

# Exploring Gender Stereotypes and Sexism in Learning Apps: Insights from Austrian Secondary School Students

Eva Schmidthaler\*, Matthias Schmollmüller, Pia Wimmer-Furian, Corinna Hörmann, Marina Rottenhofer, Barbara Sabitzer

School of Education, Johannes Kepler University, Linz, Austria

## Email address:

Eva.schmidthaler@jku.at (Eva Schmidthaler)

\*Corresponding author

## To cite this article:

Eva Schmidthaler, Matthias Schmollmüller, Pia Wimmer-Furian, Corinna Hörmann, Marina Rottenhofer, Barbara Sabitzer. Exploring Gender Stereotypes and Sexism in Learning Apps: Insights from Austrian Secondary School Students. *American Journal of Applied Psychology*. Vol. 12, No. 5, 2023, pp. 111-128. doi: 10.11648/j.ajap.20231205.11

**Received:** August 7, 2023; **Accepted:** September 6, 2023; **Published:** September 27, 2023

---

**Abstract:** Mobile educational applications (learning apps) have gained significant popularity in classrooms due to their potential to enhance student engagement and improve learning outcomes. However, it is crucial to ensure that these apps not only facilitate educational content but also promote equality, challenge gender stereotypes, and avoid perpetuating discriminatory practices. This study aims to investigate the perceptions of secondary school students regarding gender representations, the use of gender-neutral language, and the presence of gender-derogatory terms in two selected learning apps: “Simpleclub” and “StudySmarter”. This study involved a sample of 244 students aged between 11 and 18 years from two Austrian secondary schools. The students actively participated in teaching and learning activities where the learning apps were integrated into the curriculum. To gather data, an online questionnaire comprising both open-ended and closed-ended questions was administered to the participants. The questionnaire aimed to capture the students' feedback on their perceptions of gender representations, language usage, and stereotypes within the learning apps. The findings of the study revealed that gender-typical representations were prevalent in both learning apps. In “Simpleclub” men were primarily portrayed based on superficial factors such as age, clothing, attractiveness, and physical attributes. On the other hand, women were depicted in accordance with traditional gender stereotypes, focusing on their physical appearance, attractiveness, and conformity to societal beauty standards. Similarly, in “StudySmarter” men were predominantly described in terms of their occupations and external appearance, with relatively less emphasis on their physical attributes. However, gender stereotypes were still evident in the portrayal of men. In terms of gender-neutral language, the study found that its usage was limited within learning apps. The students reported difficulties in identifying consistent instances of gender-neutral language or depiction in the apps. Furthermore, participants noticed the presence of gender-derogatory and sexist language in the learning videos. These findings underscore the need for more diverse and inclusive representations of all genders in learning apps. Efforts and future research should be directed toward improving awareness and implementation of gender-appropriate language in educational materials, as well as fostering a culture of inclusivity and respect.

**Keywords:** Educational Application, Learning Apps, Teaching, Sexism, Stereotypes, Gender, Gender Role

---

## 1. Introduction

A major goal for teachers today is to get students excited about their lessons, actively engage them, and spark their individual interests. One way to meet these modern challenges is through the innovative use of digital educational resources in the form of mobile educational applications (learning apps) [6]. However, previous studies

have indicated that female students in particular, often show less interest than their male counterparts in areas such as STEM (science, technology, engineering, and mathematics) subjects [25, 26]. In this context, gender stereotypes are often cited as a cause for this phenomenon [21]. Surprisingly, most prior research has concentrated mainly on the study of gender stereotypes in traditional educational resources (e.g., textbooks) [8, 11, 19]. So far, however, comparatively few attempts have been made to explore stereotypical content in

digital or online media for educational purposes. Therefore, the present paper attempts to fill some of these research gaps by focusing on potential gender stereotypes and underlying sexism in learning applications for secondary students.

In the context of this study, stereotypes are commonly described as generalized assumptions about specific groups of people whose members are ascribed similar characteristics, regardless of actual differences between them [4]. Moreover, prejudices or stereotypes are also known to influence the formation of children's interests, especially when the topics they are interested in are presented in a stereotypical way [21]. Consequently, some topics become more engaging to children or adolescents when there is a clear link between the stereotype presented and the individual's sense of self-image [22]. A higher preference for certain topics or personal interests can therefore result from a more positive correlation between the previously mentioned aspects [16]. At the same time, stereotypes can lead to the assumption that members of a particular group (e.g., girls and/or women) are less successful in certain fields or do not belong in certain areas [26, 38, 44].

### ***1.1. Female Underrepresentation and Gender Stereotypes in STEM***

STEM fields are particularly worth mentioning in this context, as they are often associated with male attributes by children and adults [3]. According to Law et al. (2021) [23], a direct consequence of this imbalance in gender representation is a significant underrepresentation of female employees and workers in science, technology, engineering, and mathematics. Unfortunately, this negative attitude towards STEM subjects is already evident in children at an early age [21]. For example, Mulvey and Irvin (2018) demonstrated in a study that children as young as three to five years old had significant gender biases toward STEM subjects and were less open to counter-stereotypical career paths [28]. Furthermore, Brian et al. (2017), demonstrated that children from age six onwards tended to think boys were generally smarter than girls [7]. As a result, gender stereotypes consistently seem to impair not only the academic performance of girls but also their future career choices [33, 35, 38, 39, 44].

### ***1.2. Gender Stereotypes in School Books***

According to Kerkhoven et al. (2016), educational resources for science have been found to perpetuate gender stereotypes through their indirect promotion of gender bias [22]. Given that students spend up to 95% of their learning time on visual media (e.g., textbooks), the use of a wide variety of visual learning resources could consequently result in cumulative and early exposure to gender stereotypes, and with this comes the previously mentioned consequences [34]. Unfortunately, this is not a completely unknown or even new problem in modern gender research. As early as in the 1960s and 1970s, researchers pointed out existing gender-based stereotypes in children's books [29]. Even to this day, gender-based stereotypes in textbooks are considered by some

authors to be one of the most persistent and profound challenges of the gender equality movement [5]. Both the linguistic and visual representations of gender stereotypes in educational resources are at the centre of this discussion [22]. İncikabı and Ulusoy (2019) showed that in mathematics books there is an unbalanced representation of male and female characters [19]. The same study also concluded that there was a clear trend for stereotypical male roles (e.g., scientist or technician) being represented by men whereas domestic roles are more often embodied by women [19]. In part, similar results were also obtained by Moser and Hannover (2014) in their analysis of the linguistic and illustrative representation of men and women in German and mathematics books [16]. Although there was a general balance in the number of girls and boys depicted, the number of women depicted was again significantly lower than that of men [16]. According to Lumerding, stereotypes and concepts of gender roles still exist in current Austrian school books. The study was able to show that women are significantly underrepresented in quantitative terms in three out of four German textbooks examined for grade eight [24].

### ***1.3. Gender Stereotypes in Digital Media and Technologies***

However, this trend of unbalanced gender representation seems to apply not only to printed educational resources but also to digital media and technologies. For example, Dudo et al. (2011) found that researchers and scientists are portrayed much more frequently by Caucasian men in digital media [12], whereas Singh et al. (2020) state that women are generally underrepresented on various digital and social media platforms and that they are also continuously underrepresented in supposedly female-dominated professions within these platforms [37]. Thus, the results are relatively consistent with previous research findings by Steinke and Long (1996) [40]. In the course of their studies, researchers were able to show that characters in scientific children's TV series are portrayed twice as often by males. Female characters, in contrast, were largely featured in complementary roles (students, laboratory assistants). As a result of these described gender biases, some researchers believe that various forms of digital media are specially designed for men and are therefore part of the perpetuation of gender stereotypes in the field of computer science [45]. Because of this, the utilization of mobile learning apps in the classroom should be carefully evaluated, given their potential consequences. Sheldon (2004), for instance, confirmed this cause for criticism with a study on the use of educational software for children between the ages of three and six [36]. The results of the study once again showed that women were significantly less likely to appear as main characters and that female characters were considerably more often represented in gender-stereotypical ways, for example in terms of domestic behavior, profession, physical appearance, or personality traits. Given the fact that many teachers today integrate online educational technologies into their lessons alongside traditional textbooks, these previous research findings give ample cause for concern [22].

