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Hidden Figures: an interdisciplinary resource to understand the relationship between Mathematics, history, and society

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Abstract: This study analyzed the impact of the interdisciplinary pedagogical activity carried out in the *Integrated Project of Educational Practice I* discipline on the understanding of Mathematics Education undergraduate students at Instituto Federal de Mato Grosso (IFMT), campus Confresa, about the relationship between historical aspects of the constitution of Mathematics, social contexts in the constitution of humanity, and the representation of scientists in cinema, using the film *Hidden Figures* as a didactic resource. The results indicated that the activity contributed to a greater awareness among students about the importance of addressing issues of diversity, inclusion, and representation in their future teaching practices. Despite some limitations, the study pointed to the potential of interdisciplinary pedagogical activities to enrich the training of future teachers and promote a more inclusive and contextualized Mathematics Education.

Keywords: Mathematics. Interdisciplinarity. Representativeness. Social Contexts.

Figuras Ocultas: un recurso interdisciplinario para entender la relación entre las Matemáticas, la historia y la sociedad

Resumen: Este estudio analizó el impacto de la actividad pedagógica interdisciplinaria llevada a cabo en la asignatura *Proyecto Integrado de Práctica Educativa I* en la comprensión de los estudiantes del Grado en Matemáticas del Instituto Federal de Mato Grosso (IFMT), campus Confresa, sobre la relación entre aspectos históricos de la constitución de las Matemáticas, contextos sociales en la constitución de la humanidad y la representación de científicos en el cine, utilizando la película *Figuras Ocultas* como recurso didáctico. Los resultados indicaron que la actividad contribuyó a una mayor conciencia de los estudiantes sobre la importancia de abordar cuestiones de diversidad, inclusión y representatividad en sus futuras prácticas docentes. A pesar de algunas limitaciones, el estudio señaló el potencial de las actividades pedagógicas interdisciplinarias para enriquecer la formación de futuros profesores y promover una educación matemática más inclusiva y contextualizada.

Palabras clave: Matemáticas. Interdisciplinariedad. Representatividad. Contextos Sociales.

Estrelas Além do Tempo: um recurso interdisciplinar para compreender a relação entre a Matemática, a história e a sociedade

Resumo: Este estudo analisou o impacto da atividade pedagógica interdisciplinar realizada na disciplina *Projeto Integrado de Prática Educativa I* na compreensão dos estudantes de Licenciatura em Matemática do Instituto Federal de Mato Grosso (IFMT), campus Confresa,

sobre a relação entre aspectos históricos da constituição da Matemática, contextos sociais na formação da humanidade e a representação de cientistas no cinema, utilizando o filme *Estrelas Além do Tempo* como recurso didático. Os resultados indicaram que a atividade contribuiu para uma maior conscientização dos estudantes sobre a importância de abordar questões de diversidade, inclusão e representatividade em suas futuras práticas docentes. Apesar de algumas limitações, o estudo apontou o potencial de atividades pedagógicas interdisciplinares para enriquecer a formação de futuros professores e promover uma Educação Matemática mais inclusiva e contextualizada.

Palavras-chave: Matemática. Interdisciplinaridade. Representatividade. Contextos Sociais.

1 Initial Considerations

The relationship between science and society is a topic of growing relevance in today's educational context, especially when considering issues of gender and race. Science, as one of the most important human constructions, plays a crucial role in shaping ideas and decision-making in various sectors of society. However, it is essential to recognize that the history of science has been, and still is, marked by inequalities and prejudices related to gender and race, which influence both access and the participation of various social groups in the production of scientific knowledge.

Gender issues, particularly in relation to women, have been the subject of discussion in various areas of science. Historically, women have faced numerous barriers in their professional and academic careers, being under-represented or excluded from research and scientific development environments. This scenario has resulted in an imbalance in the production of knowledge and in the representation of women in positions of leadership and prominence in the scientific sphere.

Similarly, racial issues also play an important role in the scientific field and in society. The history of science is permeated by cases of discrimination and exclusion of individuals from different ethnic and racial backgrounds, which has limited diversity in the scientific field and prevented many from accessing educational and professional opportunities. Diversity is fundamental to the advancement of science, since varied perspectives and experiences can enrich the production of knowledge and promote innovation.

From this perspective, it is essential to address gender and race issues in education, in order to make students aware of the importance of equality and inclusion in science and society. By discussing these issues, it is possible to promote a deeper and more critical understanding of the role of science in people's lives and in the construction of human history, as well as highlighting the relevance of diversity in scientific production.

The choice of the movie *Hidden Figures* as a teaching resource in this context is very appropriate, as it illustrates gender and race issues in the history of science in an impactful way. The film tells the true story of three African-American women, mathematicians and engineers at the National Aeronautics and Space Administration (NASA), who faced the challenges imposed by racism and sexism while contributing significantly to the US space program during the Space Race. The film allows for a deep reflection on the obstacles faced by these women and the importance of overcoming them for the advancement of science.

