Learning *from* and *with* Menstrupedia: Towards Menstrual Health Education in India

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Menstruation has long remained a conversational taboo across India, resulting in inadequate dissemination of menstrual health education (MHE). Menstrupedia, a digital platform designed for an Indian audience, aims to bridge this information gap to impart MHE via its website and comic. We contribute a study of Menstrupedia—the information exchange on its website, the education it aims to provide, and the perceptions of its users. Using a combination of qualitative research methods, and engaging a feminist Human-Computer Interaction (HCI) lens, we critically analyze Menstrupedia's affordances and shortcomings. We also make recommendations for the design of technology-based dissemination of MHE, as well as additional sensitive and taboo topics.

Keywords: Menstrual Health Education; Menstrupedia; India; HCI4D

1 INTRODUCTION

In recent years, research related to women's health has received increasing attention within the Computer-Supported Cooperative Work (CSCW) and Human-Computer Interaction (HCI) communities, on topics such as intimate care [3], childbirth [21], pregnancy [63], breast cancer [2, 37], and sexual well-being [4, 5]. In 2017, the Conference on Human Factors in Computing Systems (CHI) also hosted a dedicated workshop on hacking women's health *"to reimagine how technology intersects with women's health"* [8]. We contribute to this nascent but growing body of work with our focus on menstrual health education (MHE), also extending HCI research conducted by Jain et al. [38] and Epstein et al. [24] on menstrual health, hygiene, and tracking. Our study takes place in India, where menstruation remains a conversational taboo, in both public and private spaces. The goal of our research was to arrive at a deeper understanding of information and communication technology (ICT) based initiatives that target MHE, so we might offer recommendations for widening its adoption and delivery, particularly in societies that are resistant to conversing and learning around such sensitive topics.

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In India, societal norms around menstruation can be quite limiting. For example, authorities at a temple in South India recently asked for a machine to be designed to detect a woman's "purity" (*i.e.,* whether she is menstruating or not) before granting her permission to enter the temple's premises [55]. In another instance, a 12 year-old schoolgirl committed suicide after she was scolded by her teacher for staining her uniform and bench with menstrual blood [77]. Additionally, the Indian education system offers limited MHE, introducing the subject to 13 year-olds as part of their science curriculum, and covering menarche to menopause in a mere 250 words [60]. Incomplete information on such health topics affects the overall well-being and development of individuals [48, 58], and of the society as a whole. To address limiting norms and limited awareness, the Indian government has adopted Menstrual Hygiene Management (MHM) guidelines [59], which emphasize the need for access to education, awareness at multiple levels (individual, family, and community), and provision of trained support on the subject. Various non-governmental organizations (NGOs) including Sachhi Saheli [66], TARSHI [73], and Vikalp Design [79] have created educational content, and regularly conduct awareness campaigns and workshops. Companies selling menstrual hygiene products have launched their own campaigns and programs (*e.g., Stayfree*'s *Women for Change* [65] and *Whisper*'s *Touch the Pickle* campaigns [62]), and earlier this year, the journey of Arunachalam Muruganantham—the *Pad Man of India*—was covered in a Bollywood film [56]. These initiatives do expand awareness and acceptability, but many more such are needed.

Our research contributes an instrumental case study [11] of Menstrupedia [50]—a social enterprise that provides a friendly and informative guide on menstrual health against the above backdrop through the use of multiple media—a website, comic, YouTube channel (which conveys updates on offerings), and Facebook page with over 39K followers and likes. The website offers a quick guide to menstruation, as well as a blog, and Q&A forum. Menstrupedia was designed with the aim of supporting young and old Indian women in managing their menstrual health. The platform claims to have reached 250 schools, 60 NGOs, and 150,000 girls across India [50]. We examine the receptivity of Menstrupedia's users to its initiatives, identifying its affordances and shortcomings in its delivery of MHE to a growing online audience across geographic and socioeconomic boundaries. Our objective here was to better understand how users react and engage with an ICT-based platform dedicated to MHE, and outline recommendations for widening adoption and delivery of MHE. For this study, we limited our scope to educated, technologically-savvy middle-class adults (identifying as male and female). Studying this population and its challenges in accessing MHE, despite its privileged status, serves as a suitable starting point for addressing societal needs in this regard.

Our paper begins with a summary of research contributions and public initiatives that propose or examine technologies or interventions aiming to provide information on taboo topics. We focus on the Menstrupedia website's users' engagement with its Q&A forum, as well as its quick guide and comic offerings. In addition, we present findings from *think-aloud* [18] sessions, where male and female participants engaged with the comic. We analyze our findings using the feminist HCI framework proposed by Bardzell [10], discussing how the six feminist principles of pluralism, advocacy, ecology, self-disclosure, participation, and embodiment surface (or *might* surface) in the design of Menstrupedia. We also reflect on how this framework might be useful for research around additional sensitive and taboo information exchange across diverse cultural contexts.

2 BACKGROUND AND RELATED WORK

Examination of the treatment of sensitive and taboo topics through technology use is a recent and growing focus of the HCI community. In 2010, Hammond discussed the affordances of ICT that made it fit for teaching and learning [27]. Sorcar et al. built on this work to examine how particular affordances of technology might contribute towards making HIV/AIDS education more accessible and actionable for Indian youth in formal learning environments. These affordances

included anonymity, privacy, and the ability to be replicated and distributed uniformly and at high fidelity [71]. Technology design for women's health, in particular, has recently received attention in HCI and CSCW, gaining special ground with the workshop on hacking women's health that was held at CHI 2017 [8]. Other research in this space looks at leveraging e-textiles to develop wearables for promoting breast self-awareness [2], teaching pelvic fitness using Augmented Reality [4], and more. Related work also explores a wide range of topics on sexual well-being, such as the design of intimate technologies [70], for sexual pleasure [9, 23], and of technologies that support and/or enable sexual interactions [13].

