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The Representation of Gender Neutrality in Indonesian Physics Textbooks: A Critical Discourse Analysis

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Abstract: Gender issues in Indonesia are pivotal issues in science/physics textbooks and any aspects of life. As learning resources commonly utilized in the science classroom, physics textbooks should present gender neutrality to urge women's contribution to science. They are frequently considered less performance than those men in science. However, in the Indonesian context, few studies of gender representation in the physics textbook are conducted. Therefore, this present study investigates gender stereotypes in Indonesian physics textbooks based on social actor criteria. A Critical Discourse Analysis (CDA) is a qualitative research method employed to analyze gender neutrality discourse. The use of visual artifacts that refer to the representation of both men and women in the textbooks were utilized to emerge the roles of men and women in three frameworks: laboratory activities, physics application in daily life, and roles of men and women in the family. This present study's findings revealed that representation both men and women were almost to have the same representations based on three of these frameworks. Finally, this present study's implication is to underpin the woman representation to contribute to science activities.

INTRODUCTION

Indonesia is a country focusing on gender equality in any aspect of life, including the educational field. In this context, gender equality has to place students in an equal portion in accessing the learning process and learning resources such as textbooks. Therefore, the textbooks should provide fairness in representing gender equality (Lestariyana et al., 2020).

In the context of textbooks' power, the textbooks should differ gender proportionally. The textbooks should avoid presenting equality in masculinity and feminism (Lestariyana et al., 2020) because gender representations tend to alter students' ability to choose other fields beyond science.

For instance, the research on gender differentiation revealed that both female and male students have the same participation in science learning. There is significant differentiation in the science field chosen by students (Dawson, 2000). The female students tend to choose to learn sociology and biology, while male students tend to be attracted to physics. This condition indeed is affected by inequality representations between male and female students concerning science fields. This argument aligns with what Kerkhoven et al. (2016) revealed that 10% to 16% of male students of

undergraduatein the United States take physics, and most students take biology.

In gender research and the textbooks utilized in schools in Indonesia, the researchers found that gender representations in school textbooks dominated by language textbooks such as the English language (Adamson et al., 1998), including in Indonesia context. Several research types also focused on textual analysis of gender representation in the textbooks that lead to men and women representation (Setyono, 2018). However, the research focused on science/physics textbooks is not yet optimally to be investigated. For instance, the existence of gender representation in school physics textbooks is rare. Also, a case study of gender achievement in one public school in West Java province shows that male's achievement is better than those female's achievement in physics. This fact indeed can be a basis for analyzing gender representation in the physics textbooks, whether this representation affects how an understanding of physics concepts in the textbooks is supported by gender representation. Therefore, the present study has several urgencies when this is conducted. First, this will answer why male students dominate in physics learning instead of female students (Elgar, 2004) whether this situation is caused by gender inequality presented in Indonesian physics textbooks. Second, the research findings can be a reference in assisting the process of generating physics textbooks in the future that emphasize gender neutrality representations (Kerkhoven et al., 2016). Indeed, this might improve the quality of physics learning in the classroom when using the book developed.

Based on these arguments presented above, the researchers aim to reveal the represenation of gender neutrality in Indonesian physics textbooks. The analysis utilized is focused on the use of Critical Discourse Analysis (CDA) (Baxter, 2003) because it utilizes lexico-grammatical analysis to investigate the values through linguistic elements and visual communication in the textbooks. Three frameworks are used in physics textbooks. First, the representations of gender neutrality are revealed in the context of laboratory activities. Second, the representations of physics application in daily life. Third, the representation of men and women in the family environment also revealed the dominant representations of gender. To assist this research so as this is on the right track, the research proposed questions are developed about how representations of gender neutrality in laboratory activities, physics application in daily life, and roles of men and women in the family are represented in Indonesian physics textbooks? The question differs from other previous research on gender in physics textbooks (Elgar, 2004) because this emphasizes analysis of social actors of gender (Van Leeuwen, 2008), not to emphasize quantitive analysis.

THEORETICAL SUPPORT

This section provides a brief overview of the theoretical framework of the research to be carried out. This brief theory reveals gender neutrality in physics textbooks and feminism post-structuralism (FPS).