#### 1.4. Gender Stereotypes in Educational Applications

So far, however, there has been little discussion about gender stereotypes in online educational resources, such as educational applications. Especially in Austria, it is particularly important to know the disadvantages, such as gender discrimination, as the integration of learning apps, as part of the digitization program for teachers and students, has been promoted by the Federal Ministry of Education, Science, and Research (BMBWF) since 2020 [6, 32]. However, this is particularly important as there is already a wide range of learning apps on the market. In addition, many teachers, parents, and students do not know what dangers the learning apps have in addition to many advantages, such as increased engagement, entertainment, learning success, motivation, and collaboration [14, 17].

## 2. Methodology

This mixed-method study employed an online questionnaire based on the structured questionnaire model to collect and analyze the opinions and perceptions of secondary school students. This research aimed to address specific research questions related to the portrayal of men and women in learning apps and the use of gender-neutral language. The data collection process involved a combination of closed-ended and open-ended questions, allowing for both quantitative and qualitative data analysis. The findings were processed using descriptive statistics [43] and the constant comparative method [39] employed in grounded theory, providing a comprehensive understanding of the research topic.

### 2.1. Research Design and Aim

This study attempts to collect and research the opinions of secondary school students regarding the perception of gender representations, and the use of gender-neutral language in texts, images, and videos of learning apps by means of an online questionnaire study. The following research questions were tried to seek to answer:

RQ: How are the men and women represented and portrayed in the apps, and how are they perceived by the participating secondary school students?

RQ: According to the participants, is gender-neutral language used in the apps, and are there any gender-derogatory terms or language in the two used learning apps?

### 2.2. Data Collection and Processing

For the data collection, an online questionnaire based on the structured questionnaire model, including both closed-ended and open-ended questions (21 items; listed in the Appendix) was created by the authors and used for each learning app (study 1: Simpleclub  $n=135$  and study 2: StudySmarter  $n=135$ ). In educational research, structured questionnaires can be designed to assess student perceptions, evaluate the effectiveness of educational applications, gather feedback on instructional materials or teaching strategies,

measure student engagement, and explore factors influencing academic achievement. The combination of closed-ended questions with fixed response options and open-ended questions allows researchers to collect both quantitative and qualitative data, providing a comprehensive understanding of the research topic.

The data was collected from 19<sup>th</sup> November 2021 to 21<sup>st</sup> January 2022. The quantitative data were processed using descriptive statistics [43], as recommended in similar studies and done by the authors before [2, 30, 31].

Qualitative data were processed using the constant comparative method employed in grounded theory [39]. Using raw participant data, the research team broke down the data and listed the codes (open coding), then made connections (axial coding) and sorted the participants' codes into four categories (*colors, physical appearance, profession, character*), and ten subcategories according to different attributes (*clothing, body hair, skin color, professional groups, activity & location, physique & anatomy, attractiveness, personality & character traits, accessories, age*) (selective coding). Researchers have recommended, and the authors have done this approach in previous studies [1, 2, 30]. Afterward, the data was reorganized, and the codes were assigned to "male", "female", or non-binary or affecting all genders ("neutral") and structured in a table [15]. The gender-specific codes were additionally visualized in images. A similar approach to a gender assignment of qualitative statements can be found in the study by [46].

In this study, the assignment of gender or gender neutrality to certain codes was not determined by the authors but rather by the responses from an additional online survey conducted on social media using a voluntary online sampling method. The survey involved 80 participants from Austria. Each participant was presented with a list of individual codes, such as "handsome" "thin" and "fit", and they assigned these codes to specific genders – "male", "female" or "neutral" (none or all genders). The methodology employed an online voluntary sampling approach, where participants willingly completed a questionnaire assessing their perceptions of specific items/words. The questionnaire aimed to understand whether participants perceived words like "powerful" as more associated with females, males, gender-neutral, or applicable to all genders. Instead of imposing their own characterizations, the authors relied on the perspectives of the participants.

### 2.3. Sampling

The teachers and their students, participating in this research were included by using the purposive sampling approach. Purposive sampling was done by the authors before, and is recommended for studies in education, aiming to examine a certain phenomenon, attitude, or concept among a specific sampling group of participants [10, 30]. The three important requirements for including the educators in this study were firstly, that they are Austrian in-service teachers, secondly, that they have some experience in m-learning (mobile learning) or with mobile educational applications in their teaching, and thirdly, that they are familiar with the two

examined learning apps.

The analyzed participants ( $n=244$ ) of both studies, one with the utilization of the app StudySmarter (Study2=120), and the second one using the learning app Simpleclub (Study1=124) were students from two Austrian secondary schools. Most of the students in this research were female

(50.9%), as seen in *Table 1*. In Study 1 53.3% of female, 44.8% male, and 1.5% non-binary students participated. In addition, in Study 2, 64.4% female, 34.8% male, and 0.7% non-binary participated. All students were between 11 and 18 years old (average Study 1 = 14.1 years and Study 2 = 12.0 years).

*Table 1. Gender and age distribution of all participating students.*

Gender	all	female	male	non-binary
Students Study 1	124 (92.5%)	64 (47.8%)	58 (43.3%)	2 (1.5%)
Students Study 2	120 (88.9%)	73 (54.1%)	46 (34.1%)	1 (0.7%)
All students	244 (90.1%)	137 (50.9%)	104 (38.7%)	3 (1.1%)

#### 2.4. Experimental and Questionnaire Design

Each of the participating classes either used the learning app *Simpleclub* or *StudySmarter*, chosen by the teachers, in their learning units. The lessons were from a wide range of different subjects: Psychology, Biology, English, Sports, Mathematics, Computer Science, Spanish, and History. The teachers were able to choose the topics that they wanted to discuss with their students. At the beginning of the lecture, all participants had to download one of the chosen learning apps. After the learning units, the students completed the questionnaire, containing open-ended and closed-ended questions (seen in the *Appendix*). In two studies, students were asked about the preferred target group of the studied learning apps. In addition, they had to give their opinions on gender-neutral language use, and stereotypical gender representation in the apps, by describing and characterizing how female and male representing people were portrayed in the apps (e.g., personality traits, characteristics, physical appearance, profession). Furthermore, they stated whether

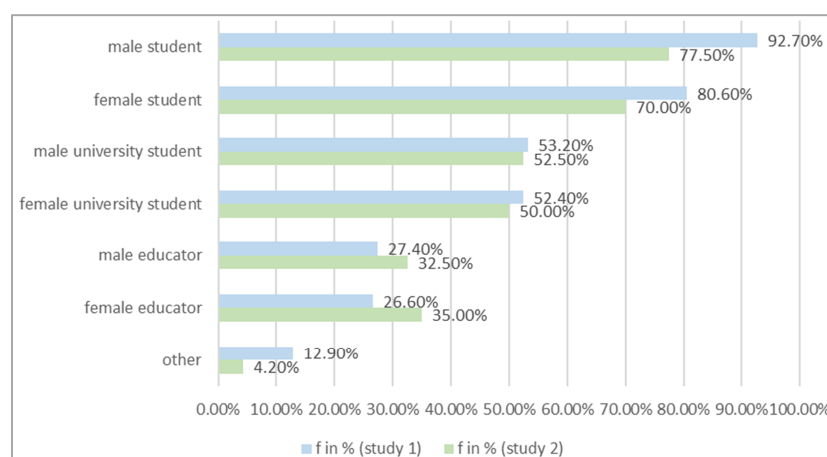
they would reuse the app, and lastly, the students were questioned if they believed that all their teachers would use this app.

### 3. Results

The results section presents the findings of the study, focusing on the perceptions of secondary school students regarding gender representations and the use of gender-neutral language in two learning apps. This section includes both quantitative and qualitative data analysis, providing a comprehensive understanding of the students' perspectives on these aspects.

#### 3.1. Results of Quantitative Data

This section presents the results of the quantitative survey. The answers were collected according to (1) the target group and reuse, (2) the presence of gender-neutral concepts, and (3) the recognition and representation of gender in the two learning apps.