There is also a strengthening focus in HCI literature on menstrual health, hygiene, tracking, and education. Jain et al. explored the use of *Snakes and Ladders*, a traditional game, to provide education on puberty, menstruation, and related myths to female youth in the North-East Indian state of Assam [38]. Tran et al. designed *Menstrual Maze*, a digitally embedded educational toy that engages parents, children, and educators in MHE [78]. Epstein et al. were the first to study menstrual tracking behavior among a North American audience at CHI 2017 [24]. Recent projects such as *Ambient Cycle* [32] and *Crimson Wave* [25] explored novel methods of embedding menstrual tracking data using ambient light- and color-emitting smart mirrors, respectively, to spark conversations on the topic. We extend this body of work on menstrual health with our study of Menstrupedia, an upcoming and popular online Indian platform, which sports a Q&A forum, blog, and comic for delivering MHE [50].

Across India, there is a serious need for improved MHE, due to deep-rooted sociocultural norms that prevent open discussion on the subject. Indian girls and women across ages are shrouded in myths, superstitions, and multiple restrictions around menstruation and menstrual health [19, 43]. A study conducted across schools in central India showed that only 3% of the girls had received premenarchal information from their teachers, and 24% were uninformed when they experienced their menarche [20]. Taking note of this dire situation surrounding MHE, the government of India has undertaken several initiatives, such as *Kishori Shakti Yojana* (KSY) [42], which distributes free sanitary napkins and promotes MHE in government schools, and the *SAATHIYA* resource kit (including an Android application in Hindi), which aims to train adolescent educators, across genders, from the community, who would then conduct peer-to-peer health awareness workshops in the field [16]. Additionally, the Indian government adopted national guidelines on Menstrual Hygiene Management (MHM) as a part of the *Swachh Bharat* (Clean India) *Mission* in 2015 [59]. To promote menstrual hygiene, various state governments are also installing sanitary pad vending machines in schools and public areas [57, 75]. Delhi's state government is in the process of developing educational materials with additional focus on sensitizing male youth [31]. Educational materials developed by the UNFPA (United Nations Population Fund) are being utilized by various state agencies across India [35]. Apart from government initiatives, many NGOs and practitioners (*e.g.,* [66, 73, 79]) have also been contributing by preparing culturally appropriate content and distributing it through awareness campaigns and workshops. The sheer number of these initiatives highlights the importance that MHE is being given at the state and national levels. However, although they all contribute towards spreading awareness, they are limited in terms of geographic and/or organizational reach. By contrast, Menstrupedia—accessible online—targets an extensive Indian audience (although there are limitations that we discuss) [50]. It also entails a 24x7 platform for users to access the MHE it aims to provide.

Online communities such as Menstrupedia's have been an active focus of CSCW scholarship for several years now. We next summarize the portion of this research that has shown engagement with sensitive topics in these communities. For example, Birnholtz et al. observed that university students leveraged the anonymity of Facebook Confession Boards (FCBs) to discuss and gain knowledge about taboo topics, including sex, illegal substances, mental health, and bodily functions [12]. These

authors observed that participants solicited information about sexual behaviors, shared their sexual experiences and fantasies, questioned stigma associated with sexuality, and more, while revealing *"potentially stigmatized identities"*. Similarly, Andalibi et al. [6] have studied information-sharing practices on the topic of sexual abuse on Reddit. They found that individuals use "throwaway" accounts to ensure anonymity while seeking online support on the subject. Related work by Semaan et al. found Iraqi users to be slowly adopting ICT (*e.g.,* online fora, blogs, and social networking sites) for engaging in discourses around various taboo topics otherwise considered "lewd" [67]. Authors observed that participants opted for ICT *"where they had full control over the audience and their real world identity—that is, ICTs through which they could move in and out of anonymity."* Carrasco et al. showed that LGBTQ+ individuals in the United States used online platforms as their safe spaces to seek support and companionship [17]. These authors found that queer populations manipulated various features offered by social platforms to achieve selective visibility, that is, selectively disclosing their identity to a specific group of people. Other studies [14, 29] have also demonstrated the use of social media platforms by LGBTQ+ communities for seeking support during (personal and social) transitions. Research shows that even for non-sexual taboo topics, such as mental health, people seek information and support on online platforms [7, 33, 46, 69]. Kumar et al.'s work demonstrated that providing an anonymous forum for discussions on HIV/AIDS significantly improved awareness on the topic among Fijian users [45]. Johnson studied how first-time mothers participated both actively and passively in online communities to explore topics such as same-sex parenting, which would otherwise seem like taboo topics [39]. Extending this body of work on navigating taboos in online communities, we aim to understand engagement on and with Menstrupedia's platform.

We use the lens of Feminist HCI, as proposed by Bardzell in 2010 [10], to analyze the data we collected for our study of Menstrupedia. This framework draws attention to the larger power dynamics that influence the design, acceptance, and adoption of technology, and has been used to analyze various technological interventions, including panic buttons for women's safety [40], mobile media use for maternal health [44], online fora for discussing street harassment [22], among others. Our work focuses on the six qualities discussed in the framework: *pluralism* rejects the idea of a "universal" solution; *ecology* encourages the designer to reflect on how design might draw from and shape the surroundings; *advocacy* promotes design for positive social change from the stakeholders' and not the designers' perspectives; *self-disclosure* values personalized design by revealing its impact on its user; *participation* prioritizes the voice of the stakeholders; *embodiment* makes bodies the focus of the design. Below we discuss how the design of Menstrupedia's platform aligns with this framework, drawing on the perceptions of its users and our research participants.

3 METHODOLOGY

We conducted an instrumental case study [11] of the Menstrupedia platform [50] in New Delhi (India) from September 2017 to February 2018, targeting an enriched understanding of the affordances and constraints of an ICT-based platform seeking to widen adoption and delivery of MHE. We gathered data from the Menstrupedia website, conducted content analysis of the Menstrupedia comic, and organized comic-reading sessions with young adults. We present our analysis of this data below, referring to the questions from the Q&A forum using *Q#*, and quotes from the interviews using *F#* and *M#* for female and male participants.