Gender Neutrality in the Textbooks

Research on textbook analysis is mostly carried out in several developed countries because many researchers reveal meaningful messages for the world of learning. Much research has focused on gender-stereotyped representations or gender bias. Such research is carried out in several fields such as history (Osler, 1994), music (Regueiro, 2000), STEM (Witherspoon & Schunn, 2020), health (Shin et al., 2015), and language (Rifkin, 1998). Other science research has also explored certain ethnic representations in a mathematical (Powell & Garcia, 1985)

and language context (Yang, 2016). This situation shows that research related to textbook analysis still attracts the interest of many researchers.

Most of the research on textbooks has focused on examining women and men (Elgar, 2004; Powell & Garcia, 1985). The research focuses on how women are always inferior to men, particularly in physics textbooks (Sadler et al., 2012). In general, the research that has been done reveals that women are less dominant in learning physics than men.

Although quantitative methods are strong enough to show data on differences in men's and women's representation in textbooks, qualitative research provides a different overview of gender discourses. Gender neutrality in textbooks needs to be studied more deeply about why male representation is more dominant. Starting from this thought, this study reveals another study regarding three things: representation of lab activities, learning physics, and the application of physics in everyday life from the perspective of feminist theory. These arguments are based on some recent research related to feminist theory, gender, and physics textbooks. First, the theory of feminism is an analytical tool in uncovering the relationship between the reality of women and men in a physics textbook in Uganda (Namatende-Sakwa, 2019). Second, feminism theory is also an analytical tool in revealing how elementary students negotiate the learning process. With the post-developmental and post-colonial approach, the construction of feminism in elementary school students is depicted (Adriany, 2019).

Gender Neutrality Considered by Feminism-Post Structuralism

Theories regarding feminism vary widely, where feminism (Harding, 2016) takes issue with women's uncritical impulses in the context of science. This explains that feminism is philosophically an uncritical approach to science itself. Also, Harding (2016) emphasizes excellent attention to the differences between those who believe that a feminist must reject science. In other words, in the context of feminism-science theory, it is negative. Feminism criticizes that women should distance themselves from science. This is because science is dominated by certain groups, which in this case are patriarchal. Of course, the feminist theory will further distance women from the context of scientific literacy that anyone should own.

In a positive context, feminism should be more critical of science or science itself. Science should not emphasize differences in gender, class, or society structure studying science. In this study, a post-structuralism feminism approach takes a critical role in science. In this context, physics is considered very subjective to masculinity. In other words, science-physics takes a dominant role in presenting men.

In this study, post-structuralism feminism, Baxter (2003) was used as an analytical tool. The centrality of discourse in constructing gender in physics textbooks is emphasized in the criteria of post-structuralism feminism (Butler, 2011). Textbooks in this study, for example, use discourse that signifies masculinity or male character to be known. The discourse that builds physics as something objective and avoids the use of emotions. This is because, discursively, emotion is related to female knowledge or feminism (Namatende-Sakwa, 2019).

Therefore, in analyzing physics textbooks, the researcher focuses on how masculinity and femininity are indexed through the discourses and practices available in people's culture. In this study, masculinity and femininity are indexed through a conventional understanding of masculinity and femininity in Indonesian society. Several analyzes related to discourse were carried out in identifying the available discourses in gender construction in textbooks. The focus of

the analysis is carried out on lab activities, physics applications in daily life, and the roles of men and women in the family, which is displayed in textbooks.

In this context, the researcher opens a double discursive structure, namely the gender of men and women. Gender is placed in the domain used to construct physics using terms that privilege masculinity while avoiding femininity. As Lazar (2007) emphasized, gender dualism is considered a characteristic of feminism that is considered less reflected in various cultures. In taking the feminism agenda, several analyzes criticize science, emphasizing the patriarchal ideology inherent in science itself. In this context, the research identifies three dominant discourses closely related to the construction of physics from the perspective of masculinity.