Considering the relevance of the topic and the educational potential of the film, this paper aims to analyze the impact of the interdisciplinary pedagogical activity carried out in the subject *Integrated Project of Educational Practice I* on the understanding of Mathematics undergraduate students at the Instituto Federal de Mato Grosso (IFMT) Confresa Campus, on

the relationship between historical aspects of the constitution of Mathematics, social contexts in the formation of humanity and the representation of scientists in cinema, using the film *Hidden Figures* as a didactic resource.

In this paper, a brief explanation is given of the film *Hidden Figures*, covering its plot and the opinions presented by some specialized critics, followed by a theoretical framework that sought to explore scientific development and issues of gender and race. The activity was conducted in three stages: watching the movie; discussing science and social issues; and answering a questionnaire. The basis of this whole process was to stimulate critical thinking about the role of science in society and the importance of an inclusive and egalitarian approach in the scientific field.

2 About the movie *Hidden Figures*

Hidden Figures is a 2016 film directed by Theodore Melfi and based on the book of the same name by Margot Lee Shetterly. The plot is inspired by the true story of three African-American women who worked at NASA during the 1960s, playing key roles in the space race between the United States and the Soviet Union. The film highlights the careers of Katherine Johnson (played by Taraji P. Henson), Dorothy Vaughan (played by Octavia Spencer) and Mary Jackson (played by Janelle Monáe).

The story takes place at the height of the Space Race and in the midst of racial segregation in the United States, a period when Jim Crow laws were still in force. Despite the barriers of race and gender imposed by society, the three protagonists stand out for their ability and intelligence in areas such as Mathematics, Physics and Engineering, making a crucial contribution to the American space conquest.

Katherine Johnson is a talented mathematician who works as a human computer at NASA, performing complex calculations for space missions. She faces prejudice and discrimination in the workplace, as she is the only black woman on her team. Throughout the movie, Katherine demonstrates her competence and skill by helping to calculate the trajectory of astronaut John Glenn on the Friendship 7 mission, which was the first manned American orbital capsule, becoming a key player in the success of the mission.

Dorothy Vaughan is the unofficial supervisor of the African-American computer group at NASA. As well as fighting for recognition of her position, Dorothy faces the challenge of automation when NASA acquires an IBM computer that threatens to replace human computers. With determination and self-education, Dorothy learns to program the computer and ensures that her group stays at NASA, becoming the first African-American supervisor at the space agency.

Mary Jackson is a talented engineer who wants to become NASA's first black engineer. However, she faces obstacles getting into an engineering course, as the schools offering the program are segregated. Mary persists in her struggle, gets permission to attend classes and eventually becomes an aerospace engineer.

The film is inspiring when it tackles important themes such as the fight against racism, sexism and overcoming social barriers. The story of the three protagonists illustrates the importance of inclusion and diversity in scientific and technological progress. In addition, the film highlights the role of women in science, demonstrating that, when given opportunities, they can contribute significantly to the development of humanity. The plot serves as a reminder of the ongoing need to combat discrimination and promote equality, not only in the field of science, but in all aspects of life.

The reviews received by the movie *Hidden Figures* address various positive aspects of the production. For example, Scott (2016), film critic for The New York Times, praises the emotional and moving narrative, highlighting the performances of Taraji P. Henson, Octavia Spencer and Janelle Monáe, and emphasizes the rare insight into the lives of black women in a work environment dominated by white men. Hornaday (2016), from The Washington Post, praises the way the film approaches American history and the themes of racism and sexism, pointing out the balance between emotion and humor, as well as the realistic and inspiring treatment of the main characters.

In Brazil, Villaça (2017) also highlights, on his website *Cinema em Cena*, the efficient script and the convincing performances of the lead actresses, emphasizing the emotional impact and the importance of bringing to light the contributions of the protagonists to the history of science. These reviews exemplify the wide recognition the film has received for its engaging narrative, strong performances and sensitive approach to significant themes such as racism, sexism and the fight for equality.

Some specialized critics have noted that *Hidden Figures* is not entirely faithful to historical events. Odie Henderson (2016), film critic for the website *RogerEbert.com*, mentioned in his analysis that the film takes creative liberties in relation to the real events, but argued that this does not diminish the emotional and inspirational impact of the story.

Mariane Morisawa (2017) presents some scenes from the movie that were adapted from the book it was inspired by*, Hidden Figures: the American dream and the untold story of the black women mathematicians who helped win the space race*, written by Margot Lee Shetterly. As in the completely fictional scene, the car carrying the three protagonists to work is approached by a policeman, recreating the tension that was experienced in 1961 in the state of Virginia. Driven by patriotism, the policeman escorts them, ensuring a quicker arrival at NASA. In reality, the three women knew each other, but they weren't that close. Dorothy hadn't even learned to drive and Katherine would hitch a ride with someone else to work. According to the author, the scene serves more to show how patriotism was part of the Space Race between the United States and the Soviet Union and to highlight how strong racism still was.