3.1 Menstrupedia Website

Menstrupedia's website (https://www.menstrupedia.com/) was launched in October 2012 with the aim of overcoming the stigma and myths surrounding menstruation by providing information in a friendly and accessible fashion [76]. It currently has four main segments: a quick guide, a comic

section, a Q&A forum, and a blog. The website asks users to choose a screen-name and does not collect any demographic information except an undisclosed email address. On the website, we studied the Q&A forum and quick guide (the ASK and LEARN sections).
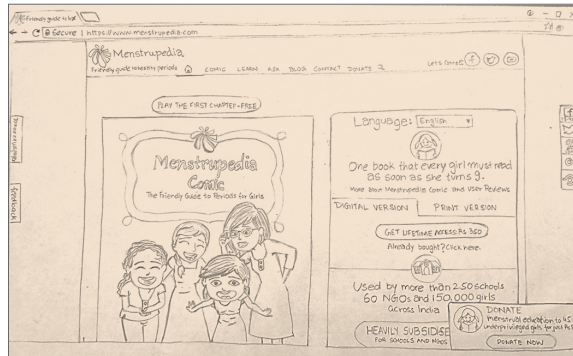

Fig. 1. Sketch of Menstrupedia website. The website hosts a Q&A forum in its ASK section, a blog, and a quick informational guide in its LEARN section. The COMIC section presents details, history, and reviews of the comic.

3.1.1 Q&A Forum. The ASK section of the website allows a registered user (of any gender) to post queries or answer existing questions. Posts are public; anyone can view them without having to register. Clicking on a question opens it up and increments its "views" count. For each question asked from the launch of the website until January 31, 2018, we collected the title, content, date of post, number of views, number of responses, author name, and tags. Since the post only discloses the screen-name of the author, we did not have access to authors' demographic information. This process yielded 226 questions, of which we removed 3 redundant questions that were asked under different titles. We used the remaining 223 questions as our data set, subjecting it to thematic analysis [15] in two phases, where we applied a two-level coding (question *topic* and question *type*) scheme.

In the first phase, we began by preparing a topic codebook (see Table 2), before conducting thematic analysis of the data. In 9 of 223 cases, we were unable to arrive at a consensus, so we discarded those questions and further analyzed the remaining 214. In the second phase, questions under the 'Other' *topic* code (49 questions) were eliminated and the remaining data (165) was subjected to thematic analysis (see Table 3). Our goal was to classify these questions on the basis of their nature. We adopted a two-level analysis. In the first level, we followed the coding scheme used by Harper et al. [28] with two codes: *Informational Questions* (with intent of getting information) and *Conversational Questions* (with intent of stimulating discussion). In the second level, the informational questions were coded via a tailored version of the scheme used by Morris et al. [54], with two categories: *recommendation/opinion* (subjective answer) and *fact-based knowledge* (objective answer).

3.1.2 Quick Guide. We studied the content presented in the *quick guide* under the LEARN section of the website. This guide provides educational information in small paragraphs (with a median word count of 119 per topic, a minimum of 30, and a maximum of 848), supported by colorful graphics on puberty, menstruation, myths, and hygiene. To check if the content was comprehensive, by examining the facets covered and the extent to which they were discussed, we used deductive content analysis [15]. We used a tailored version of the coding scheme that was used for analyzing

	Controlled Environment (10)	Uncontrolled Environment (10)
Site	Cabin (Private Space)	Cafeteria (Public Space)
Gender	Female (5), Male (5)	Female (5), Male (5)
Age	Min 18, Max 20, Median 19	Min 18, Max 20, Median 19
Major	Design (10)	Computer science (3), Maths (1), Design (6)
Family Income	Middle [$5K to $26K] (6),	Middle [$5K to $26K] (5),
(per annum)	High > $26K (4)	High > $26K (5)

Table 1. We conducted think-aloud comic reading sessions with 20 young adults (10 female and 10 male) in a public and a private setting, followed by a ten minute semi-structured interview. All the participants were first-year undergraduates. We audio-recorded these sessions and took hand-written notes and sketches.

the Q&A forum, with seven categories: *education*, *hygiene and management*, *myths and taboo*, *basic physiology*, *medical issues*, *irregularity*, and *menses & reproductive health*. We also evaluated the content and supporting graphics using Bardzell's framework [10].

3.2 Menstrupedia Comic

The Menstrupedia comic was developed in association with the sanitary pad-producing company *Whisper*, over a period of 18 months (in 2013-2014), with the help of a successful crowd-funding campaign [51]. This comic has 88 pages organized into four chapters—*growing up* (on puberty-related changes in male and female bodies), *what are periods?* (on menstruation), *when is my next period?* (on menstrual tracking), and *taking care during periods* (on myths, hygiene, and management). Although the comic targets girls who are nine years and older, the website promotes it as being relevant for "younger or older girls and even boys". This comic is available in English, Hindi, and nine regional Indian languages. Except for the English version, which is available in print and as an e-book, all versions are only available in print. They are available for purchase on www.menstrupedia.com and www.amazon.in. At the time of writing, this comic claimed to have reached 250 schools, 60 NGOs, and 150,000 girls across India (see Figure 1) [50].

3.2.1 Content Analysis. We analyzed the graphic and textual content in the Hindi and English versions of the comic using the lens of feminist HCI [10]. We conducted deductive content analysis [15] using the codebook we created for analyzing the quick guide.

3.2.2 Reading Sessions. We conducted comic reading sessions with 20 adults (see Table 1) to understand how young adults (male and female) might respond to Menstrupedia's approach to MHE. We combined the use of the think-aloud protocol [18] with interviews between the book chapters, followed by a brief post-session interview. These sessions were conducted in public and private settings, to study the impact of the surroundings on the participants' reading of the comic.

At the start of every session, we explained the think-aloud protocol to participants. We also gave them the choice of reading the Hindi or English version of the comic. After each chapter, we asked them three questions to capture what they liked, disliked, and if they had learned something new. On average, the reading session lasted for 30 minutes, and was followed by a 10-minute semi-structured interview. Participants were asked to fill out a survey of nine questions, including seven demographic questions, a rating question regarding their preference of media for receiving MHE, and a checklist of emotions to capture their experience of engaging with the comic.

We selected our participants out of a class of first-year engineering undergraduates. We approached the class of students and solicited voluntary participation after explaining our study objective. All recruited participants provided us with written consent; we also informed them that

they could leave at any time. We conducted our interviews in Hindi and/or English, depending on the participants' comfort levels. Our sessions were audio-recorded to be translated and transcribed in English for analysis. We also took hand-written notes during our interactions with the students, observing their body language as well. We read and coded interview transcripts line by line, and analyzed the data iteratively using inductive analysis [15].

