Empowering Girls Through Science and Coding: Using Computational Thinking to Address Social Issues

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ABSTRACT

This research aims to close the gap between scientific facts and social beliefs when the human reproductive system is taught, with a focus on the issue of stigmatizing menstruation. The point is to introduce computational thinking into science education as a means of producing not only understandable but also empathetic and socially aware learning. Using a qualitative descriptive approach, the ninth graders from a rural middle school were involved in learning through the 5E Learning Cycle model and computational thinking steps. Girls participated in a survey on menstrual experiences, while boys researched the stigma and misconceptions. Data were analyzed and used to develop educational websites with the assistance of Canva Code and ChatGPT. The output reflected the increase of both cognitive and affective levels, as girls became more self-assured and conscious of themselves, whereas boys, conversely, gained empathy and respect for menstruation. Research findings highlight that computational thinking has the potential not only to foster a logical understanding but also a human one, which in turn makes science learning a powerful tool for societal change. Authors propose this method to be applied in various scientific and social contexts for subsequent research.

Keywords: *computational thinking, empowering girls, menstrual cycle prediction, reproductive system, social issue.*

1. INTRODUCTION

This research reveals the differences between scientific knowledge and societal reality that exist in the case of the human reproductive system learning. More specifically, it is aimed at getting rid of the stigmatization of menstruation. The project wants to use science education as an occasion to reach out to the learners by integrating computational thinking, thus making the learning process empathetic and socially aware. Using a qualitative descriptive approach, 9th-grade students from a rural junior high school learned through the 5E Learning Cycle model combined with computational thinking steps. Girls were surveyed on their personal experiences with menstruation while boys talked about stigma and misconceptions. After analyzing the data, websites were created for educational purposes with the help of Canva Code and ChatGPT.

Despite the differences in culture and time, the fact that menstruation is among the most misunderstood and stigmatized aspects of human biology has remained unchanged. Even though it is a natural physiological process, it is still a phenomenon that is often met with silence and shame, especially in conservative or rural societies (Baruah, 2025; Chrisler, 2013; Kaundal, 2014). A lot of adolescent girls experience their

first menstruation without receiving any correct information, guidance, or emotional support, which results in them feeling anxious, embarrassed, and having bad menstrual hygiene practices. These problems go beyond the scope of the individual's challenge - they are the characteristics of the system and the education sector. When schools do not openly talk about menstruation, they are at the same time promoting it as a hidden curriculum which not only maintains gender inequality but also misinformation (Okafor-Terver, 2025).

Scholarly works reveal that the denial of menstrual hygiene is mainly due to maintaining social taboos, compliance with religious rules, and the lack of informative education about reproductive health (Peranovic, 2025). Such stigma at times is a factor that cuts girls off from school life and thus, it is an ultimate cause of absenteeism, loss of confidence as well as unequal experiences of learning (Rath et al., 2020). Also, males to a great extent are unaware of menstruation during childhood and they see it as something that is secretive and not suitable to be talked about. The lack of knowledge among boys might be the reason why they harass girls with whom they make fun of, and whom they scorn further.

Learning, therefore, is not only an imperative but also an urgent matter. According to Baruah (2025), education is “a transformative instrument capable of reshaping beliefs, dismantling myths, and promoting empathy.” Menstrual issues being taught through scientific subjects can make students realize the truth about menstruation and this would alleviate misconceptions or taboos especially in the case of boys. The matter, however, calls a teaching method that does not simply consist of reproduction organs' names or that of functions of the body. Learning should be the way by which students question the norms of the society, doubt scientific facts, and use their knowledge in their daily life.

Introducing menstruation in a manner that is inclusive has two advantages: firstly, it makes female biology a matter of common knowledge, and secondly, through it boys get the understanding of girls. When boys are a part of talks on menstruation, they stop seeing it as a topic that makes them embarrassed and treat it as a part of a bigger knowledge of human health. Various research have been conducted to prove that such all-inclusive educational methods result in less stigma and in turn more positive social attitudes towards young people (Johnston-Robledo et al., 2007; Peranovic, 2025). Thus, menstrual education should not be just limited to health classes—it should be a moral and societal lesson delivered through science.

Therefore, educational intervention in this case, is not only necessary but also of the highest urgency. Baruah (2025) expresses it, education is "a transformational tool capable of changing one's views, tearing down falsehoods, and, above all, spreading understanding." Incorporating menstrual education in science teaching would enable students (both boys and girls) to perceive menstruation as a natural biological process

rather than a moral or socio-cultural taboo. However, this undoubtedly involves a teaching method that does not only touch on the reproductive organs or even simply naming the bodily functions. On the contrary, education should enable students to challenge social norms, to question scientifically proven facts, and to use their knowledge in the real world.