METHOD

This present study is qualitative research focusing on Critical Discourse Analysis (CDA) because it investigates gender representations (women and men) in physics textbooks. CDA is an interdisciplinary study of discourse that views language as a social practice and considers the context of language use (Talib & Fitzgerald, 2018). Because the selected textbooks are curriculum documents and cultural texts, CDA is the most suitable tool in investigating how these texts represent and construct social realities that are contextually related to certain ideologies (values) through hidden messages (Widodo et al., 2018). This is interesting because the context of science is viewed from a very dynamic language framework. For this reason, lexico-grammatical analysis as the micro-language analysis is specifically used to examine values through the choice of textual and visual elements in discourse (Roberts & Philip, 2006; Widodo et al., 2018) in representing gender neutrality in Physics textbooks.

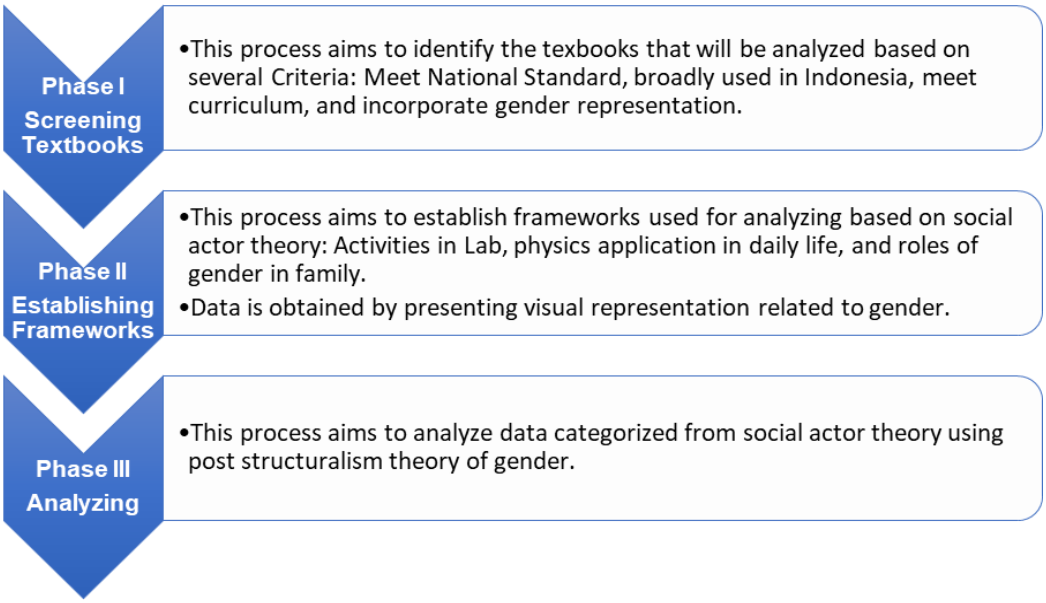


Figure 1. Study Flowchart

A critical analysis is carried out through visual representations. A series of physics textbooks published by the Ministry of Education and Culture was analyzed, the physics textbooks Indrajit (2009a, 2009b, 2009c) entitling *Mudah dan Aktif Belajar Fisika* (Easy and Active Study Physics) were chosen based on several reasons. First, textbooks meet the criteria set by the National Education Standards Agency. Second, textbooks are used in almost all schools in Indonesia.

Third, textbooks have played an essential role in the implementation of the new curriculum. Fourth, the incorporation of gender material in Physics textbooks needs to be criticized and assessed. Besides, to ensure why these textbooks represent gender neutrality in Indonesian physics textbooks, our manual analyses show that the book depicted many representations of other physics textbooks published by the Ministry of Education and Culture.

Data analysis is focused on the representation of women and men who are represented in the physics textbooks. The analysis was conducted using all three frameworks. First, the textbooks were read, and men and women's representations were categorized based on theme and location. Second, the use of three frameworks (i.e., laboratory activities, physics application in daily life, and roles of men and women in family represented in Indonesian physics textbooks) was utilized to analyze text discourse and visual representations critically. Finally, an analysis of men and women's representations in the context of the frameworks provided using the post-structuralism approach (See figure 1).

RESULT AND DISCUSSION

There are some stereotypes of men and women represented in the physics textbooks based on visual communication presented in pictures/photos in the textbooks. All descriptions and locations of these visual representations/pictures can be considered in Table 1 and Table 2.