3.3 Study Limitations

India is a large country with a greatly diverse population. We acknowledge that our study participants represented a small percentage of an expansive but relatively privileged middle class, when compared to the rest of the country. They spoke and understood English well, and were well-versed with technological advancements. Our findings would likely be quite different if we were working with socioeconomically marginalized populations, in rural or urban India, where resources are even more constrained and challenging to access. While this is a limitation of our study, we also emphasize that even the best endowed groups in India struggle with lack of attention to MHE (and similarly taboo topics). By addressing their under-studied struggles first, we believe that we will find ourselves a step closer to addressing the struggles of more vulnerable populations.

3.4 Reflexivity

All authors are of Indian origin and have fieldwork experience across different regions and with diverse marginalized communities in India. We have all conducted HCI research with a focus on designing ICT-based solutions across multiple domains, including health and education. Three of four authors are women, and all authors have had personal experiences with challenging information delivery and exchange on menstruation and other taboo topics. We approach this study with an emancipatory action research approach, and from a feminist standpoint. Our interpretation of the data collected is likely to be biased by our strong desire to improve access to MHE in India and challenge the stigma associated with its provision. We ask that our paper be read as such.

4 FINDINGS

We now present our findings, first on user participation on the Menstrupedia website, before shifting focus to our participants' engagement with the Menstrupedia comic. Finally, we take a consolidated view of the information provided by both the Menstrupedia website and comic to analyze how they are similar and different. Throughout, we reflect on how the offerings of Menstrupedia (website and comic) align with Feminist HCI principles, or—in some cases—might align better [10].

4.1 Online Participation: Information Solicited and Revealed

4.1.1 Who were the users? Menstrupedia allows only registered members to post questions, revealing the users' screen-names, profile pictures, and timestamps for posts, in addition to the actual post. Our data showed, however, that 96% did not use a profile picture, almost 5% used *"anonymous"* as their screen-name, and 61% used a pseudonym (as far as we could tell). The text in the questions did reveal facets of users' identities, however, such as age and gender, though self-reported data could be inaccurate. To the best of our assessment, 69% of the questions were posed by female participants and 15% by male participants. Additionally, 26% users explicitly mentioned their ages (the minimum was 14, maximum 52, and median was 22). For example, *"I am 23 years old i did not have my periods for 6 months. i do not know what to do next and i really need help. please guide me"* (Q96). Users also appeared to solicit information as intermediaries. Approximately 5% questions focused on the well-being of the user's daughter, mother, sister, friend, wife, or sexual partner. This important finding affirmed that, subjected to the accuracy of self-reported data, the Menstrupedia

platform is not used by women alone and allows for an ***ecology*** of actors to participate [10]. For example, the quote below appears to be from a male user:

> *"Please let me know about PMS and how to deal with it? Being of the other gender we guys often tend to misunderstand our sister's or girlfriend's or wife's behavior at these times most importantly the mood-swings. Please let me know how to take care of our sister or girlfriend or wife when she is facing 'this' time.. the DO's and DON'Ts for us"* (Q161).

That this Q&A forum was open for participation across ages and genders shows that it was ***pluralistic*** in its design [10]. As we later discuss, however, there was also scope for greater pluralism.

4.1.2   What did they ask? The questions ranged across diverse topics (see Table 2). Of the 223 questions we analyzed, 165 were connected to menstrual health, while the remaining 49 fell broadly in the realm of sexual and reproductive health. Not only do we see a categorization of the MHE gaps present among Menstrupedia's current users, we also note additional areas in which these users were lacking information. Most of these questions were accompanied with multiple sentences that explained the context in depth before the question was posed. Sometimes, multiple questions that drew on different contexts sought similar answers, such as the two questions below. In both examples, the users appeared anxious to determine whether they might be pregnant:

> *"Hi! I didn't had my periods last month n went for unprotected sex with my partner several times within 4 days consuming 2 contraceptive I pills... Still I m missing my periods. Its been a month n a half now without periods.... Is der a chance of getting pregnant???? Its really bothering me now pls help"* (Q198)

> *"I am 32 years old. last month i had periods 2 times then i took treatment from Gynac for the same. This month I got my periods on 16th Feb. But there was no proper bleeding only 2-3 spots in a day. Me & my husband had unprotected sex on 12th Feb. Is there any chances of that i am pregnant.? Please advise"* (Q185).

The absence of other, easily accessible platforms made questions on Menstrupedia more wide-ranging. Participants were curious about menstruation-related topics, but also voiced a desire for all kinds of other information, such as regarding pregnancy and/or sexual health. This indicates a mismatched set of expectations between Menstrupedia and its users, and perhaps the lack of ***participation*** as Bardzell describes it [10]. More user research may be needed to determine whether this lack of alignment is costing Menstrupedia in terms of users looking for MHE.

4.1.3   And how? We arrived at a categorization of—and examples for—the types of questions that were posed, drawing on Morris et al.'s approach in their study of Q&A on online communities [54]. Users sought—almost in equal measure—fact-based information (approx. 37%) as well as subjective opinions and recommendations (approx. 43%), and frequently asked open-ended questions to initiate discussion (approx. 18%). In Table 3, we see examples of these types. While Q14 asks for a recommendation for what to do when there is pain during periods, Q110 asks about why there are abdominal cramps at the start of the period, and Q164 has a more open-ended question around why a girl should not go to the temple during her periods. These highlight how users of Menstrupedia's platform sought different kinds of assistance and support—from peers as well as medical experts—and a larger ***ecology*** of actors [10].