*Figure 1. Students' opinions on the target group regarding both apps ( $n1=124$ ;  $n2=120$ ).*

##### 3.1.1. Target Audience and Reuse of the Learning Apps

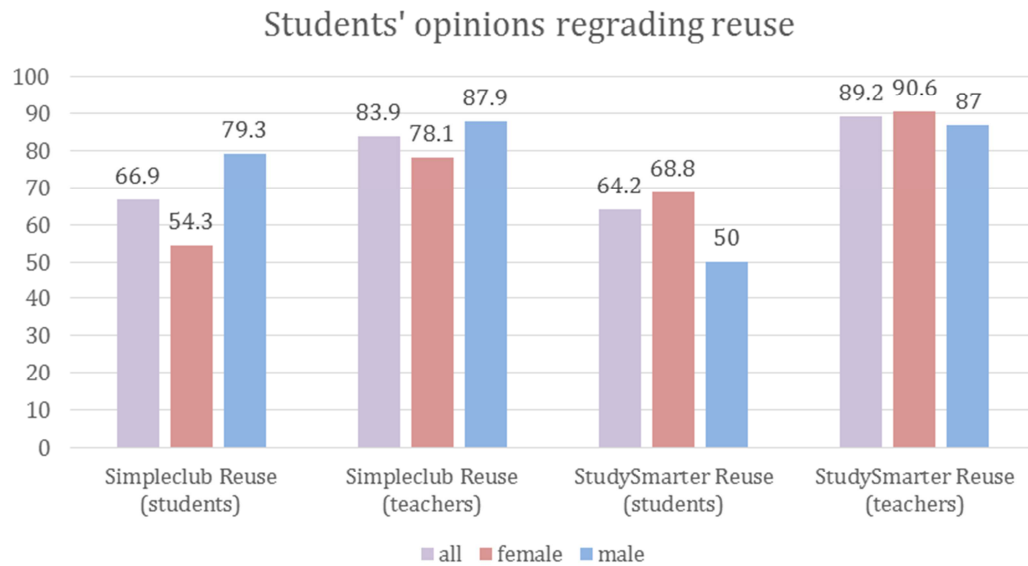
After analyzing the quantitative data, according to the majority of the students, the main target group (audience) of both learning apps are secondary school students, especially male students (study 1: 92.7%; study 2: 77.5%), as shown in *Figure 1*. In Study 1 the data was followed by female

students (80.6%), male university students (53.2%), female university students (52.4%), male teachers (27.4%), and female teachers (26.6%). The Study 2 data varied slightly: the numbers were followed by female students (70.0%), male university students (52.5%), female university students (50.0%), female teachers (35.0%), and male teachers (32.5%).

Regarding reuse, 66.9% of the participating students

would reuse the app Simpleclub for their studies and in their learning process. Furthermore, 83.9% believed, that their teachers would reuse the app. In the second study, 64.2%

would reuse the app StudySmarter and 89.2% stated that they think their teachers would use the app StudySmarter (Figure 2).

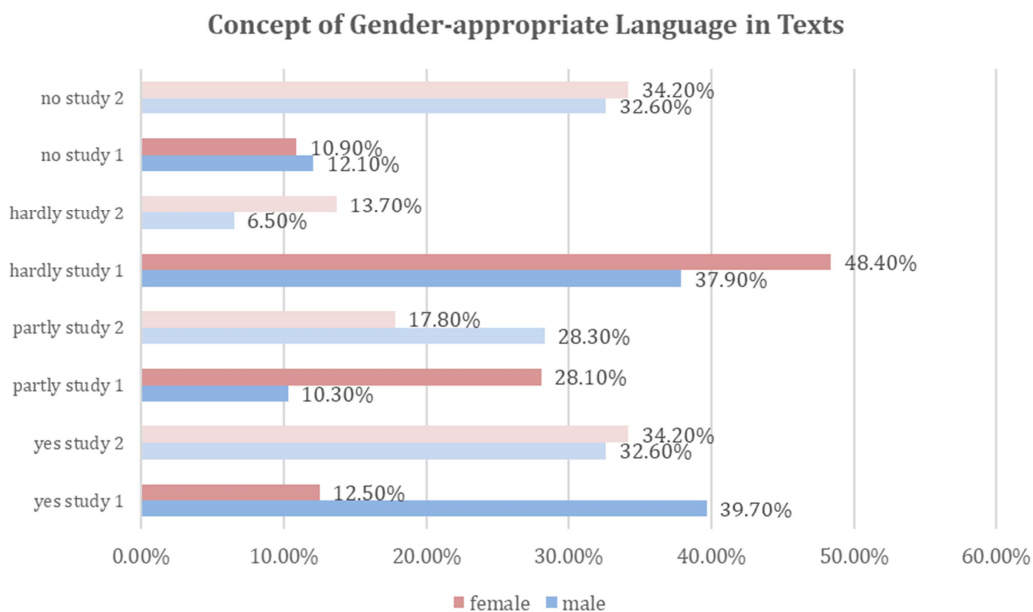


**Figure 2.** The graph shows the (possible) reuse of the two learning apps (in %). The participating students indicated whether they would reuse the apps Simpleclub and StudySmarter and whether they thought their teachers would use the apps.

### 3.1.2. Concept of Gender-Appropriate Language

Regarding the concept of gender-neutral language in texts, images, and videos, the majority of participants in both studies recognized little or no concept of gender-appropriate language in the texts of the app (Study 1: 54.8%; Study2: 45%), in the learning videos (only in Study 1: 47.5%), and the figures (study 1: 50.0%; study2: 53.3%), as shown in Table 3. If the answers of all genders are compared (non-binary people were not analyzed because the number of participants is not big

enough), a trend can be seen that slightly more male students stated that they can clearly or partially (Answer: “yes” or “partly”) see a gender-appropriate language in the apps’ text (Study 1: male 50%; female 40.6%; Study 2: 60.9%; female 52%), videos (Study 1: male 56.9%; female 50%), and images (Study 1: male 55.2%; female 45.3%; Study 2: male 54.3%; female 42.4%). In Study 1 only 12.3% of the female students stated that there a concept was evident in the learning videos, and 12.5% in the text.



**Figure 3.** The gender distribution of the participating students regarding their opinion on a gender-appropriate concept in the apps' text in both studies.

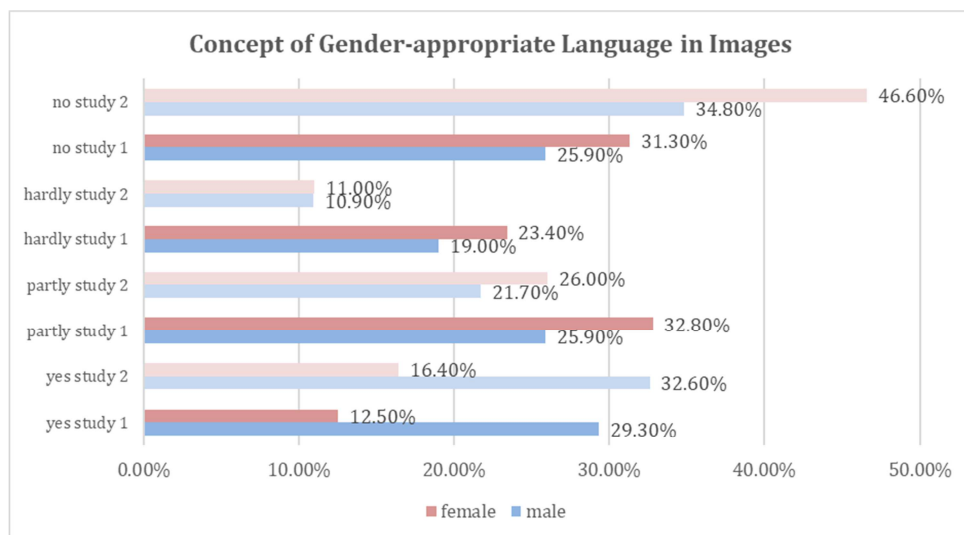


Figure 4. The gender distribution of the participating students regarding their opinion on a gender-appropriate concept in the apps' images in both studies.