Table 1. The Representations Based on Visual Representation/Pictures Displayed in the Textbooks

Theme	Description	Grade Location/Page
Linear motion	Riding bicycle	Grade X (p.47)
Linear motion	Play basketball	Grade X (p.62)
Work and Energy	Drive car	Grade XI (p.68)
Work and Energy	Using toys	Grade XI (p.68)
Work and Energy	Moving box	Grade XI (p.78)
Collision and impulse	Exercise boxing	Grade XI (p.91)
Static Fluid	Fishing	Grade XI (p.144)
Optic Physics	Lab experiment	Grade XII (p.41)
Sound wave	Play music instrument	Grade XII (p.50)
Sound wave	Repair bicycle	Grade XII (p.53)
Static Electricity	Scientist	Grade XII (p.78)

Table 2. The Representations of Women Based on Visual Representation/Pictures Displayed in the Textbooks

Theme	Description	Grade Location/Page
Light and optic	Reflect in plan mirror	Grade X (p.111)
Light and optic	Visual analysis in solving the problem of mirror	Grade X (p.112)
Electricity	Mixer devise for cooking	Grade X (p.193)
Electromagnetic wave	Name's text for showing woman identity	Grade X (p.200)
Work and energy	Woman use traditional transportation	Grade XI (p.73)
Work and energy	Mother and daughter play a game	Grade XI (p. 95)
Sound wave	USG Device to control woman health	Grade XII (p.54)
Optic geometry	Female students conduct a physics experiment	Grade XII (p.55)
Static electricity	A woman uses a photocopy machine	Grade XII (p.76)
Static electricity	A woman uses a Van Der Graff generator	Grade XII (p.96)

When we consider the men's representations (see Table 1), we found that some representations were concerned with men's activities, roles of men in science, and men's roles in daily activities. Interestingly, women's representations emphasize several aspects: the nature of women's activities, women's activities in science, women in daily activities, devices concerning

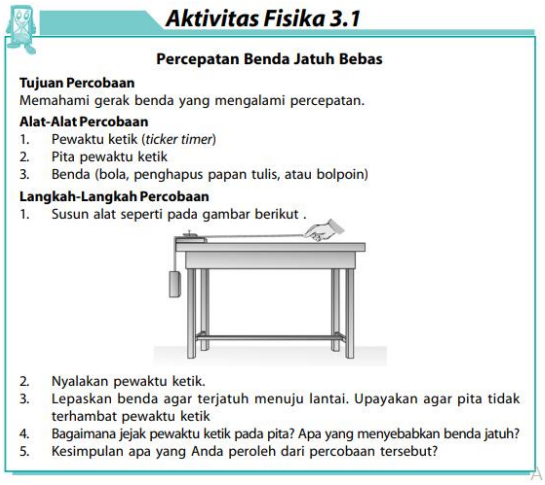
women's activities, and roles of women in the family. In our consideration, some men's activities show that men's activities are related to male characters' nature showing masculinity (Lestariyana et al., 2020). For instance, fishing activity is one of the natural men activities in which they tend to have this hobby and spend much time in spare time. On the contrary, the nature of women's character tends to be feminism in various cultures (Lazar, 2007), represented in the physics textbooks reflecting in the plane mirror. This activity is a part of women dressing up in which women care about their appearance. These findings align with the research conducted by (Lestariyana et al., 2020), although they analyzed the English language textbooks in Indonesia.

In the context of women's representations, women are rare to be presented as a scientist. Almost all scientists in physics textbooks are represented in men's representations. This situation indeed is based on the fact that men master the dominations of scientist in physics. Only a few woman scientists are presented in the textbooks, such as Mary Currie; she also overlaps with the chemistry scientist. This also emerges when we know this representation dealing with the assumption that women are underperformance in science. Today, this representation is altered with many contributions of women in science. For instance, in 2018, Donna Strickland, the Canadian woman scientist of physics, received the Nobel laureate for her Laser invention. This is a fact that woman has the same significant contribution in science, although women representations in physics textbooks are still rare.

This research is focused on three main aspects based on social actors, such as representations of gender neutrality in laboratory activities, physics application in daily life, and the roles of men and women in the family represented in Indonesian physics textbooks. The researchers analyzed these aspects based on visual discourse.