4.2   The Menstrupedia Comic: Information Provided and Participants' Response

The comic features four female characters—Pinky (nine years old), her older sister Priya who is a doctor, and Pinky's two friends Jiya and Meera. The comic begins with Pinky's birthday party, during which Jiya experiences menarche. The story unfolds with Priya introducing and

explaining puberty and menstruation to the three girls. The families featured evidently come from a middle-high income level. The three girls represent different stages of adolescence: Pinky—a pre-pubescent girl who is yet to be introduced to the topic of menstruation, Jiya—who has just experienced menarche and is confused, and Meera—an adolescent girl who is familiar with having

Menstrual Health-Related Questions (165)			
Theme	Topics	%	Example
Irregularity	Irregularity of menses and flow	17.29%	*"I am a girl of 16 Its been 40 days since my last periods. What's the reason for it?" (Q75)*
Sex, menses, pregnancy	Delayed menses post sexual activity, linked to chances of pregnancy	16.82%	*"We had sex 4 days before her periods date and aftet ipill consumption she did not have period for december. do you think we should worry about pregnancy." (Q91)*
Medical issues	Various diseases associated with menstrual health	12.62%	*"Continual white discharge through out the month before and after the periods, feeling so discomfort." (Q8)*
Hygiene & management	Hygiene practices and flow management products	11.21%	*"Is there protection that works best for extreme sports?" (Q118)*
Myths & taboos	Societal taboos and cultural practices	4.67%	*"Why is it not allowed to have head bath during 1st 2 days of menstruation?" (Q37)*
Controlling menses	Ways to prepone/postpone cycles per convenience	4.67%	*"What is the process to get periods before my periods time? " (Q21)*
Pills & menses	Various pills and their impact on menstrual cycles	3.74%	*"Does intake of Heavy Antibiotics affects Menstrual Cycle?" (Q11)*
Education	Awareness campaigns, appropriate age for introducing MHE, and more	3.27%	*"What is the appropriate age to educate young girls about periods?" (Q158)*
Basic physiology	Physiology underlying the phenomenon of menstruation	2.80%	*What are the causes of delayed onset of menses in a 16 yr old girl?" (Q156)*
Other Questions (49)			
Masturbation	Masturbation and its effects	28.57%	*"I usually mastrubate 2-3 times a week I have pimples on my face. Is this due to the above cause ?" (Q183)*
Male physiology	Specifically ejaculation, erection, and nocturnal dreams	26.53%	*"In almost 4 out of 5 days, my penis is erect when I wake up in the morning or whenever I wake up after sleep....what can I do??" (Q202)*
Pregnancy	Pregnancy and abortion	14.29%	*"What is the abortion pill (RU486, Mifepristone, Mifegyne)?" (Q209)*
Contraception	Various contraceptive methods	6.12%	*"What do I do if I miss an OC pill?" (Q208)*
Miscellaneous	All remaining questions	24.49%	*"This website shows more about female hygiene. what about male hygiene not explained here?" (Q207)*

Table 2. Of 223 questions analyzed, 165 were related to menstrual health and 49 were classified under 'other' (consensus was not reached for 9 questions). The data presented here highlights the information needs of (a segment of) the Indian population on sexual well-being and family life.

Type (%)	Subtype (%)	Example
Informational (82.42 %)	Recommendation/ opinion (52.94 %)	*"During periods, my stomach and hip pains a lot.I feel very tired. I feel like my head is rounding.Because of this i miss my school. What to do?" (Q14)*
	Fact-based (46.32 %)	*"I usually get abdominal cramps during the first two days of my periods! is it normal? why do we get it anyways?" (Q110)*
Conversational (17.58 %)		*"Why shouldn't a girl go to the temple during her periods?" (Q164)*

Table 3. This table presents the distribution of questions based on their type. Questions that were *informational* were subjected to second-level coding for a deeper understanding of information-seeking behavior. Most questions seeking a recommendation or opinion seemed to want medical advice.

periods and seeks clarifications on associated myths [74]. Use of these different characters indicates a ***pluralistic*** approach towards female readers at different stages in their lives [10].

4.2.1 A Friendly Format. The dominant view among all participants was one of appreciation that the comic used real life scenarios to deliver critical information, as F10 shared:

> *"I like how they came up with personal accounts so you know they [girls] can feel a little less embarrassed about everything. It is how that she [the older sister] talked about things, how she normalizes the entire experience..."* (F10)

The characters featured in the comic were widely appreciated, and participants expressed comfort in engaging with instructional content that was delivered by a doctor figure (the older sister). Here we confirm the findings of Sorcar et al., who also found that students were comfortable learning about HIV/AIDS from a doctor featured in their animated curriculum [71]. This appeared to enhance our participants' perception of the comic as a legitimate source of information, invoking a sense of ***advocacy*** [10]. As one participant commented, *"... it was informative and the way they portrayed it using a doctor... it was very nice and particularly about being informed about such things at an earlier stage is always beneficial"* (M8).

More generally, participants liked the illustrations used to capture the reader's attention:

> *"It is really cute and funny in places, quite funny. I like how there are a lot of diagrams and not like cartoony diagrams but like proper detailed diagrams. It is actually cute how they tell you to calculate, how your cycle is going to be. I like how they say [when] you should visit a doctor. I like how it is so detailed because there so many questions that you want to ask, you want to know and you are not really comfortable you know going to someone and being like okay my period blood is this color, is that normal? But if you read this [comic] you do come across this then. This is really cool like 'Mujhe kyun nahi dia jab main choti thi' (I wish I was given something like this when I was an adolescent)"* (F2).

There were specific aspects of the comic that were appreciated, such as the warnings regarding when to consult a doctor. As one male participant said, *"the good thing is the way they have given that warnings in a proper manner, which should be there so that your eyes are drawn towards that and it is not skipped over the whole conversation"* (M9).

4.2.2 Boundaries of Comfort. Participants found most visual representations and diagrams in the comic appropriate except the visuals presented in Figure 2. Male participants found all three visuals *"a bit discomforting"*, while female participants found the line diagram of the vagina (the rightmost image) to be *"crude"* and expressed their preference for a subtler representation. This was

not unexpected, and affirmed the lack of comfort around taboo topics, including graphics. More could be done, as we discuss later, to make audiences more at ease, but also gradually become more comfortable with this content, potentially through incorporating **embodiment** [10].

We also tried to gauge the participants' comfort levels by asking if they would be comfortable reading the comic *"while traveling in a crowded coach of Delhi Metro during peak hours?"* Approximately 70% of male participants and 40% of female participants indicated their discomfort in reading the comic in such crowded public spaces, because they felt they would be judged:

> *"Not in the metro because other people might see us and they might judge us but in the cafe or where someone is not directly seeing us then it may be fine when reading this. No I would not want to be seen because people just see us and judge like what is he doing reading because most people don't understand these things that's why"* (M2).