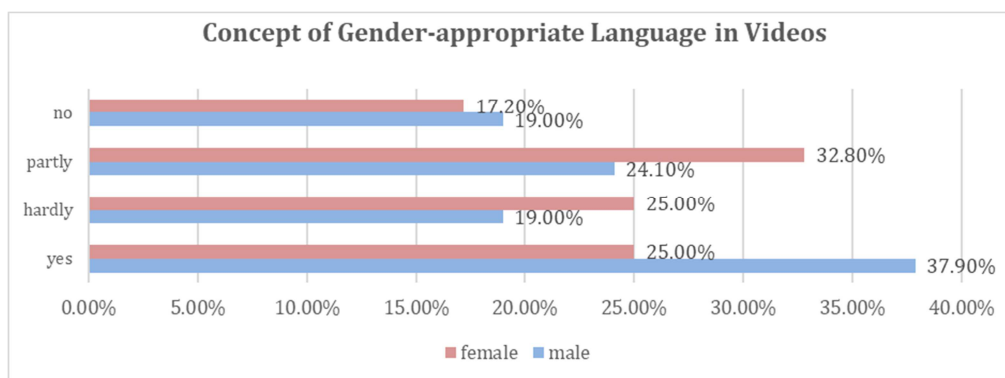


Figure 5. The gender distribution of the participating students regarding their opinion on a gender-appropriate concept in learning videos in Study 1.

The results in Study 2 regarding the text vary slightly from Study 1. Hence, 34.2% of the female students agreed with the statement that there is indeed a gender-appropriate concept in the text and 16.4% in the images, as shown in Figures 3-5.

In summary, most participating students in both studies had limited or no recognition of gender-neutral language in the learning apps' texts, videos, and images, with slight variations between male and female students.

### 3.1.3. Recognition and Representation of Gender

Most of the participants (91.0%) discovered images of men, boys, or people assigned to the gender "male" in study 1 and even 83.6% saw pictures of women, girls, or people assigned to the gender "female". In study 2, 65.2% recognized male and 62.2% female images.

In study 1, 53.7% of the participants stated that gender-derogatory and sexist language against men (25.4%), women (46.3%), or non-binary people (10.4%) was used in the educational videos. The learning videos were perceived by the participants as "sexist and gender-derogatory" through images or pictures (26.1%), derogatory language (35.8%), jokes (61.9%), comic-like depictions (39.6%), slogans (13.4%) and with the conscious omission and ignoring of non-binary people (2.2%).

## 3.2. Results of Qualitative Data

This section presents the results of the qualitative survey. The answers were structured in (1) the representation of men and male-associated individuals in learning apps according to students, and (2) the representation of women and female-associated individuals in learning apps according to students. In Study 1, males (or individuals externally identified as male) were associated with 253 codes, while in Study 2, they were associated with 139 codes. Similarly, in Study 1, women (or individuals externally identified as female) were represented by 242 codes, and in Study 2, they were represented by 116 codes. The complete list of codes can be found in four tables in the appendix. In both studies, gender is described by the participating students based on their profession, character and personality, and physical appearance.

### 3.2.1. Representation of Men and Male-Associated Individuals in Learning Apps According to Students

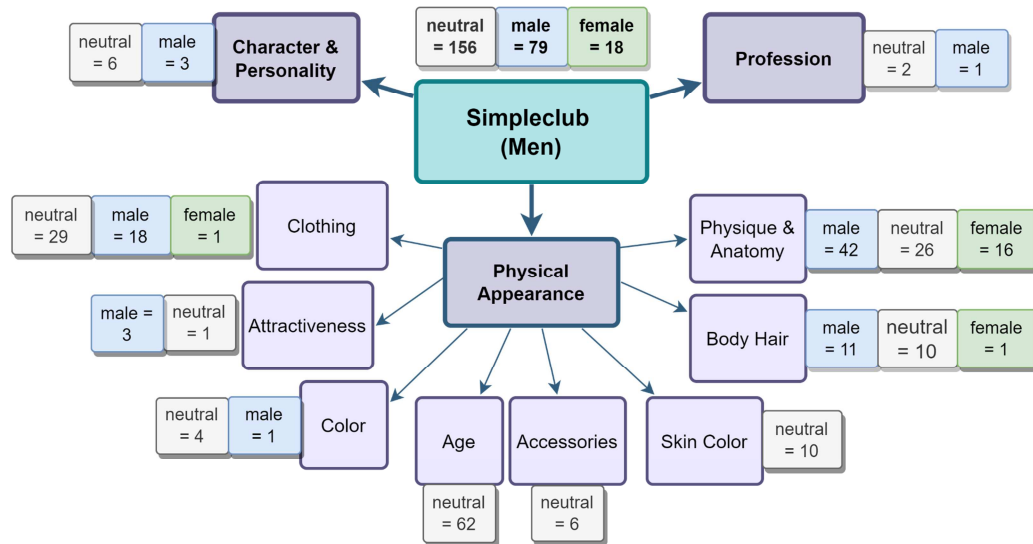
Regarding the perception of the students and the categorization of the codes of the external participants, male-presenting individuals were described with 156 neutral codes, 79 associated with males, and 18 associated with females in the first study. In the second study, there were 112 neutral



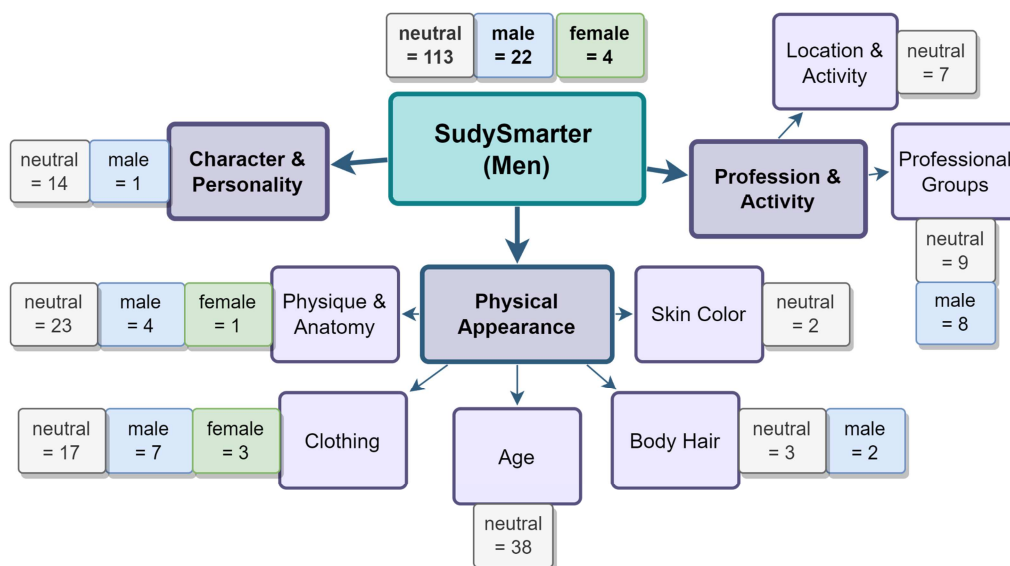
codes, 22 associated with males, and 4 associated with females (Figures 6-8).