In a scene that illustrates the adversities faced by black women, Katherine discovers that the toilets intended for them are located in the old West Computing Group building. This causes her to waste precious time every day going there, often carrying the necessary calculations, even in the rain. One day, after being reprimanded by Al Garrison for her constant disappearances, she explains why. Garrison then tears down the sign identifying the segregated toilets. However, Morisawa (2017) points out, based on the book, that it was Mary who faced this situation while working in the East Computing Group building. Katherine, on the other hand, never noticed the segregation and, when warned about using the white bathroom, refused to change her habits and never heard any more comments about it.

For a while, there was an area in Langley's cafeteria reserved for black people only. One of the mathematicians removed the sign indicating the division, but it was put back and removed again. In the movie, Katherine, Mary and Dorothy are shown having lunch in a black-only cafeteria. However, Morisawa (2017) points out, based on the book, that Katherine chose to bring her own lunch from home and eat at her own table for economic, practical and health reasons. In addition, this choice allowed Katherine to eliminate the segregated cafeteria from her daily routine, avoiding yet another reminder of the system that could limit her movements and thoughts.

It's important to remember that the cinematic adaptation of real events often involves taking artistic liberties to create a compelling and exciting narrative. Despite the historical

inaccuracies, *Hidden Figures* is still an important work for highlighting the achievements of African-American women at NASA and bringing to light a little-known story.

3 Science, society, inequality and prejudice

Science and society are intrinsically intertwined, and as such, it is essential to examine how social issues such as gender and race manifest themselves in the scientific context. The following theoretical framework explores this relationship, addressing the importance of equality and inclusion in science, as well as the role of education in promoting greater diversity in the scientific field.

Initially, it is worth mentioning the pioneering work of Kuhn (1962), which highlights the social and historical nature of science, and how scientific practices are rooted in specific cultural contexts. This perspective emphasizes the dimension of addressing gender and race issues in science as part of a broader analysis of the values and norms that shape scientific practice.

With regard to gender issues, Beauvoir's work (1949) is a milestone in the discussion about the oppression of women and gender inequalities. Although it doesn't deal specifically with science, its impact transcends several areas, including scientific research and education. From this perspective, it is possible to understand that the under-representation of women in science is related to the social construction of gender and the limitations imposed on them in the professional and academic world.

Gender issues have been widely discussed in the literature, with an emphasis on the role of women in the history of science and the challenges they face in academia and the job market. Keller's (1985) pioneering study highlights how scientific practices and knowledge have been shaped by gender bias and how this has affected the representation of women in science. Similarly, Valian's (1998) study analyzes how gender stereotypes influence the expectations and opportunities of women and men in scientific careers, leading to persistent inequalities.

Another relevant work is that in which Crenshaw (1991) explores intersectionality, which is essential for understanding the intersection of gender and race issues in the scientific sphere. Intersectionality argues that multiple forms of discrimination and inequality (such as gender, race, class) are interconnected and must be considered together in order to understand the full experience of marginalized groups. This perspective is especially relevant when discussing the experience of black women in science, as illustrated in the film *Hidden Figures*.

In addition, Davis (2016) discusses the intersectionality between gender, race and class in the struggle for equality and social justice. The author points out that the oppression of black women is the result of the interaction between racism and sexism, which also applies to the participation of black women in science. The analysis suggests that it is necessary to address these issues together in order to promote equality and inclusion in the scientific field.

In relation to racial approaches in science, Gould's work (1991) provides a critical analysis of historical attempts to justify racial discrimination on the basis of supposed biological differences. This work reveals how racial prejudices have influenced the development of science and public perception of ethnic and racial groups. Mills' work (1997) is also relevant, as it analyzes the systematic nature of racial inequalities in institutions, including science, and how this affects the production of knowledge and the distribution of resources.

Diversity is fundamental to the advancement of science, since different perspectives and experiences can enrich the production of knowledge and promote innovation. The work of Page (2007) demonstrates how diversity of thought and experience contributes to better results in

problem-solving and decision-making. Page argues that diverse teams are more likely to generate new ideas and perspectives, which is crucial for scientific innovation and progress.

In the field of education, the work of Ladson-Billings (1995) highlights the importance of culturally relevant pedagogy to address gender and race issues in education. This approach seeks to empower students from marginalized groups by recognizing and valuing their cultures and identities, promoting an inclusive and egalitarian educational environment. By applying this perspective to science teaching, it is possible to develop effective pedagogical strategies to address inequalities and promote diversity in the scientific field.

Harding (1991) proposes a feminist approach to science that questions the values and norms shaping scientific practice and advocates for the inclusion of marginalized voices and perspectives in knowledge production. This stance offers a theoretical basis for analyzing gender and race issues in science and education, and for developing pedagogical strategies that promote equality and diversity in science education. In the field of Philosophy of Science, Harding (1986) discusses the relationship between science and gender, critiquing the supposed neutrality and objectivity of science. It is argued that science is influenced by social factors, including gender biases, and proposes a *feminist science* that considers a diversity of perspectives and experiences, contributing to a more inclusive and egalitarian science.