We asked if covering the comic with a newspaper or giving it a different cover would solve the problem, but all participants said that it was not the cover but the illustrations and content that would make them uncomfortable:

> *"In India there is a lot of stereotype about all this stuff. Even when you go to buy sanitary napkins they give it to you in a black polythene. So yeah there is a lot of stereotype with this so I don't think I will be comfortable reading this in a public space. I don't think that [book's] cover is a problem as such I think the visuals inside it are... still no"* (F5).

We also had our participants engage with the comic in both public and private settings, but did not observe any difference in their body language—neither across settings, nor across genders. Almost all participants reported that they felt relaxed throughout the session. A more **participation**-oriented approach might benefit Menstrupedia by helping to identify these boundaries of comfort [10].

4.2.3 Instructional, for the Most Part. Reviews also indicated that the comic was a good and much needed initiative, affirming that it had instructional value. Around 80% (62/77) of user reviews praised Menstrupedia's efforts using expressions such as "great"(28/62), "good" (20/62), "informative" (16/62), and "amazing" (14/62). One review said:

> *"Even after menstruating for over a decade, there is a lot I learned from this comic. I even suggested it to my mother (a vice principal in a school) to keep a few copies in her library. She also loved it, and says that it has really helped the teachers educate adolescent girls about the goings-on in their bodies."*

Although participants were in agreement that a comic—visual, illustrative, and narrative—was a compelling way of educating adolescents on the topic, some also raised concerns around the length of the comic, saying that 88 pages were too *"stretched"* and *"dragged"*, impacting their engagement with the comic. All female participants agreed that the last chapter was the most informative, and the third chapter was redundant (period tracking was introduced in chapter 2 and revisited in depth in chapter 3). During the post-session interviews, most female participants shared that they felt curious while reading the comic. Fewer boys reported having felt curious during their reading. More iteration of the comic's design from a **participation** lens could further aid readability [10].

4.2.4 English, the Language of Science. The comic is available in English (in print and as an e-book), and in Hindi (and other languages), only in print, for purchase. Our content analysis revealed that there was no difference in meaning or cultural expression between the two texts; they were direct translations of each other. The Hindi version had used several English words transliterated, such as "period" and "sanitary pad". Also, Hindi translations of less known scientific words (*e.g.,* pituitary gland) were accompanied by their English translations in parentheses. Although we gave our participants the choice of engaging with the text in either language, they all opted for English.

This bias towards English may convey lack of a *pluralistic* approach, but prior HCI research has also shown that middle class technology users across India lean towards English, even when they are more fluent in other available languages [41]. There are still, however, many different user groups that are not targeted, particularly users who may lack necessary literacies for engaging with the text. Innovating around other modalities, as approached by prior work on voice-based systems and text-free interfaces (*e.g.,* [1, 47, 49]), could improve the reach of the Menstrupedia platform and make it more ***pluralistic*** [10].
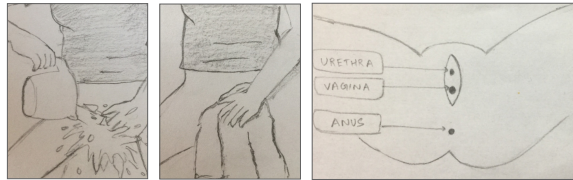

Fig. 2. Sketches of discomforting visual representations. The line diagram of vagina appears on page 11 and the remaining illustrations depicting the steps for maintaining genital hygiene appear towards the end of the comic (page 80). Boys found all three visuals discomforting, while girls only expressed concern regarding the rightmost image.

4.2.5 Engaging the Non-Menstruating Sex. Our analysis also highlighted missed opportunities, which might have been leveraged to advocate for behavioral change. Not only the lead characters but most supporting characters (including the pet dog and patients in Pinky's clinic) were female, supporting the stereotype that the topic of menstruation was meant for "girls only":

> *"There are too many females, I mean there is no father no brother they are just all girls having this conversation. So you know it's a typical [mind set] 'ye ladkiyo wali baat hai' (it's a girl thing) "* (F2).

The only male characters used in the comic are Pinky's father, Jiya's father, and her younger brother, who have a visual presence but do not speak. All these male characters appear at critical points in the narrative—Jiya's father comes to pick her up when she experiences menarche, Pinky's father enters the house to find ripped pieces of a used pad scattered in the house by their pet dog, and Jiya's younger brother uses a sanitary napkin to absorb the ink spilled on his notebook. In each of these cases, we see characters of the non-menstruating sex refrain from participating in the ongoing dialog. Although the comic encourages seeking clarifications from parents, the visual representations (*e.g.,* the girl is shown talking to her mother over the phone, while her father stands behind the mother) reinforce a preference for the female over the male parent.

Almost all participants (17/20) believed that including a male lead character would be a compelling way of presenting a male perspective on the topic of menstruation. The journey of the male character (brother/friend) could be used to sensitize male readers, also informing them of various ways in which they might provide support to the menstruating sex:

> *"we can like show this comics from a boy's point of view, like how they behave or treat girls when they know that their fellow acquaintances have the thing"* (F8).

Moreover, for readers identifying as male, the inclusion of a male character could help them relate to the ongoing discussion in the comic. One of the male participants expressed:

> *"It might make a difference that there is a boy character and how he reacts to something which is not normally talked about to him, something which is very new to him so knowing his psychological changes might yes make a difference to people"* (M10)

The visuals in the comic leave room for greater exploration of the qualities of **ecology** and **advocacy** [10]; when we fail to include the non-menstruating sex in addressing taboos around MHE, we also restrict the avenues available for social change.

4.3 The Menstrupedia Platform: A Multi-Faceted Approach for Delivering MHE

4.3.1 Access to Menstrupedia. The Menstrupedia platform provides support for both online (website) and offline (comic) information delivery. According to a December 2017 report by the Internet and Mobile Association of India [36], there are 481 million internet users (40% of the population), and only 30% of them are female. To address the needs of this large percentage of offline female users, the platform developed its comic, *"because awareness is needed everywhere"* (as Tuhin Paul, the co-founder of Menstrupedia, stated on the Q&A forum). The comic is available in English, Hindi, and nine regional Indian languages. However, the cost of the comic ($4.5 to $6) renders it unaffordable for many across rural India having monthly per capita consumer expenditure (MPCE) of approximately $22 [52]. Moreover, the books can only be ordered online, also limiting access.