Laboratory Activities

In the physics textbooks analyzed, we revealed that the textbooks represented two visual messages concerning gender representations (see Figure 2a and 2b) in laboratory activities.



Aktivitas Fisika 3.1

Percepatan Benda Jatuh Bebas

Tujuan Percobaan

Memahami gerak benda yang mengalami percepatan.

Alat-Alat Percobaan

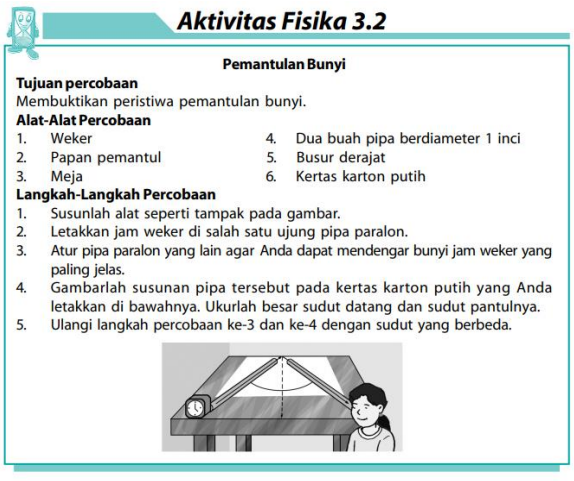
1. Pewaktu ketik (*ticker timer*)
2. Pita pewaktu ketik
3. Benda (bola, penghapus papan tulis, atau bolpoin)

Langkah-Langkah Percobaan

1. Susun alat seperti pada gambar berikut .

2. Nyalakan pewaktu ketik.
3. Lepaskan benda agar terjatuh menuju lantai. Upayakan agar pita tidak terhambat pewaktu ketik
4. Bagaimana jejak pewaktu ketik pada pita? Apa yang menyebabkan benda jatuh?
5. Kesimpulan apa yang Anda peroleh dari percobaan tersebut?

(a)



Aktivitas Fisika 3.2

Pemantulan Bunyi

Tujuan percobaan

Membuktikan peristiwa pemantulan bunyi.

Alat-Alat Percobaan

1. Weker
2. Papan pemantul
3. Meja
4. Dua buah pipa berdiameter 1 inci
5. Busur derajat
6. Kertas karton putih

Langkah-Langkah Percobaan

1. Susunlah alat seperti tampak pada gambar.
2. Letakkan jam weker di salah satu ujung pipa paralon.
3. Atur pipa paralon yang lain agar Anda dapat mendengar bunyi jam weker yang paling jelas.
4. Gambarlah susunan pipa tersebut pada kertas karton putih yang Anda letakkan di bawahnya. Ukurlah besar sudut datang dan sudut pantulnya.
5. Ulangi langkah percobaan ke-3 dan ke-4 dengan sudut yang berbeda.

(b)

Figure 2. (a) Biased Gender Depicted in Laboratory Activities, (b) Woman Representation in Laboratory Activities

Interestingly, in laboratory activities (see Figure 2a), there is a biased gender representation. As we know that the hand presented in the box of laboratory activities can be a male or female student. This provides a meaning that this activity could be connected to both male and female students. In contrast, the second

laboratory activity (see Figure 2b) shows the special meaning that this activity is significantly connected to female students. A mirror, a device frequently used to dress up, leads to this female character. In context feminism-post structuralism, this situation will affect woman representation in Indonesian culture. This aligns with Namatende-Sakwa (2019) and Glapka (2018), arguing that emotions are required to relate to female knowledge or feminism so the female students can be attracted to science activity.

Physics Application in Daily Life

The physics theory application implemented in the apparatus of daily life correlates with gender representations (see Figures 3a and 3b). The first figure depicts two pictures that are mixer and drill. In a mixer, this is a device using energy transformation from electric energy to mechanical energy. Concerning gender, this device represents women because we know that naturally, in Indonesian culture, women should have the ability to cook and use cooking stuff.