Jordan (2006) presents interviews with black female scientists who share their experiences and challenges in their scientific careers. The book offers a unique insight into racial and gender issues in science, highlighting the need to address these demands in order to promote equality and diversity in the production of scientific knowledge.

The issue of race in science has also begun to be discussed in greater depth in recent decades. Haraway (1995) argued that diversity is crucial to the production of scientific knowledge and that science must be understood as a situated practice that incorporates multiple perspectives and experiences. The author highlights the importance of including marginalized voices, such as those from different racial and ethnic backgrounds.

In the Brazilian context, Ribeiro (2001), in her thesis, discusses the issue of race in science and in the academic community. The author analyzes the trajectory of black Brazilian scientists and highlights the challenges they face in their quest for recognition and inclusion in the scientific field. Her study contributes to understanding racial inequalities in science in Brazil and draws attention to the need for policies that promote inclusion and diversity in the sector.

In addition to theoretical discussions, practical initiatives aimed at promoting gender and racial equality in science have also emerged. One example is the Brazilian government's *Science without Borders* project, which sought to increase the international mobility of students and researchers, with a focus on including under-represented groups, such as women and people from different racial and ethnic backgrounds (Brasil, 2011).

With increasing awareness of the importance of diversity in science, various initiatives and approaches have been proposed to tackle gender and racial inequalities in the scientific field. The works analyzed in this theoretical framework provide valuable insights into how policies, educational practices and affirmative action can be used to promote gender equality and the inclusion of underrepresented groups in science.

Freire's (2019) work also offers valuable insights into how to address social issues in education, advocating a critical pedagogy that empowers students and fosters awareness of oppression and inequality. This approach is particularly relevant to science teaching, as it allows students to develop a critical understanding of science and its relationship to society, including issues of gender and race.

Teaching and the training of educators also play a crucial role in promoting diversity and inclusion in the scientific field. The integration of gender and race issues into the curriculum and educational practice, as highlighted in the works of Thomson and Tippins (2013) and Hussénius, Andersson, Gullberg and Scantlebury (2013), can contribute significantly to the training of teachers who are more aware of and committed to equality and diversity in science.

In addition, the participation of organizations and institutions, such as unions and funding agencies, in promoting racial and gender diversity in science is also fundamental. As demonstrated by Hanashiro and Carvalho (2005), Heredero (2010) and Saraiva and Irigaray (2009), these organizations have the power to influence policies and practices that can lead to a more inclusive and diverse academic and scientific environment.

The evolution of the theoretical framework on science and the social issues of gender and race has accompanied the changes in the understanding of science as a socially situated activity. From the pioneering work of Thomas Kuhn to more recent works in both English and Portuguese, the discussion of gender and race in science has gained increasing space and relevance. This evolution contributes to raising awareness of the importance of diversity and inclusion in the production of scientific knowledge and to promoting policies and practices aimed at overcoming historical inequalities in the scientific field.

The discussion presented explores the relationship between science, gender and race, highlighting the importance of addressing these social issues in science education. The framework of publications referenced provides a solid basis for analyzing and understanding gender and racial inequalities in science and their implications for science teaching. By considering these theoretical perspectives, it is possible to develop pedagogical approaches that promote equality, diversity and inclusion in the scientific field, contributing to a fairer and more equitable science education.

In conclusion, the theoretical framework presented offers a comprehensive overview of the evolution of discussions on gender and race in science and its implications for science education and the training of educators. The works analyzed provide a solid basis for understanding the challenges faced by women and people from different racial and ethnic backgrounds in science and for developing effective strategies to promote equality, diversity and inclusion in the scientific field. This understanding is fundamental to ensuring that science teaching and educational practice are able to address and overcome existing inequalities, building a more inclusive and equal future for all those involved in the scientific field.

4 Research procedure

The method used in the activity carried out in the classroom during the subject *Integrated Educational Practice Project I* sought to engage students in a critical reflection on the historical aspects of the constitution of Mathematics and its relationship with the various social contexts in the formation of humanity. The activity involved 18 students from the Mathematics degree course offered by the Instituto Federal de Mato Grosso (IFMT), Confresa campus, and was divided into three stages:

Moment 1 — Watching the movie *Hidden Figures* in class (two lessons): the movie was chosen because it portrays the story of three black women who worked as mathematicians at NASA during the Space Race. In addition, the film was used as a teaching resource because it addresses issues relevant to the subject, such as the participation of women and ethnic minorities in science. In addition, the film presents a historical context of social and gender inequalities, which served as a starting point for discussion in the classroom.

Moment 2 — Holding a discussion on science and social issues (one lesson): after watching the film, the students took part in a classroom debate in order to share their impressions and reflect on gender and racial issues related to science and mathematics. The discussion was conducted based on Paulo Freire's (2019) dialogic methodology, which proposes critical and reflective teaching, encouraging students to question reality and actively participate in the educational process.