Certainly, by design, Menstrupedia honors the quality of **pluralism** in that it has made the effort to produce its comics in several Indian languages, also aiming to target a potentially large offline audience. However, the content has merely been translated across languages without an accompanying change in cultural expression. In addition, the co-founder recognizes Menstrupedia's limited reach, and the need for its information to be more widely accessible, but the platform so far seems unable to respond to this need.

4.3.2 Disparities and Inadequacies of Content. We also studied how topics covered in the comic compared to the content presented on the website. The comic offers an in-depth explanation of menstrual tracking, using the example of a paper-based calendar, but it does not mention any digital means (*e.g.,* mobile tracking applications) that are now available. As one participant mentioned:

> *"They can also tell us about the apps that are coming because this [marking on a calendar] is too much effort. You can tells us about the apps, there are so many apps coming up"* (F4)

Additionally, the comic only covers sanitary napkins and cloth pads, leaving out other products, such as tampons and menstrual cups, although the website explains the use and disposal of all products. One of the participants shared:

> *"The thing is tampons aren't very common, so I think it is very necessary to talk about tampons because some people may prefer using them so like at least you should have the knowledge about them. You don't feel comfortable with them that is another thing but at least you should know that this kind of products also exists. So I feel that they should definitely include them [in comic]"* (F10)

Information on infections or diseases related to menstrual health was inadequate on the website and in the comic. The comic discussed pre-menstrual syndrome (PMS), but the website did not provide any information on the same. There was also content that was omitted on both the comic and the website, as pointed out by participants. For example, our analysis of the Q&A forum indicated that 15% of the questions under the *medical issues* category were on Polycystic Ovarian Syndrome/Disease (PCOS/PCOD). A recent survey has also shown that roughly 20% of Indian women suffer from PCOS [61]. Other medical conditions related to menstrual hygiene management include urinary track infection [26], cervical cancer [30], and toxic shock syndrome [53, 68]. This information gap was identified during reading sessions by all female participants. As one pointed out: *"Yeah so if I am recommending it to my age group then I definitely would want to add all these*

tampons stuff and the diseases stuff" (F8). Here, again, we see potential for Menstrupedia to take a more ***participatory*** approach to cater to additional information needs of their users [10].
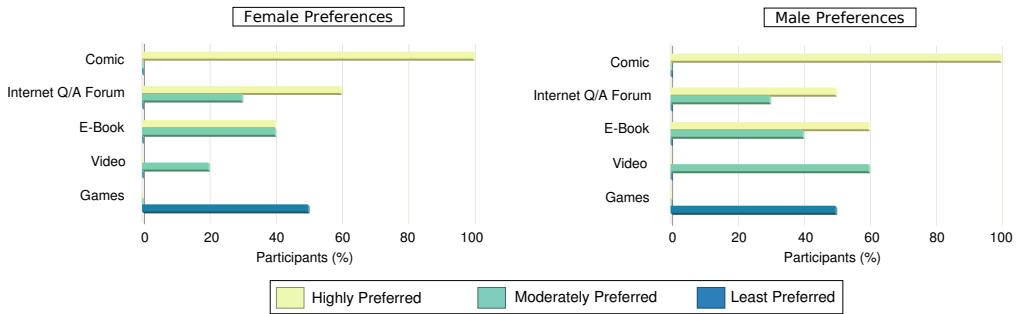

Fig. 3. Distribution of participants' preferences regarding delivery mechanisms for MHE. All participants from our comic reading sessions were asked to rate these mechanisms on a scale of 1 to 9 (highly preferred to least preferred). We then classified these ratings into three categories: highly preferred (1-3), moderately preferred (4-6), and least preferred (7-9).

4.3.3 Digital vs. Material. We asked our participants to indicate their preferences regarding different delivery mechanisms. The majority preferred comics (see Figure 3) for two main reasons. First, they expressed that the tangibility of a comic would bring them to reflect more on the topic, and stay committed. Second, the comic eliminated the possibility of getting distracted easily, which is what would happen—they said—on digital platforms. As M10 shared:

> *"I rank this [comic at first preference] because you are more involved doing the activity like reading a comic book, seeing illustrations, you are more focus on to that, you are less tend to be distracted or vary actually from the topic"* (M10)

Participants also saw value in the availability of internet fora for seeking answers to specific personalized queries:

> *"When you have some questions you go and Google it and go read about it on the online platforms like Quora and stuff. So I think those are more helpful in such a case. So instead of reading the whole text you can get your answer through the particular thing"* (F5)

We also see here different modes of engaging with MHE that may offer insights for designing different kinds of interactions. While comics offered the opportunity to learn in an engaged fashion, without distractions, the website offered quick look-ups when the user was in information-seeking mode. Allowing for different modes of engagement with MHE also conveys a ***pluralistic*** approach, as it targets user engagement across different learning mindsets [10].

5 DISCUSSION

Menstrupedia is a platform that emerged to address the menstrual health education (MHE) needs of an Indian audience. Our study examines the offerings of Menstrupedia, including its website and comic, for an enriched understanding of the challenges and opportunities in providing MHE to a growing middle class user group. We now present takeaways from our analysis, using Bardzell's feminist HCI lens [10] to propose design implications for imparting MHE via technology-based platforms. We also reflect on how this framework might be extended for use in research around sensitive and taboo information exchange across diverse cultural contexts.

5.1 Encouraging Active Participation

Menstrupedia's goal is to provide information on menstrual health and hygiene that is otherwise challenging to access for the Indian population, given limiting societal norms and taboos. By creating a Q&A forum, it provides an important avenue for ***participation*** where users can pose questions targeting MHE. Our data showed that this forum is not very widely used for posting questions—only 223 were posed over 5 years. However, the number of passive users appears to be much larger. Total number of views, till 30th Jan. 2018, were above 4 million (highest view: 740000 with median: 3100). Additionally, the topics covered by these questions highlighted that menstruation is not the only source of curiosity among the users, as also shown in Table 2, even though MHE is clearly the goal of the website. Depending on the users' age, gender, and other aspects of their backgrounds, the questions asked were also quite varied. Platforms for various kinds of sensitive information exchange might recognize and allow for this scoping challenge.