In the first study, male-associated individuals were primarily described and perceived by the students through their physical appearance, particularly focusing on their physique and anatomy, followed by clothing. Similar results were observed for female-associated individuals. Participants in the first study described them mainly based on their physical appearance, particularly emphasizing body structure and anatomy, clothing, and body hair. In Study 2, male-associated individuals were described mostly by their physical appearance, especially with their age, clothing, and physique, followed by their profession and character, and personality. Most notably, in study 1, participants describe men shown in the app based on their appearance (clothing, age, attractiveness, accessories, skin color, body hair, and body anatomy). In study 1, men are predominantly described

as young ( $f=20$ , 16.13%) or middle-aged ( $f=23$ , 18.55%), wearing normal clothing ( $f=15$ , 12.10%), such as a T-shirt ( $f=15$ , 12.10%) or jeans ( $f=15$ , 12.10%), or unobtrusive, simple, or non-specific clothing ( $f=4$ , 3.23%), or nothing ( $f=6$ , 4.84%). Males' physical appearance in the app's videos or images is described as slim or thin ( $f=12$ , 9.68%), neutral or normal ( $f=10$ , 8.06%), muscular or well-trained ( $f=9$ , 7.26%), strong ( $f=8$ , 6.45%), tall ( $f=8$ , 6.45%), stereotype or cliché ( $f=8$ , 6.45%), masculine or manly ( $f=6$ , 4.84%), sporty or fit ( $f=6$ , 4.84%), and men having a higher female voice ( $f=3$ , 2.42%) or a deep voice ( $f=2$ , 1.61%) in the videos. In terms of body hair and skin color, men are represented as having fair skin ( $f=10$ , 8.06%), being hairy ( $f=3$ , 2.42%), having short ( $f=5$ , 4.03%) and/or dark hair ( $f=10$ , 8.06%), or a beard ( $f=2$ , 1.61%). In addition, male-representing people are shown with the colors white ( $f=3$ , 2.42%) and blue ( $f=1$ , 0.81%), and wearing sunglasses as accessories ( $f=6$ , 4.84%).



**Figure 6.** Men (or persons externally assigned as male) are identified in Study 1 (Simpleclub) with 253 codes (male=79, female=18, gender neutral=156).



**Figure 7.** Males (or persons externally assigned as male) are identified in Study 2 (StudySmarter) with 139 codes (male=22, female=4, gender neutral=113).



**Figure 8.** Exemplary quotes from the participating students about the visual representation of masculine presenting people in the learning apps Simpleclub and StudySmarter.

In the second study, men are more often described in terms of occupations (philosopher  $f=4$ , 3.33%, author  $f=4$ , 3.33%, police officer  $f=3$ , 2.50%) as in study 1. Similar results can be found in the external description of appearance and clothing: men are mainly young ( $f=14$ , 11.67%) or student-age ( $f=4$ , 3.33%), but are also shown older ( $f=14$ , 11.67%). Their clothing consists of a shirt ( $f=5$ , 4.17%), trousers ( $f=4$ , 3.33%), and/or suit ( $f=2$ , 1.67%), and the style is described as modern ( $f=4$ , 3.33%), normal ( $f=2$ , 1.67%), or well-dressed ( $f=3$ , 2.50%). External appearance is described as normal ( $f=8$ , 6.67%), average ( $f=4$ , 3.33%), masculine ( $f=3$ , 2.50%), neat ( $f=2$ , 1.67%), or neutral ( $f=2$ , 1.67%). Men are shown with light skin color ( $f=2$ , 1.67%), white or grey ( $f=3$ , 2.50%) hair, or a beard ( $f=2$ , 1.67%).

### 3.2.2. Representation of Women and Female-Associated Individuals in Learning Apps According to Students

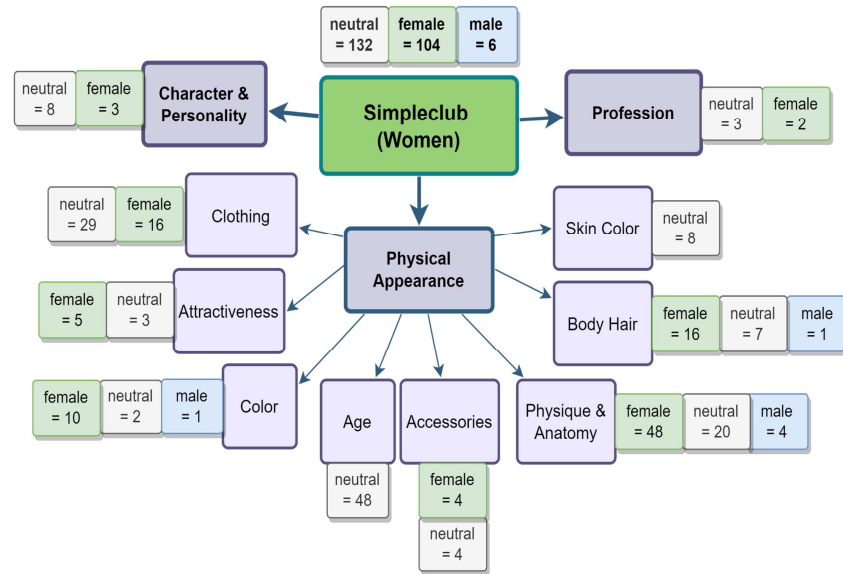
This section shows the results examining the perception of female-associated characters in two learning apps used by Austrian secondary school students. In the case of female-presenting individuals, findings show that in the first study 242 codes were used by the participants for description: 132 neutral, 104 associated with females, and 6 associated with males. The second study had 116: 91 neutral, 19 associated with females, and 6 associated with males (Figures 9-11). In Study 1, female-associated individuals were predominantly represented by their physical appearance, especially with their, physique, age, clothing, and body hair. As in the first study, in the second study, they are mostly described by their physical appearance. Besides their physique and age, female-associated characters are further represented by their character.

The findings in Study 1 revealed that these characters were often depicted as being attracted to men ( $f=1$ , 0.81%), impressed by men ( $f=1$ , 0.81%), and possessing tender traits

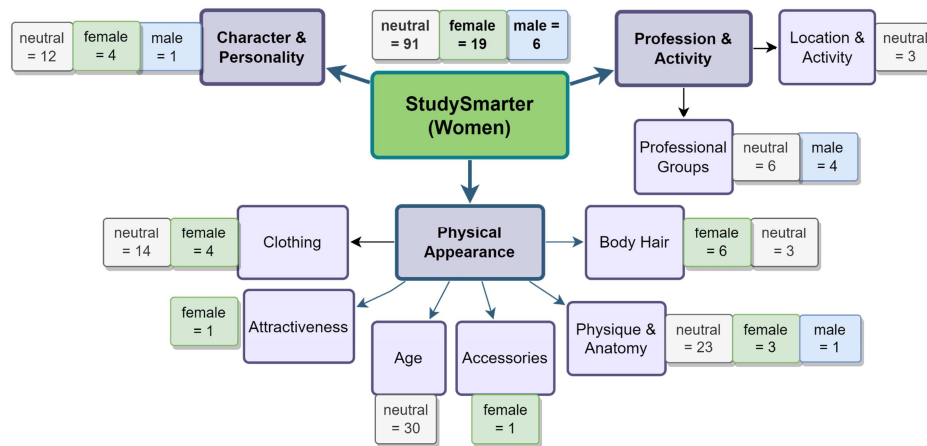
( $f=1$ , 0.81%). In terms of physical appearance, they were frequently portrayed as young ( $f=19$ , 15.32%), dressed in revealing or tight-fitting clothing ( $f=16$ , 12.90%), and conforming to Instagram beauty standards ( $f=3$ , 2.42%). Stereotypical associations were observed, including feminine traits ( $f=5$ , 4.03%) and references to specific female body parts such as breasts and buttocks ( $f=6$ , 4.84%). The characters were also commonly described as beautiful ( $f=5$ , 4.03%) and portrayed with long hair ( $f=10$ , 8.06%). These findings indicate the presence of gender stereotypes and potentially reinforce traditional and sexist representations of women within the learning apps.

The results of Study 2 vary slightly from study 1. Findings showed that in the category of character or personality traits, women were commonly described as friendly ( $f=2$ , 1.67%), tender ( $f=1$ , 0.84%), good ( $f=1$ , 0.84%), nice ( $f=1$ , 0.84%), intelligent ( $f=3$ , 2.5%), positive ( $f=1$ , 0.84%), happy ( $f=2$ , 1.67%), satisfied ( $f=1$ , 0.84%), less famous ( $f=1$ , 0.84%), serious ( $f=1$ , 0.84%), educated ( $f=1$ , 0.84%), and confident ( $f=1$ , 0.84%). In terms of professional groups, women were associated with being employees ( $f=5$ , 4.17%) and academics ( $f=1$ , 0.84%). Regarding physical appearance, they were described as young ( $f=18$ , 15%), middle-aged ( $f=4$ , 3.33%), student-aged ( $f=5$ , 4.17%), and adults ( $f=2$ , 1.67%). They were also associated with various clothing styles such as dresses ( $f=1$ , 0.84%), blouses ( $f=1$ , 0.84%), well-dressed attire ( $f=2$ , 1.67%), and modern clothing ( $f=5$ , 4.17%). In terms of physique and anatomy, women were described as feminine ( $f=1$ , 0.84%), thin or slim ( $f=2$ , 1.67%), while also being recognized as having neutral ( $f=2$ , 1.67%) or average appearances ( $f=10$ , 8.33%). In terms of attractiveness, the perception was that women were beautiful ( $f=1$ , 0.84%). Additionally, women were associated with long hair ( $f=6$ , 5%), and makeup ( $f=1$ , 0.84%) as accessories.