In order to deal with menstruation in a substantial manner, educators require teaching materials which would attract students not only intellectually but also socially and emotionally. The instructional intervention was designed using the 5E Learning Cycle (Engagement, Exploration, Explanation, Elaboration, and Evaluation) as the pedagogical structure, while Computational Thinking served as the cognitive framework guiding data analysis and digital product development.

The 5E model has been widely referred to as an efficient teaching tool that helps students understand concepts and become scientifically literate. Beffa-Negrini et al. (2007) claimed that the 5E method significantly raises teachers' and students' capacity to evaluate information with a critical eye and to use inquiry-based reasoning in different contexts. Baptist (2006) also noted that students who were taught through the 5E method remembered the concepts for a longer time and were able to communicate and reason better. The 5E model, with its iterative and introspective nature, is very helpful in menstrual education as it turns the transformation of the topic from something that is emotionally charged into an authentic, respectful conversation and understanding.

Besides constructivist ways, Computational Thinking (CT) is a framework that has become a benchmark for students as it teaches them to solve problems in a logical and innovative way. Wing (2006) regards CT as "the thought processes involved in formulating problems and their solutions in a way that a computer—human or machine—can effectively carry out." The first one is decomposition, which means breaking down complex problems into smaller parts, pattern recognition, which involves identifying similarities, abstraction, which is about focusing on the most essential information, and algorithm design, which is about creating step-by-step solutions (Selby, 2015). In science education, CT becomes instrumental for students to order and display data, invent digital models, and obtain a well-organized grasp of the natural systems. Integrating CT into the science curriculum helps connect empathy with logic, application with theory. Students are allowed to observe that data is capable of narrating the human experience and that algorithms can be used not only for solving mathematical problems but also for dealing with social realities. The fusion of technology with social consciousness is, in fact, the core of the digitally-driven pedagogy of the 21st century whereby the students' learning outcomes include cognitive, digital as well as emotional literacy at the same time (Selby, 2015).

The integration of the 5E Learning Cycle and Computational Thinking is a strong step to deep transformative learning. The 5E model is the pedagogical framework which supports the stages of inquiry and reflection, while CT offers the cognitive tools that facilitate the organization of complex problems and the creation of clever solutions. Consequently, they generate an environment in which learners gain not only science knowledge but also use it to bring about positive changes. Here, the topic of menstrual cycle goes beyond human biology to agency of social innovation. Students employ digital tools to depict biological data, analyze social trends, and deliver empathetic messages. This is consistent with the view of Bybee (2006) who defines scientific literacy for social responsibility as the capability of using scientific knowledge to solve ethical and societal issues. Therefore, the integrated model of 5E and CT serves as a vehicle for engaging, thoughtful, and joyful learning. Learning that challenges the intellect, emotion, and conscience.

This study, in theory, is based on constructivist and socio-cultural learning theories. Learners are regarded as active participants who, through their interaction with the environment and collaboration with peers, construct their understanding. While dealing with menstruation stigma, students are portrayed as not just the passive recipients of knowledge, but as the co-creators of the solutions. They take the data to challenge tameness, use technology to educate, and through reflection, they get to know the feeling of others. In agreement with this, Chrisler (2013) states, "When we teach taboo topics, we teach courage, compassion, and critical thinking all at once."

The combination of menstrual education, the 5E Learning Cycle, and Computational Thinking places the learning of science as a link between knowledge and humanity. It reveals that technology and empathy can be two sides of the same coin in a lesson plan, and that coding can be a means of social transformation rather than just a simple product. These kinds of methods in low-resource schools demonstrate that innovations do not always have to be accompanied by expensive and sophisticated instruments; what is needed is just a well-thought-out design, its relevance, and the bravery. According to Baruah (2025), "education has the most amazing power when it becomes the power to build understanding that uplifts human dignity." Science will be one of the means through which kids will not only study nature but also develop empathy and become aware of their own power."

2. METHODOLOGY

2.1. Research Design

The research employed qualitative descriptive research design with elements of classroom action research, focusing on understanding how integrating computational thinking in science education could impact students' knowledge, attitudes, and empathy towards menstruation. The instrument was selected as it provided the teacher who was

also the researcher a chance to examine real learning experiences in the regular setting. The study was not about testing a hypothesis but rather describing and interpreting the results of an instructional intervention that combined the 5E Learning Cycle model with computational thinking in a real classroom context. The change happened in three sessions in the natural science subject area, the human reproductive system being the emphasis. The lesson plan combined Learning Cycle 5E (Engage, Explore, Explain, Elaborate, Evaluate) and the Computational Thinking framework (decomposition, pattern recognition, abstraction, and algorithm design).