A one-size-fits-all use of the platform, which offers the same information to all its users, runs the risk of turning away users whose sensibilities may be hurt on account of explicit questions regarding engaging in sexual intercourse, for example, *"... what is tha difference between male and female masturbation i mean if male masturbate semen release from penis and what about females masturbate"* (Q173). How might the platform welcome a wider audience and set of stakeholders without offending sensibilities of a large conservative middle class population? Also, we may need to better understand the reasons why questions are viewed in large numbers but not many are posed, and consider ways of fostering more active participation, perhaps at lower stakes. For example, users could be given means to highlight lines of text or clap several times (such as on medium.com) or they could add question marks if they wished for greater detail. This can hold also for topics outside of menstruation.

5.2 Embracing Different Backgrounds

From the point of view of ***pluralism***, we saw that the Menstrupedia platform provided different ways of engaging with MHE—through the website's Q&A forum, the quick guide, the e-book, and the comic. By offering the comic in different languages, it also targeted an audience with varied cultural backgrounds and literacies. Moreover, the comic addressed different ages of adolescence and stages of puberty with the three friends' characters. However, there might exist many more types of differences present among the target audience. Different families might have different attitudes towards open communication, cultural *dos and don'ts* during one's period, among other things. Although our participants came from reasonably homogeneous backgrounds, they also had varying responses to the topics covered in the comic. A platform that recognizes these deeply divergent backgrounds, and also allows every user to achieve a personalized interaction (given the intimate focus of MHE) might be more effective, our findings suggest. Accounting for ***self-disclosure***—the platform currently does not—might be one way of catering to varying audiences and varying questions. This might also respect the user's desire for a more intimate experience, which was a need communicated by our participants in their reaction to reading the comic in its material, rather than digital, form. The larger idea here is of respecting users and granting them the opportunity to clearly convey what information they are ready for and no more.

5.3 Taking a Holistic Approach

One key finding that came across throughout our data set was the need for taking an ***ecological*** approach. First, this showed up in the questions asked that were seeking medical advice and recommendations. It was also evident from the need users apparently had for open-ended discussions, where peers could potentially engage. And in questions asked by users who (reportedly) were asking

for their friends and family. This also came across in the comic, which—as participants noted—failed to engage the non-menstruating gender. Questions around reading in the metro also highlighted this, since the fear of being judged by strangers on a train for reading a comic about menstruation was evident across participants. How might Menstrupedia use a more ecological approach to foster open and respectful information exchange across peers, medical experts, (male and female) family members, teachers, and even the society as a whole? For example, a UNICEF team in Indonesia designed a comic book which, when held in one way, informs girls about periods, and when turned upside down, converts into a guide for sensitizing boys on the subject [64]. Likewise, designers might innovate around improving communication between various actors in this ecology. It may be prudent to note, however, that not all ecological actors are equally invested. Prioritizing the more vulnerable populations is a worthy choice to make; even if male users are challenging to engage, we might still wish to engage the female ones. This insight is also generalizable across topics, although stakeholders may change. Leveraging the popularity of Bollywood actors, as Sorcar et al. do [71], can be one way of making an ecological approach more user-friendly as well.

A tension also emerged in this regard around the balance of responsibilities between humans and technology in this ecology. The importance of face-to-face interaction was stressed by several of our participants, despite acknowledging that Menstrupedia offered learning that was otherwise inaccessible to them. Although technologies can be designed to educate in various ways, such as by offering mixed reality experiences or through games [38, 78], a human must be in control to ensure that the right information is being accessed and consumed, as many participants expressed. This is also likely to be why our participants considered games the least preferred medium for MHE (see Figure 3). Technology design must focus on supporting, leveraging, and extending human communication, as against replacing the need for it. This connects also to the larger debate in CSCW and HCI regarding how we might achieve an appropriate balance among these roles.

5.4 Engaging with the Body

Our interviews with young adults showed that Menstrupedia was perceived to have a friendly format; there was also general acceptability around the notion that Menstrupedia provided important information (*e.g.,* vaginal discharge, different color of blood, dietary habits, PMS and more). Many of the visuals were engaging, but some others caused discomfort, particularly to male participants. This raises questions regarding how we might incorporate **embodiment** into our designs. It may be preferable to begin with visuals that are less explicit, with a potential advanced goal of having (male and female) adolescents physically engage with their bodies to better understand how these are impacted by menstruation. Designers have also tried to generate empathy among male users in prior work (*e.g.,* [72]). Here, it is important to recognize that the cultural context has a major role to play in the success of an intervention. No matter how progressive the designers might be, aligning with the needs of a conservative audience and setting appropriate thresholds is critical, whether for MHE or for other topics.

Labella innovated around the design of underwear to enable self-learning in a private space [5], and this may be one way to foster familiarity with different menstrual products. However, intimate surroundings are not always easily created—particularly in urban middle class India, and a strong fear of judgment might prevent users from engaging. This means that we might need to think of design in ways that do not view privacy as a prerequisite. Sorcar's approach makes some recommendations on how we might be more subtle in our designs [71]. This also makes design more pluralistic by showing respect towards the sensibilities *and constraints* of the user, even if these are projected onto him/her by the environment, such as in the case of the male participant who shared that his mother would be offended if she found him reading about menstruation in the

metro, or the one who mentioned his preference for an e-book so that no one could tell what he was reading.

5.5 Fostering Advocacy

Our study also brings up pressing questions around ***advocacy***, particularly for us as designers. How much must design abide by societal norms to gain adoption and approval, and how far might it push these boundaries? This is a question raised also by Ibtasam et al.'s recent research on financial inclusion of women in Pakistan [34]. Feminist values change from the Global North to the Global South, as well as from region to region, and city to city. There are no absolute answers, but we might recognize that change is slow, and we may need to take small, consistent steps towards it. Generating both short- and long-term goals can be helpful for designers, and ensure that users are in the right place at the right time to engage with the right design for them, so to speak.

Above we reflected on our findings through the lens of Bardzell's feminist HCI [10] framework to arrive at implications for designing MHE platforms in the future, also offering more general takeaways for topics beyond menstruation that might be conversationally taboo. We reiterate that technologies can be particularly assistive in imparting education on such topics, but as our study of Menstrupedia shows—there are affordances as well as shortcomings that must be understood to make such efforts successful.

ACKNOWLEDGEMENTS

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