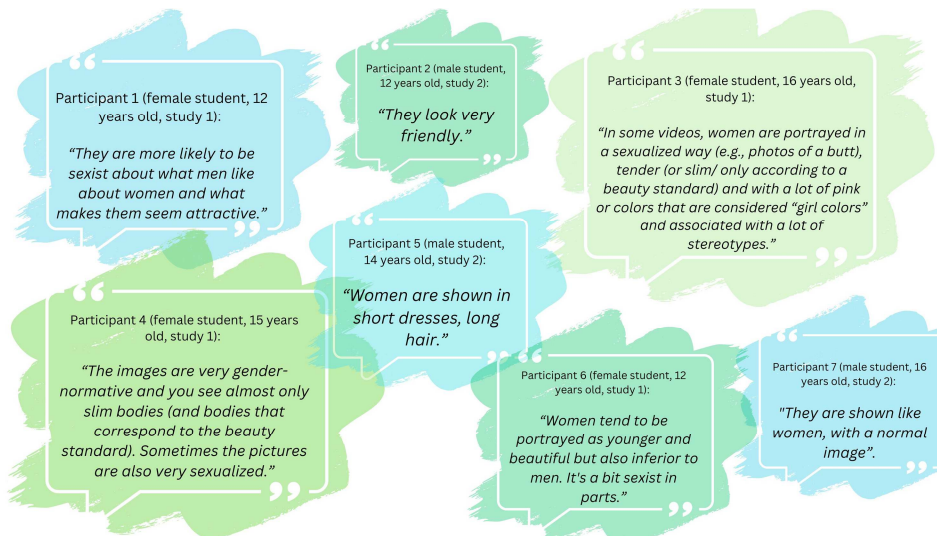




**Figure 9.** Women (or persons externally assigned as female) are presented in Study 1 (Simpleclub) with 242 codes (male=6, female=104, gender neutral=132).



**Figure 10.** Women (or persons externally assigned as female) are presented in Study 2 (StudySmarter) with 116 codes (male=6, female=19, gender neutral=91).



**Figure 11.** Exemplary quotes from the participating students about the visual representation of masculine presenting people in the learning apps Simpleclub and StudySmarter.

### 3.3. Summary

Most students in both studies identified secondary school students, particularly male students, as the main target audience for the two learning apps. A significant percentage of students expressed their willingness to reuse both apps for studying, and they believed their teachers would do the same. When it came to gender-appropriate language in the app's texts, videos, and images, overall, most students had limited recognition of gender-neutral language in the learning apps' content.

In Study 1, the representation of men in the learning app "Simpleclub" focused on their physical appearance, including clothing, age, attractiveness, accessories, skin color, body hair, and body anatomy. Men were often portrayed as young or middle-aged, wearing normal or simple clothing, and having various physical attributes such as slimness, muscularity, and height. The app also associated men with specific accessories like sunglasses. However, the portrayal of women in the app was influenced by gender stereotypes, with emphasis on their attractiveness, revealing clothing, and adherence to Instagram beauty standards. Female characters were frequently described as young, beautiful, and depicted with long hair.

In Study 2, conducted using the learning app "StudySmarter" men were primarily described in terms of their occupations and external appearance. They were associated with professions such as philosophers, authors, and police officers. The portrayal of men's physical appearance was characterized as normal, average, or masculine. The app depicted men with light skin color, various hair colors, and sometimes a beard.

Regarding the perception of secondary school students, both studies indicated the presence of gender stereotypes and underlying sexism in learning apps. Female-associated characters were often described in relation to men, impressed by them or exhibiting tender traits. Their physical appearance, clothing, and adherence to beauty standards were emphasized, reinforcing traditional and potentially sexist representations of women.

## 4. Discussion

This research examined possible gender stereotypes and underlying sexism in two selected learning apps used by Austrian secondary school students (11-18 years), focusing on differences in representation, recognition of gender-neutral language, perception of stereotypical portrayals, and identification of derogatory language. One key finding of the current study was that in both learning apps, a slightly larger proportion of the people depicted were perceived as male. Participants in both studies recognized more male images (or images presented as male) than female images (or images presented as female). Previous observations showed that women or female characters are often underrepresented in various forms of today's media [12, 37, 41]. Furthermore,

several studies have also found a similar pattern in educational resources (e.g., textbooks). For example, several authors have shown that men or boys were generally more frequently featured in school textbooks than women or girls [13, 19, 24, 27].

In addition, a number of studies have reported gender bias in the portrayal of men's and women's occupations in various textbooks [42, 46]. For example, Islam and Asadullah (2018) analyzed the visual content of various textbooks for students and found that women were frequently displayed in traditional gender activities (e.g., domestic work or indoor activities), whereas men were often shown in more prestigious activities and professions [20]. These results are supported by Kerkhoven et al. (2016), who investigated gender representations in online resources for science education [22]. In the course of their research, the authors found that stereotypical representations of men and women were a frequent component in their examined sample. Similar to the previously mentioned studies, the authors not only highlighted the disparity in the number of men and women portrayed but also confirmed that female characters were less likely to be assigned to scientific professions. In summary, these studies as well as the present results appear to outline a consistent picture of gender representation in educational resources. In this context, women are often not only underrepresented in educational media but are also frequently reduced to traditional role models or areas of responsibility.

Another important finding of this study is that men and women were described with stereotypes and clichés regarding their physical appearance, characteristics, and personal traits. For example, male individuals were characterized as "powerful, successful, severe, ambitious, rich or confident", while female individuals were predominantly described as "stereotype, gender normative, cliché or classic feminine". In accordance with the present results, previous studies have demonstrated that female characters in textbooks are attributed to passive personality traits significantly more often than male characters [9, 20]. Moreover, Damigella and Licciardello (2014), who have analyzed gender stereotypes in primary school reading books, note that male characters were given positive personality traits (e.g., courage or sympathy) significantly more often than female illustrations [11]. In addition, the researchers found that female characters exhibited higher levels of negative character traits (e.g., envy or vanity) [11].

Another perspective on this topic was adopted by Hawkins et al. (2019) who argue that gender representations in digital learning games are related to young children's motivations towards using these games (or specific in-game characters) [18]. In their study, the authors found a positive correlation between the children's motivation and certain physical traits of the scientists portrayed. In particular, their results showed that highly masculine depicted male and/or sparsely female-portrayed characters were associated with more motivation for STEM-based learning. However, the researchers also note that the effects of gender expression diminish the older the

study participants become. To some extent, this combination of previous and present results supports the conceptual assumption that women, or rather their personality traits as well as physical characteristics, continue to be represented using gender stereotypes in multiple forms of media today.

A third finding of the study is that a significant proportion of participants in Study 1 stated that gender-derogatory and sexist language was used against all genders in the educational videos. The participants identified sexism mainly in inappropriate jokes, gender-degrading images, embarrassing comics or slogans, and gender-derogatory language used in different videos. Furthermore, female participants were more likely than male participants to notice a lack of gender-inclusive language in texts, graphics, and learning videos as well as the derogatory portrayal of all genders. However, the findings of the current study do not completely support previous research. In contrast to this study, Cendra et al. (2019) argues that especially on the internet, sexist jokes are mainly directed against women [8]. In their study, the authors compared the number and content of several jokes on a selected online platform. Their results showed that about 90% of the analyzed jokes would attack women in a sexist as well as stereotypical way. If these results are considered in light of the findings of the present study, a similar but at the same time contrasting picture emerges. Like Cendra et al. [8], the current data support the view that the humorous content (e.g., jokes, pictures) on the online platforms investigated is predominantly directed against women in a sexist or gender-stereotypical manner. In contrast to those earlier findings, the outlined extent of gender stereotypical jokes could not be confirmed in the context of this study.