Based on the works of authors such as Thomas Kuhn (1962), Sandra Harding (1986; 1991) and Ribeiro (2001), who address science as a social and historically situated activity, as well as the importance of considering gender and race issues in the construction of scientific knowledge, the dynamics of the discussion allowed the students to share their opinions, experiences and ideas on the points presented in the film, promoting the collective construction of knowledge.

Moment 3 — Answering the questionnaire with four questions (one lesson): in the last stage of the activity, the students answered a questionnaire made up of four questions. These questions were designed based on Gil's (2008) studies, in order to emphasize the importance of the connection between the students' previous knowledge and the new information presented. Below are the questions and their respective purposes:

Question 1 — *What social and scientific themes are covered in the movie Hidden Figures?*

Purpose: To encourage students to identify and reflect on the social and scientific themes present in the film, recognizing the relationship between science, gender and racial issues.

Question 2 — *If during the evolution of civilization all people had equal opportunities, do you think science could be more developed than it is today? Justify your argument.*

Purpose: To encourage students to consider the impact of social inequalities on the evolution of science and the construction of scientific knowledge.

Question 3 — *When living in society, opportunities often arise in which people are evaluated, selected and chosen. Considering such opportunities, for example: the offer of studies; employment; promotion at work; social recognition; among others, these choices can be influenced by various factors, such as social, gender and ethnic aspects. Given this, within your social context, how do you analyze issues of opportunity for individuals?*

Purpose: To encourage students to reflect on the inequalities that exist in their own social context, considering the opportunities and obstacles faced by different individuals due to factors such as gender, race and social class.

Question 4 — "*There is no such thing as impartiality. Everyone is guided by an ideological base. The question is: is your ideological basis inclusive or exclusionary?" (Freire, 2019). Based on these words, in your future professional practice as a teacher who teaches mathematics, how do you intend to act: in an inclusive or exclusionary way? How do you imagine you will do this?*

Purpose: To invite students to reflect on their own practices and beliefs as future teachers and how they can act in an inclusive way, ensuring that all students, regardless of gender, race or social class, have access to learning and development opportunities.

By following this method in three moments, the students were encouraged to reflect on the role of social, gender and racial issues in the constitution of mathematics and the construction of scientific knowledge. This activity sought to provide students with an active

and reflective learning experience, in which they could establish connections between theory and practice, while at the same time developing a critical understanding of social issues related to science and mathematics.

By using the movie *Hidden Figures* as a starting point, the activity allowed the students to engage in discussions and reflections on relevant and current issues, such as gender, race and social inequalities, contributing to their training as conscious educators committed to promoting inclusion and diversity in the teaching of mathematics.

For the data produced, the gender of the students was identified in order to be able to analyze whether this factor can influence their experiences and perceptions of prejudice, especially when it comes to issues of gender and race. By identifying the gender of the students, the reader can see if there were significant differences in the answers based on this information. However, no identification was made in relation to the issue of race, as the initial focus of the activities was on gender issues, and the issue of race arose during the course of the activities. Therefore, no research instrument was designed to collect data in this regard.

5 Discussion based on the research results

In the movie *Hidden Figures*, the students identified several relevant social and scientific themes. These include: racial segregation; gender prejudice; women's struggle for equality and recognition; and the Space Race during the Cold War. It is interesting to note how the perspectives of both male and female students approach these issues in similar ways.

In relation to the first question, the students emphasize the importance of the theme of racial segregation in the film. For example, Student 1 (Female) mentions that racism at the time was more intense, while Student 3 (Male) highlights the prejudice against black people and the lack of recognition for the protagonists.

Both genres also highlight the struggle of women in the job market and gender prejudice. Student 2 (Female) discusses women's challenges in gaining access to universities, and Student 12 (Male) talks about the restrictions faced by the protagonists because they are black women in a scientific environment dominated by white men. These opinions reflect what has already been observed by Valian (1998) and Ribeiro (2001) regarding gender stereotypes influencing women's expectations and opportunities in scientific careers.

The Space Race and scientific advances are also themes that appear in the answers of students of both genders. Student 17 (Female) mentions aspects such as the history of the Space Race, NASA and launches into orbit, while Student 13 (Male) talks about the methods used to find calculations and launch man into space.

The students' responses also highlight the importance of the protagonists' persistence and determination to overcome the challenges imposed by society. This is in line with what Jordan (2006) said when he interviewed black female scientists who shared their experiences and challenges in their scientific careers. Student 6 (Female) comments on the struggle of women for their space and the willpower to achieve their goals, while Student 16 (Male) emphasizes science as being largely responsible for the achievements of women at NASA.

In summary, the students' responses, regardless of gender, show a common appreciation for the social and scientific themes addressed in the movie *Hidden Figures*. Analysis of the answers to the first question highlights the importance of discussing issues such as racial segregation, gender prejudice and women's struggle for equality and recognition, as well as the influence of science and technology in overcoming these challenges.