Table 1. Learning Session

Session	Activities	Model/approach
Session 1 (70')	Discussion on the reproductive system and menstrual process; and conduct surveys with younger peers (Grades 5-8)	5E LC: Engagement
Session 2 (105')	Students analyse survey results using computational thinking steps and apply findings to design digital products.	5E LC: Exploration Explanation Elaboration CT: Decomposition Pattern recognition Abstraction Algorithm
Session 3 (75')	Students present and evaluate their digital products to younger peers; and reflect on learning outcomes and social impact.	5E LC: Evaluation

2.2. Participants of the Study

The main participants of this study were 25 ninth-grade students (ages 14–15) from SMPN 2 Karangploso Satu Atap, consisting of 17 female and 8 male students. These students took part in the full instructional intervention and served as the primary research subjects.

In addition, students from grades 7-8 in the same school and student grade 5-6 primary school from the same school cluster (ages approximately 11–13) were involved as survey respondents. They were not part of the intervention but contributed as data sources for the ninth graders' initial investigation phase. It was mandatory to bring these elementary students to make the 9th graders understand real problems of menstrual stigma which vary in different age groups. The surveys were done under the monitoring of teachers and the green light was given by the school administration to keep everything ethical and age-appropriate.

2.3. Instruments

Data collection employed three main instruments: (1) pre-learning surveys, (2) observation checklists, (3) reflective journals.

Pre-learning Surveys.

Two distinct questionnaires were created. A questionnaire for female students and a questionnaire for male students. Girls from grades 5–8 were the target of the female students' survey to collect data about the menstrual experience (cycle length, comfort level, hygiene practices, and knowledge sources). Boys from the same grade range were the target of the male students' survey to examine perceptions and misconceptions about menstruation. Each questionnaire had ten closed and open-ended questions aimed at obtaining factual and attitudinal data. These questionnaires were used as both a learning tool and research data for mapping menstrual stigma.

Observation Checklists

As a researcher, the teacher closely watched the classroom activities with the help of a structured observation form. The main focus was on the involvement of students, their cooperation, and gender interactions during the different phases of 5E. Some notes were also taken in the field right after every session to record student behaviour, their way of solving problems, and their emotional reactions to the talks about menstruation, which, in fact, were some of the newly arising themes.

Reflective Journals

Once students finished each session, they wrote brief reflections on what they learned, difficulties they faced, and changes in their thinking. These reflections served as a window to students' intellectual and emotional growth during the learning process.

2.4. Data Analysis Technique

Data analysis followed a qualitative descriptive approach using thematic analysis (Braun & Clarke, 2006). The process included four stages: data organization, coding, theme generation, and interpretation.

Data Organization: The complete set of field notes, student reflections, and feedback responses were documented and sorted based on data sources (survey results, observation, reflection, feedback). Quantitative data from the feedback questionnaire were utilized descriptively to provide evidence for qualitative findings.

Coding: Information were hand-coded to find the most frequently discussed concepts and the most common attitudes in the text related to (a) understanding of reproductive concepts, (b) empathy and perspective-taking, (c) digital literacy and problem-solving, and (d) gender interaction patterns.

Theme Generation: The words were combined to the overarching themes which not only reflected the changes in student understanding but also their social attitudes like "from taboo to openness", "science as empathy", and "coding as collaboration." Interpretation: The topics were understood in relation to the research goals and the theoretical framework of constructivism and computational thinking.

Cross-source triangulation was used to verify the results obtained through different methods or sources—survey data, observations, reflections, and feedback were compared to check the trustworthiness of the findings and to confirm the patterns that were emerging.

3. RESULT AND DISCUSSION

The following are the findings and the discussion presented based on the stated objectives of the study.

Finding 1: Improved conceptual understanding of the reproductive system. Analysis of students' written responses, reflections, and classroom observations revealed a clear improvement in conceptual understanding of the human reproductive system. During the Evaluation phase of the 5E cycle, 20 out of 25 students accurately described both the function of reproductive organs and the hormonal regulation of the menstrual cycle. Moreover, they were able to link scientific concepts with sociocultural issues that existed in their survey data. This aligns with the results of Beffa-Negrini et al. (2007), who found 5E-based learning to be a means of achieving long-term conceptual understanding through inquiry and reflection.