#### *Limitations*

There are limitations in this study that could be addressed in future research. First, the composition of the subjects showed a possible gender bias in favour of female participants. Therefore, a more balanced ratio of male and female study participating students could have improved the informative value of the present study. Second, due to the research design, the data collected only illustrate the perceptions and impressions of the study participants. Based on this, future research might focus on more objective study methods, such as visual content analysis. Furthermore, this research was conducted in two Austrian secondary schools, which may limit the generalizability of the findings to other educational contexts. The cultural, social, and educational differences in other countries could influence the perceptions of gender stereotypes and language in learning apps. In addition, this study included 244 students aged 11-18 years, but the demographic information of the participants (e.g., socioeconomic background, cultural diversity) is not provided. The sample may not be representative of the broader population of students, which could impact the external validity of the findings.

Another limitation is the data collection relied on self-reported responses from the students through an online questionnaire. Self-report measures are subject to biases such

as social desirability bias. This bias could affect the accuracy and reliability of the data collected.

This study acknowledges the need for further research on the topic, especially with younger students and teachers. However, the study itself does not provide a comprehensive investigation of the topic, and future research is necessary to build upon these initial findings.

## **5. Conclusion and Outlook**

This study was designed to investigate possible gender stereotypes as well as underlying sexism in two selected learning apps for Austrian secondary school students. The results indicate that (1) the majority of students and teachers of all genders perceived the two learning apps as mainly targeted at or made for male students (target audience), (2) a large proportion of the study participants were not able to identify consistent concepts of gender-neutral language or depiction in texts, videos or graphics, (3) gender-specific portrayals were associated with stereotypical descriptions clichés regarding physical appearance, characteristics, and personal traits and (4) slightly more than half of all study participants could detect derogatory language elements in the learning videos.

In conclusion, the present study found according to the participating students that the two learning apps analysed are predominantly targeting male students and in the apps, males are more represented, especially in a stereotypical way. Similarly, consistent concepts of gender-neutral language and illustrations in texts, videos, or graphics appeared to be absent or poorly perceived. In addition, the study participants assigned the physical appearance, character, and personality traits of the men and women portrayed to a rather stereotypical representation scheme. Also, derogatory language and image elements in the sense of inappropriate jokes, slogans, or gender-degrading images towards both genders were noticed by a majority of the study participants. Taken altogether, the general picture emerging from this study is that digital learning applications should create a more balanced and gender-neutral representation of men and women. Although learning applications and similar digital education programs often reflect only a sheer replication of the prevailing social distribution of both males and females, the goal should be to create balanced representations of both genders, especially in the education sector.

Overall, the findings highlight the great need for more diverse and inclusive representations of both men and women in educational apps to challenge gender stereotypes and promote equality. Furthermore, efforts are needed to improve awareness and implementation of gender-appropriate language in educational materials. These results are important for parents and teachers so that when using the apps, they can address these issues with their children or students.

In 2024, there will be studies with certified learning apps from Austria, in which the materials will be analysed for stereotypes and students will be asked about them. There

have already been talks with the developers of the app Simpleclub. The study will be repeated as a comparison with this app to find out if the representation became more diverse.

## Appendix

The questionnaire is based on a structured questionnaire model using closed-ended and open-ended questions. There are a total of 21 questions (items) in this questionnaire.

Demographic information:

Question 1: Age

Question 2: Gender

Question 3: Occupation (multiple choices possible)

The target audience of the learning app:

Question 4: Target audience of the learning app (multiple choices possible)

Question 5: Use of gender-neutral language in texts

Question 6: Gender representation in spoken learning videos

Question 7: Gender representation in visual representations,

tables, and graphics

Representation of genders in the learning app:

Questions 8 and 9: Presence of images, representations, or photos of males and/or boys

Questions 10 and 11: Presence of images, representations, or photos of females and/or girls

Content and advertising:

Question 12: Linking of advertising or other websites.

Question 13: Topics covered in the linked websites.

Sexist content:

Question 14: Use of sexist language, photos, or graphics in learning videos (multiple choices possible)

Question 15: Description of the sexist content

Usage and acceptance of the learning app:

Question 16: Use of the app outside of school/study/work

Questions 17 and 18: Use of the app by students of any gender

Question 19: Potential disturbances for students

Questions 20 and 21: Use of the app by teachers of any gender and potential disturbances for teachers

**Table 2.** Overview of the codes of gender representation in the two learning apps. The table shows the male descriptions in the app Simpleclub.

Simpleclub: Male descriptions					
Category	Subcategory	Subcategory (f)	Gender	Gender assigned (f)	Codes (f)
Character	Personality and Character Traits	9	m	3	arguing or angry (2) nerdy (1) nice (1) cool (2)
			n	6	outgoing (1) stupid (1) powerful (1)
Profession	Professional groups	3	m	1	technical (1)
			n	2	employee (2) young (20) middle-aged (23)
Physical Appearance	Age	62	n	62	adult (2) old (7) student-age (7) different age (2) not specific (1)
			m	18	shirt (3) T-Shirt (15) jeans (15) normal (12) no clothing or nakedness (6)
	Clothing	48	n	29	trousers (3) business or work clothing (2) casual or simple (2) unobtrusive or not specific (2) pullover (1) different (1) well-dressed (1) muscular, well-trained/built (9) strong (8)
			f	1	tall (8)
	Physique and Anatomy	84	m	42	stereotype, cliché (8) masculine, manly (6) deep voice (2) neutral, normal (10) sporty or fit (6) average (4) simple (1) diverse (1) pejorative (1)
			n	26	

Simpleclub: Male descriptions					
Category	Subcategory	Subcategory (f)	Gender	Gender assigned (f)	Codes (f)
					spherical (1) not muscular (1) fat (1) slim or thin (12) higher or female voice (3) Instagram-ideal (1) handsome (3) attractive (1) short hair (5) hairy or lots of body hair (3) beard (2) gelled hair (1) dark/brown hair (10) long hair (1) light or white (10) sunglasses (6) blue (1) white (3) brown (1)
	Attractiveness	4	f m n	16 3 1	
	Body Hair	22	m n f	11 10 1	
	Skin Color	10	n	10	
	Accessories	6	n m	6 1	
	Colors	5	n	4	

**Table 3.** Overview of the codes of gender representation in the two learning apps. The table shows the male descriptions in the app StudySmarter.

StudySmarter: Male descriptions					
Category	Subcategory	Subcategory (f)	Gender	Gender assigned (f)	Codes (f)
			m	1	heroic (1) ambitious (1) confident (1) serious (1) rich (1) cool (1) unhappy (1) happy (2) intelligent or smart (4) educated (2) police officer (3) philosopher (4) scientist (1) teacher (1) author (4) artist (1) musician (1) academic (1) historic personality (1) waiting (1) sitting (on stairs) (2) standing on the beach (1) using technology (2) working (1) young (14) middle-aged (3) adult (3) old (14) student-age (4) shirt (5) suit (2) normal (2) trousers (4) work clothing (1) simple (2) modern (4) every-day (1) formal (1) civilian (1) historic (1) well-dressed (3) tall (1)
Character	Personality and Character Traits	15	n	14	
Profession and Activity	Professional groups	24	m n	8 9	
	Location or Activity		n	7	
	Age	38	n	38	
Physical Appearance	Clothing	27	m n	7 17	
	Physique and	28	f m	3 4	



StudySmarter: Male descriptions					
Category	Subcategory	Subcategory (f)	Gender	Gender assigned (f)	Codes (f)
	Anatomy				masculine, manly (3) neutral (2) normal (8) neat (2) average (4) diverse (2) comic (2) abstract, unrecognizable, or silhouette (3)
			n	23	
			f	1	thin (1)
			m	2	beard (2)
	Body Hair	5	n	3	White hair (2) grey hair (1)
	Skin Color	2	n	2	light or white (2)

**Table 4.** Overview of the codes of gender representation in the two learning apps. The table shows the female descriptions in the app Simpleclub.