Analyzing the students' answers to Question 2, there is general agreement that if all people had equal opportunities throughout the evolution of civilization, science could be more advanced today. This finding is in line with what Keller (1985) and Harding (1986) indicate, in which scientific knowledge is shaped by prejudices. The students highlighted various aspects that justify this perspective.

The Student 1 (Female) argues that equal rights are essential for development, and that many talents have been wasted due to obstacles faced, such as gender and racial inequalities. Student 2 (Female) also believes that brilliant minds have been held back by social divisions; while Student 3 (Male) points out that people with great potential have been subjugated because they are black, indigenous, poor or women.

The answers from female students generally highlight the importance of overcoming social inequalities and prejudices for the development of science. For example, Student 5 (Female) mentions that many brilliant minds are ignored due to gender bias and racism. Student 7 (Female) emphasizes that with equal opportunities and access to qualified information, people would have a greater chance of developing critical thinking.

Male students also recognize the importance of equal opportunities for scientific progress. Student 8 (Male) argues that any form of prejudice and discrimination breaks the bridge of knowledge. Student 12 (Male) points out that discrimination based on gender, race and religion has restricted many geniuses from developing their knowledge.

The students' answers also establish connections between them. For example, Student 4 (Female) and Student 13 (Male) agree that science could be more developed due to the joining of forces and the contribution of intelligent people who, due to discrimination, have not been heard. Student 9 (Female) and Student 14 (Male) emphasize that the diversity of ideas is fundamental for scientific development.

The students discuss the evolution of science over time and the need to continue working for equality. Student 11 (Female) says that, despite positive changes, there is still a lot of prejudice and a need for improvement. Student 15 (Female) adds that if everyone had the same opportunities, not only science but society as a whole would be more developed.

In summary, the students' responses show a consensus that science could be more developed if all people had equal opportunities throughout the evolution of civilization. The students' responses highlight the importance of overcoming inequalities of gender, race and other discriminatory factors to allow more brilliant minds to contribute to scientific advancement. In addition, the students emphasize the need to promote diversity of ideas and perspectives, as well as access to quality education and information for all.

The students also recognize that, although progress has been made in relation to equal opportunities, there is still a lot of work to be done to ensure that everyone can contribute fully to the development of science and society. Student 16 (Male) points out that if everyone had the same opportunities, more geniuses could be revealed; while Student 17 (Female) mentions that the movie *Hidden Figures* illustrates well how inequality and prejudice have held back many talented people from showing their skills and knowledge.

Analysis of the responses from students of both genders reveals a shared understanding that equal opportunities are crucial for scientific and social development. This is indicated by Page (2007), who, in his studies, demonstrated how diversity of thought and experience contributes to better results in problem-solving and decision-making. Diversity of perspectives, experiences and talents is recognized as a crucial factor for the progress of science and society. Therefore, the search for equal opportunities must remain a priority.

In short, the analysis of the students' answers to Question 2 indicates that if all people had been given equal opportunities throughout the evolution of civilization, science might be more developed today. Overcoming inequalities and discrimination, as well as promoting diversity of ideas and perspectives, are fundamental aspects of ensuring that everyone can contribute to scientific and social development. For, according to Haraway (1995), diversity is crucial to the production of scientific knowledge, and science must be understood as a practice that incorporates multiple perspectives and experiences.

Analyzing the students' answers to Question 3, we see that many of them point out that there are still significant inequalities in the opportunities offered to people due to factors such as gender, race and social class. This situation is highlighted and nicknamed intersectionality by Crenshaw (1991) and reinforced by Davis (2016), a concept that describes how different forms of discrimination or oppression can overlap and interact. Students express concerns about access to education, employment and social recognition, emphasizing the need for transformations in society to promote equal opportunities.

Student 1 (Female) observes that although many changes have taken place, it is necessary to continue working to promote equality; Student 2 (Female) mentions that factors such as economic cost and time can affect the way people take advantage of opportunities. Student 5 (Female) points out that, despite advances compared to the past, there is still prejudice and discrimination faced by individuals from certain social classes.

Many students mention the quota system in competitions and entrance exams as an attempt to address the inequality of opportunities. Student 3 (Male) sees the quota as a form of prejudice, while other students — such as Student 11 (Female) and Student 12 (Male) — recognize that opportunities and the quality of education are still not equal for everyone.

With regard to job opportunities, Student 9 (Female) points out that scientific areas still prioritize men, while Student 15 (Female) points out that women face prejudice at work and in society in general. Student 10 (Male) mentions that social class is often a determining factor in obtaining opportunities, and Student 14 (Male) addresses the issue of physical appearance as a criterion for selection for job vacancies. It should be noted that society has changed, but the essence of these situations remains, as described by Beauvoir (1949), showing that oppression against women and gender inequalities still exist.

The students also discuss the importance of equity to ensure fair competition for opportunities. Student 16 (Male) states that *"there is a lack of equity for people to actually compete fairly for the opportunities that arise"*, and Student 17 (Female) recognizes that, although progress has been made, class individuality still affects selection for jobs and universities.