Finding 2: Development of Computational Thinking and Digital Literacy. Students were able to apply the CT components (decomposition, pattern recognition, abstraction, and algorithm design) to transform the raw survey data into digital outputs. During decomposition, students took apart the complex problems into smaller parts that they could handle: understanding cycle patterns, emotional responses, and misconceptions. After that, pattern recognition came, meaning that students found the patterns in the data. With abstraction, they decided on the essential variables that they would include in their digital products, thus, getting rid of the unnecessary data. Lastly, in algorithmic design, they devised logical steps to work out menstrual predictions or to facilitate educational content. This activity resulted in the production of two different websites with the help of Canva Code and ChatGPT as programming assistants. Female students developed a menstrual cycle tracker, while male students built a myth-busting-educational-site. Both results showed the employees' skills not only on the technical level but also on the empathy-driven level, which corresponds to the statement of Grover and Pea (2018) that computational thinking is a tool not only for analytical but also for ethical reasoning.

Finding 3: Increased confidence and agency among female students. A survey after the dissemination showed that 19 out of 25 girls of grades 5-8 reported that they felt "more confident" and "less embarrassed" when talking about menstruation. Reflection responses frequently highlighted a shift from embarrassment to self-acceptance, suggesting that learning activities helped normalize menstruation as a natural biological process rather than a private or shameful topic.

Finding 4: Growth of Empathy and Reduction of Menstrual Stigma among Male Students. 18 out of 24 boys stated "greater understanding" and "respect" of female peers. The present results are in accordance with the research of Johnston-Robledo et al. (2007) who pointed out that a detailed menstrual education program result in less stigma and more empathy among adolescents. Moreover, the observation data indicated a difference in the classroom mood. Boys were more involved in a thoughtful manner, and concurrently, there were no more casual jokes on menstruation.

The students' affective transformation, which was obvious in the behavior of the children, is also an acknowledgment of the learning's focus. The learning environment, which revolved around open discussion, collaboration, and real-life application, was the main factor in bringing about the commonality of menstruation among all human beings. The observed results are in agreement with Liu et al. (2009) who argue that emotion and cognition are interconnected when learning is based on authentic inquiry.

The findings support the view of Baruah (2025) that education has the potential to be a “transformative instrument” in breaking down myths and creating empathy. Here students didn't just study menstruation; rather they learned through menstruation by using data analysis, conversation, and coding as means of social awareness creation. By their work, they shortened the gap between biological sciences and human experience thus, becoming an instance of what Bybee (2006) calls scientific literacy for social responsibility.

The different pieces of evidence figure out that one of the leading reasons for the 5E Learning Cycle and Computational Thinking to have such a massive impact on scientific understanding to be the simultaneous use of these two approaches. The argument for the hallmark of this approach being its dual machinery is that it offers both cognitive support through a 5E framework and it also enhances systematic reasoning through CT. The students were guided through the well-organized stages of Engagement, Exploration, Explanation, Elaboration, and Evaluation in order to change their state of being simply curious to that of actually carrying out the action while, at the same time, CT provided a logical means for problem-solving and digital creation (Bybee et al., 2006; Wing, 2006; Selby, 2015).

4. CONCLUSION

The study brought to light the fact that integrating computational thinking in science instruction has a power impact on students' understanding, the way they apply and reflect real-world issues. The fusion of programming, scientific inquiry, and social awareness made the students to not only understand menstruation as a natural process but as a common human experience that is related to empathy, respect, and gender equity. Their learning journey- built through the 5E learning cycle and computational

steps- helped the students to bridge the gap between the theoretical knowledge and their lived realities.

Students' cognitive abilities were raised to a higher level as they became capable of giving more supporting explanations for the reproductive functions. Their psychomotor skills were developed as well when they became competent in designing and carrying out simple algorithms for making functional websites. Moreover, the most significant component of the first paragraph is that female students were able to collect self-esteem and body consciousness, while male students learned to show empathy instead of stigma. The change of behavior of male students towards being more positive is, therefore, a clear indication of the real success of the innovation when science becomes a medium for social understanding.

As a result, we can consider various practical proposals based on these points. First of all, teachers may use the approach as a model to integrate digital literacy with value-based teaching, thus getting students motivated to use technology in a manner which is not only logical but also caring. Schools, on the other hand, should focus on creating a climate that is conducive to the open discussion of even the most sensitive issues such as reproductive health so that empathy and respect among the genders can be developed. Lastly, the next generation of researchers, by studying computational thinking in various social or health-related scenarios, not only may deepen their understanding of the issue but also may uncover that digital learning can be an influential tool for social transformation.

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