Also, a drill is related to energy transformation in which there is an alteration from electric energy to mechanical energy. Related to gender representation, this device shows how men can use this in many mechanical jobs. This means that gender neutrality in the physic application context represents a balance of gender representation by presenting two devices utilized by men and women. This sends the message that there is a disparity to place the men more potent than women concerning daily stuff. According to feminism-post structuralism, this representation constructs a view that feminism is parallel with masculinity (Butler, 2011). Further, in strengthening gender neutrality, the physics textbooks show the laboratory apparatus, oscilloscope, utilized in laboratorium to consider the electromagnetic wave. This device can be related to both male and female students in physics experiments.

(a) (b)

Figure 3. (a) The Devices Related to Men and Women Activities, (b) The Lab Apparatus Represent Biased Gender

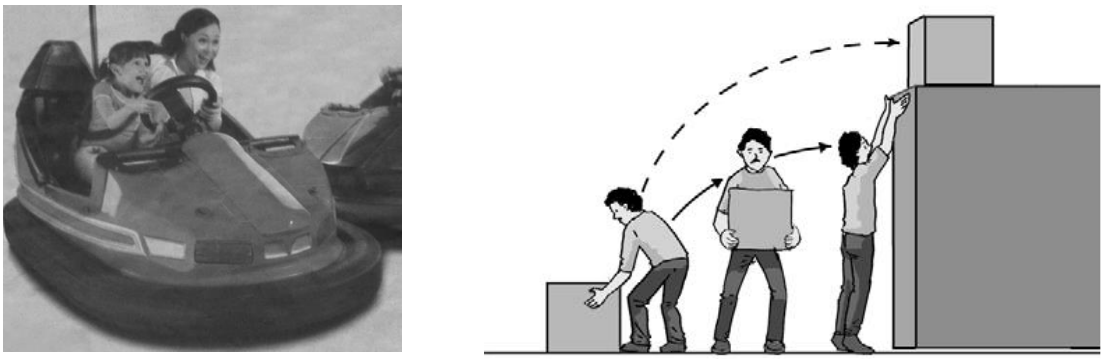
Roles of Men and Women in a Family

Both men and women have different roles in the family. Men are identified as a leader culturally in the family in Indonesia. In other words, men are responsible for working and support the finance of the family. Men decide men's decision as a leader, and the women just follow a choice selected. The women indeed have different roles in which they play the role of carrying family such as taking a great responsibility like women character.

In the physics textbooks, the book presented the same portion in presenting men and women (see Figure 4a and 4b) in

the family. In this textbook, the roles of women in the family are presented in the role of mother. A mother plays with her daughter, so this situation aligns with women's responsibility in the Indonesian family. On the other hand, men's representations were depicted as people who take responsibility for supporting family finance. In the textbooks, a man is depicted to lift the box to a higher position than before.

Interestingly, if we consider the feminism-post structuralism perspectives (Namatende-Sakwa, 2019), the textbooks might try to construct feminism and masculinity perceptions based on the nature of both man and woman characters. This situation genuinely presents biased gender construction in men and women's roles in which the women are not depicted in an unsatisfactory situation. This contradicted what Elgar (2004) argued that women's representation in science textbooks was frequently presented in a bad situation.



(a) (b)

Figure 4. (a) The Role of Women in Family, (b) The Role of Men in Family

The textbooks strongly send the messages that men's and women's roles in the family on the track are represented in daily activities in Indonesian culture. In other words, the textbooks do not provide other perspectives in considering women's position higher than men, such as in the context of job acquisition, as argued by Lestariyana et al. (2020).

In physics learning, any representation of gender, including the roles of men and women in family life with the same proportion, will contribute to creating equality of gender stereotype in science/physics education resources. This means that the stereotypical representation of men and women in science is a true reflection of the gender distribution in science that should aim for a more balanced representation (Kerkhoven et al., 2016). Such a balance is a primary first step towards presenting children that both men and women can conduct science, supporting more gender-balanced science in the classroom.

CONCLUSION

Because this present study aims to present gender neutrality in Indonesian physics textbooks in three scopes, namely laboratory activities, physics application in daily life, and roles of men and women in the family, we conclude that generally, the textbooks analyzed present equal representations in these frameworks.

Interestingly, based on findings, there is a little domination of women in Indonesian physics textbooks in laboratory activities. This is truly good to underpin the contribution of women in the science context. Its implication will affect the female students' interest in taking a science not only in physics learning but also in any field such as science, technology, engineering, and mathematics (STEM).

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