Analyzing the responses from both genders, there is a shared concern about the persistence of unequal opportunities in society, whether in relation to education, employment or social recognition. The students express the need to change and promote equality, and many of them recognize that significant progress has already been made, although there is still a lot of work to be done. These ideas converge with what was elucidated by Mills (1997), when he discussed the systematic nature of racial inequalities in institutions.

The analysis of the students' answers to Question 3 reveals a general perception that there are still significant inequalities in the opportunities offered to people on the basis of factors such as gender, race and social class. Students emphasize the need to continue working to promote equality and eliminate prejudices and discrimination that affect access to opportunities in various areas of life. In addition, students point to the importance of public policies — for

example, quotas in competitive exams and entrance exams — as a way of addressing these inequalities, although some opinions may differ as to the effectiveness of these policies.

The students' responses also highlight the importance of individual factors, such as willpower and determination to take advantage of the opportunities available. Student 6 (Female) states that *"everyone has the ability to do everything"* and that success depends on the individual's willpower.

However, it is essential to take into account the social and structural barriers that can prevent some people from reaching their full potential. As mentioned by some students — Student 4 (Female) and Student 8 (Male) — society can be selective and exclude individuals based on their origin, parentage or other characteristics, limiting their opportunities for success.

In summary, the analysis of the students' answers to Question 3 highlights the importance of addressing inequalities of opportunity and promoting equality in all areas of life. There is still a lot of work to be done to ensure that all individuals, regardless of gender, race or social class, have the same chances of personal and professional success and fulfillment.

Analysis of the students' answers to Question 4 reveals that the majority of them express a commitment to promoting inclusion in their professional practice as mathematics teachers. This inclusive stance is shared by students of different genders, with 10 female and 8 male students. Thomson and Tippins (2013) and Hussénius et al. (2013) highlight the value of training teachers who are more aware of and committed to equality and diversity in science.

Inclusion is mentioned in various ways in the students' responses. For example, Student 1 (Female) states that school inclusion should meet the learning needs of all students, regardless of disability, ethnicity, culture or socio-economic conditions. Student 4 (Female) also expresses her desire to support all students, regardless of class, color or gender, and to be a teacher capable of recognizing the character, willingness, struggle and pain of each one.

The importance of addressing the diversity of needs and promoting equality is emphasized by several students. Student 5 (Female) highlights the need to respect the differences between individuals and to deliver teaching in an equal way. Student 7 (Female) expresses her goal of eliminating exclusionary barriers and ensuring that students have the same opportunity to develop intellectually.

Several students recognize that inclusion can be a challenge in teaching practice. Student 16 (Male) mentions that the educational system itself can be exclusionary and that, although he wants to promote inclusion, he can't do it alone. This student advocates a change in the way we think about teaching practice, in order to bring out the best in each student, even with their differences.

Some answers also highlight the importance of inclusive pedagogical approaches and techniques. Student 17 (Female) emphasizes the need to work on teaching mathematics in an accessible, dynamic, enjoyable, sophisticated and flexible way, given the complexity of the subject. Student 13 (Male) proposes developing inclusive activities and involving different students in solving problems on the board.

Paulo Freire's quote, which states that everyone is guided by an ideological basis, whether inclusive or exclusionary, seems to have motivated the students to reflect. The majority of students express a commitment to an inclusive approach, which is encouraging. However, implementation can be challenging and complex, as some students point out. The search for an inclusive teaching practice requires continuous effort, reflection and collaboration between educators, students and communities. Ladson-Billings (1995) highlights the need for culturally

relevant pedagogy to address gender and race issues in education.

In short, the analysis of the students' answers to Question 4 shows that most of them intend to promote inclusion in their future professional practices as mathematics teachers. This is evident in the answers from students of both genders, indicating a general understanding of the importance of inclusion in the educational context. These aspects are also discussed, albeit indirectly, by Freire (2019) when he questions oppression and inequality. It should be noted that it is important for future teachers to have this conception, since in many situations the teacher can serve, even if unintentionally, to maintain an oppressive system without equality.

In addition, the students highlight the need to develop pedagogical skills and strategies that allow teaching to be adapted to the individual needs of the students. Student 3 (Male) mentions the importance of treating everyone, regardless of social class, ethnicity or religious belief, equally and impartially, providing the best possible education for each one. Student 8 (Male) expresses his commitment to always giving opportunities to all students, showing that everyone is equal and capable of learning mathematics.

This analysis also suggests that students are aware that the quest for inclusion can be challenging and that, in some cases, the education system itself can be exclusionary. To overcome these barriers, it is important that future teachers are willing to learn, adapt and collaborate with colleagues and communities. Student 15 (Female) emphasizes the need to guarantee learning for everyone, without exception, seeking knowledge to help students with difficulties and improve their teaching and education.

The motivation and commitment to inclusion expressed by students is an important step towards creating inclusive and effective learning environments. However, it is crucial that this commitment is translated into concrete actions and pedagogical strategies that truly support all students. By tackling the challenges and obstacles that may arise along the way, future teachers have the opportunity to become agents of change, promoting inclusion and equity in math teaching and education as a whole.

