading expectation
- teaching a heterogenous group
- coming up a fair rubric

Educators

- Know various methods
- choose an appropriate MbDM for design and learning goals
- figure out best ways to teach it
- deliver the lectures, study material etc
- monitor, Q&A
- reflect and feedback

Learners

- Learn method details
- related theoretical background
- Its purpose of use in the overall design process

- clashes with other prevalent design approaches

- previous movement skill of a student
- students educational background

- creativity enhancing exercises
- better expectations in terms of practical tasks and kind of results one can get

- Providing senstizing materials, Ad-hoc instructions, Ad-hoc preparations

Overall design processes and other activities.

Prepare
- know effective ways to execute the method
- prepare and provide materials used in the session (software, hardware, props etc
- select and facilitate any warm-up exercises

Prepare
- learn what the method is for
- learn how to do the method
- align with design brief- what they achieve in MbDM
- organize group's internal activities
- orient teams' actions/roles in the activity

- facing the strange unknown
- not learning the practical know-how of the method
- resistance to leaving old ways

- social barriers among students
- not knowing how to practically go about implementing a method

- soft skills of a student
- student's temperament and personality traits
- previous movement skill of a student

- prior skill in interaction, iterative, participatory design

Meanout cards

MbDM practical Session

- getting to know each other activities shoul be increased and made part of the course

- prompt them to change roles
- make students think of particular material qualities

- prompt students to come up with particular use situations
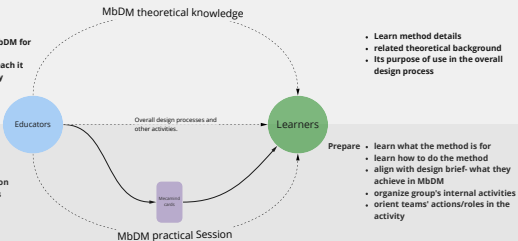- tweak involvement per group - help in preparation or execution or analysis
- prompt them to change perspectives, intro new use-case situations to them

Execute
- (optional) conduct any prep activities
- intro students to the context of design problem
- provide instructions and establish goals for the MbDM activity
- (if needed) invite experts and moderate the session b/w students & experts.
- facilitate the different rounds of activities
- support students in execution

Execute
- Work with the material of MbDM activity
- organize the team members/users roles and responsibilities
- document the insights that arise in the activity
  - make observations during/after the acivity
- consolidate all insights
- integrate the insights for the next stage

- it might not have the easiest threshold
- how to make use of what they see
- a better expectation from the session - practicalities and possibilities

- difficult to integrate their experiential learnings
- extracting and abstracting insights
- discomfort leads to less engagement

- prior expectations improve receptivity
- leveraging skills learn elsewhere
- knowing what to explore
- figuring it out together

- icebreaker to get comfortable in the team
- getting familiar with the method
- scenarios and user quirks during ideation MbDM

- students personality traits
- knowing each other in a team
- Student's ability to reflect

Master's Thesis

Nancy Sihmar