Analysis of the answers to Question 4 of the questionnaire indicates that the majority of students, both female and male, are committed to promoting inclusion in their future professional practice as mathematics teachers. Students recognize the importance of addressing the diversity of students' needs, promoting equality and developing inclusive pedagogical strategies. Although implementing these approaches can be challenging and complex, they demonstrate motivation and commitment to meeting these challenges and promoting inclusive and effective learning environments.

There were no explicitly prejudiced passages in the answers to the four questions. They expressed their ideas about the film *Hidden Figures* and, instigated by the questions posed, highlighted themes addressed in the film, such as racism, prejudice, racial segregation and the challenges faced by women, especially black women, in the job market and in the scientific field. These discussions are important for raising awareness and combating prejudice in society.

Based on the students' speeches, no prejudice is identified. They are all talking about the importance of equal rights and opportunities, the damage that prejudice and discrimination can cause and how these factors can prevent the full development of society and science. They discuss the negative effects of prejudice, but do not express prejudice themselves. Instead, they advocate equality and inclusion. In addition, in general, the students' speeches demonstrate a critical awareness of the social, racial, gender and class inequalities that are still present in society. They discuss how these inequalities influence opportunities and the distribution of resources.

However, the words of Student 3 (Male) can be interpreted as potentially prejudiced. He says that the quota, a mechanism for social inclusion and equal opportunities, *"treats the quota holder as an inferior candidate in terms of intelligence"*. This is a misinterpretation of the quota system, which actually aims to correct historical inequalities and offer opportunities to under-represented groups, and is not based on the assumption that these groups are inferior.

Student 14's (Male) statement can also be seen as problematic, as he suggests that *"women with prettier looks are unlikely to get a tougher job in a tougher place"*, while *"people with uglier looks and different colors are taken to the tougher job"*. This statement generalizes and stereotypes the experiences of individuals based on their physical appearance and skin color, which can be seen as prejudiced.

It should be noted that these are only possible interpretations of the students' statements. In this case, it is always important to have an open and educational dialog about these topics to promote greater understanding and respect for diversity. It is important to note that prejudice involves a negative or hostile attitude towards a group based on generalizations derived from incorrect or incomplete perceptions. The students' statements here, however, are in line with the principles of inclusion, equality and respect for diversity. However, as a result of the society in which they live, they may incur certain prejudices in the way they express themselves and this is an opportunity for teaching and learning for people who are open to discussing the issue in a sensitive and equal manner.

6 Final thoughts

The purpose of this paper was to analyze the impact of the interdisciplinary pedagogical activity carried out in the subject *Integrated Project of Educational Practice I* on the understanding of Mathematics undergraduate students at the Instituto Federal de Mato Grosso (IFMT), Confresa Campus, about the relationship between historical aspects of the constitution of Mathematics, social contexts in the formation of humanity and the representation of scientists in cinema, using the film *Hidden Figures* as a didactic resource.

After analyzing the students' responses to the questionnaire, it can be said that the proposed objective was partially achieved. The students demonstrated a deeper understanding of the relationships between mathematics, history and society, as well as greater sensitivity to issues of gender, ethnicity and inclusion in mathematics education. However, some answers suggested that not all students fully understood the complexity of the relationship between science and social aspects, nor were they able to make clear connections between these elements and their future teaching practices.

One of the limitations of this research is its exploratory nature and the size of the sample. With only 18 students taking part in the study, it is not possible to generalize the results to the entire population of mathematics undergraduates. In addition, the research was based on just one questionnaire, which limits the possibility of delving deeper into students' perceptions and understanding of the topic in question. It would be interesting in future studies to use additional data collection methods, such as interviews and classroom observations, to enrich the analysis and provide a more complete view of the impact of the interdisciplinary pedagogical activity.

Despite these limitations, this research contributes to the mathematics teacher education literature by providing insights into how interdisciplinary pedagogical activities can enrich students' understanding of the relationship between mathematics and social and historical aspects, as well as promoting reflection on the inclusion and representation of under-represented groups in mathematics education. The results of this study can also be useful for educators and teacher trainers in the search for pedagogical approaches that allow students to

develop a more comprehensive and contextualized picture of mathematics and its applications in society.

As a possibility for future studies, it would be appropriate to explore the factors that contribute to the greater effectiveness of interdisciplinary pedagogical activities in promoting student understanding and training teachers who are more inclusive and aware of the social and historical aspects related to mathematics. This analysis could provide valuable information for improving the design and implementation of interdisciplinary activities, as well as identifying best practices in teaching and teacher training.

Finally, considering the growing importance of diversity and inclusion, it would be relevant to investigate how educational institutions and systems can support and encourage the implementation of interdisciplinary pedagogical activities in their curricula and teacher training programs. This would lead to the development of more effective policies and practices to promote the integration of mathematics with other areas of knowledge, as well as training teachers capable of addressing issues of diversity and inclusion in their pedagogical practices.

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