Simpleclub: Female descriptions					
Category	Subcategory	Subcategory (f)	Gender	Gender assigned (f)	Codes (f)
Character	Character or Personality Traits	11	f	3	tender (1) attracted to men (1) impressed by men (1) weak (2) supporting character (2)
			n	8	nice (1) sympathetic (1) unwilling (1) silent (1)
Profession	Professional groups	5	f	2	princess (1) wife (1)
			n	3	office job (2) No profession recognizable (1)
Physical Appearance	Age	48	n	48	young (19) middle-aged (16) student-age (6) old (er) (4) different age (3) dresses (9) tight and/or fitting (2) underwear (3) Bikini (1) well-dressed (1) no clothing or nakedness (7) dressed (2) simple (1) normal (4) revealing (2) jeans (2) T-shirt (4) trousers (1) jacket (1) unobtrusive (2) work clothing (1) diverse (1) insinuating (1) stereotype or cliché (9) female body parts (6) (breast, buttocks) feminine (5) Instagram-ideal or beauty standard (3) thin or slim (19)
			f	16	
Physical Appearance	Clothing	45	n	29	
			f	16	
Physical Appearance	Physique and Anatomy	72	f	48	sexist (3) sexualized (2) pregnant (1) neutral (4) normal (5) simple (1) fit (3)
			n	20	

Simpleclub: Female descriptions					
Category	Subcategory	Subcategory (f)	Gender	Gender assigned (f)	Codes (f)
					not muscular (1) unrecognizable or silhouette (3) average or nothing special (2) diverse (1) spherical (1) tall (4)
	Attractiveness	8	m f n	4 5 3	beautiful (5) attractive (3) long hair (10) long lashes (3) pubic hair (1) med-length hair (1) braided hair (1) blonde hair (1) brown hair (6)
	Body Hair	24	f n	16 7	hairy (1) light or white (8) ribbon (1) earrings (1) makeup (1) heart (1) sunglasses (3) glasses (1) lilac (1)
	Skin Color	8	m n	1 8	pink (7) rose (1) girl color (1) white (1) red (1) blue (1)
	Accessories	8	f n	4 4	
	Colors	13	f n m	10 2 1	

**Table 5.** Overview of the codes of gender representation in the two learning apps. The table shows the female descriptions in the app StudySmarter.

StudySmarter: Female descriptions					
Category	Subcategory	Subcategory (f)	Gender	Gender assigned (f)	Codes (f)
Character	Character or Personality Traits	17	f n	4 12	Friendly (2) Tender (1) Good (1) nice (1) intelligent (3) positive (1) happy (2) satisfied (1) less famous (1) serious (1) educated (1) confident (1) heroic (1)
Profession and Activity	Professional groups	10	m n m	1 6 4	Employee (5) academic (1) police officer (1) corporate partner (3) standing on the beach (1) using technology (1) working (1) young (18) middle-aged (4) student-age (5) adult (2)
	Location or Activity	3	n	3	different age (1) dresses (1) blouse (1) well-dressed (2) no clothing or nakedness (1) simple (1) normal (1)
	Age	30	n	30	
Physical Appearance	Clothing	18	f n	4 14	

StudySmarter: Female descriptions					
Category	Subcategory	Subcategory (f)	Gender	Gender assigned (f)	Codes (f)
					jacket (1) work or business clothing (2) formal (1) modern (5) average (1) every-day (1) feminine (1) thin or slim (2) neutral (2) normal (10) neat (2) sporty (1) not muscular (1) unrecognizable or silhouette (3) average (3) diverse (1) tall (1) beautiful (1) long hair (6) blonde hair (1) brown hair (1) colorful hair (1) Makeup (1)
	Physique and Anatomy	27	f	3	
			n	23	
	Attractiveness	1	m	1	
			f	1	
			f	6	
	Body Hair	9			
			n	3	
	Accessories	1	f	1	

## References

- [1] Altun, D. (2019). Preschoolers' Emergent Motivations to Learn Reading: A Grounded Theory Study. *Early Childhood Educ J* 47, 427–443. <https://doi.org/10.1007/s10643-019-00939-3>
- [2] Andić, B., Kadic, S., Grujicic, R. and Malidžan, D. (2018). A Comparative Analysis of the Attitudes of Primary School Students and Teachers Regarding the Use of Games in Teaching, *IAFOR Journal of Education*, Vol. 6, No. 22, pp. 5–16. <https://doi.org/10.22492/ije.6.2.01>
- [3] Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2013). "Not girly, not sexy, not glamorous": Primary school girls' and parents' construction of science aspirations. *Pedagogy, Culture & Society*, 21 (1), S. 171-194. <https://doi.org/10.1080/14681366.2012.748676>
- [4] Aronson, E., Wilson, T., & Akert, R. (2014). *Sozialpsychologie* (8., aktualisierte Aufl.). Hallbergmoos: Pearson.
- [5] Blumberg, R. L. (2007). Gender bias in textbooks: A hidden obstacle on the road to gender equality in education. Paris: Unesco. <http://unesdoc.unesco.org/images/0015/001555/155509e.pdf>
- [6] BMBWF (Federal Ministry of Education, Science and Research). (2020). Seal of Quality for Learning Apps. Retrieved 08.08.2022 from Gütesiegel Lern-Apps ([bmbwf.gv.at](http://bmbwf.gv.at)).
- [7] Brian, L., Leslie, S. J., & and Cimpian, A. (2017). Gender stereotypes about intellectual ability emerge early and influence children's interests. *Science*, 355, S. 389-391. <https://doi.org/10.1126/science.aah6524>
- [8] Cendra, A. N., Triutami, T. D., & Bram, B. (2019). Gender stereotypes depicted in online sexist jokes. *The European Journal of Humour Research*, 7 (2), 44-66. <https://doi.org/10.7592/EJHR2019.7.2.cendra>
- [9] Concordă, E. (2018). Gender stereotypes in school textbooks. *Revista Românească pentru Educație Multidimensională*, 10 (4), S. 65-81. <https://doi.org/10.18662/rrem/73>
- [10] Cohen, M. Z., Kahn, D. L., & Steeves, D. L. (2000). *Hermeneutic phenomenological research: A practical guide for nurse researchers*. Thousand Oaks, CA: Sage Publications.
- [11] Damigella, D., & Licciardello, O. (2014). Stereotypes and prejudices at school: A study on primary school reading books. *Procedia-Social and Behavioral Sciences*, 127, S. 209-213. <https://doi.org/10.1016/j.sbspro.2014.03.242>
- [12] Dudo, A., Dunwoody, S., & Scheufele, D. A. (2011). The emergence of nano tracking thematic trends and changes in US newspaper coverage of nanotechnology. *Journalism and Mass Communication Quarterly*, 88 (1), S. 55-75. <https://doi.org/10.1177/107769901108800104>
- [13] Elgar, A. G. (2004). Science textbooks for lower secondary schools in Brunei: issues of gender equity. *Int J Sci Educ*. 2004, 26 (7), S. 875-894. <https://doi.org/10.1080/0950069032000138888>
- [14] Gangaiamaran, R., & Pasupathi, M. (2017). Review on use of mobile apps for language learning. *International Journal of Applied Engineering Research*, 12 (21), 11242-11251.
- [15] Glaser, B., & Strauss, A. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Mill Valley, CA: Sociology Press.
- [16] Hannover, B., & Kessels, U. (2004). Self-to-prototype matching as a strategy for making academic choices. Why high school students do not like math and science. *Learn Instr.*, 14 (1), S. 51-67. <http://dx.doi.org/10.1016/j.learninstruc.2003.10.002>
- [17] Harrison, T. R. & Lee, H. S. (2018). iPads in the mathematics classroom: Developing criteria for selecting appropriate learning apps. *International Journal of Education in Mathematics, Science and Technology (IJEMST)*, 6 (2), 155-172. <https://doi.org/10.18404/ijemst.408939>

- [18] Hawkins, I., Ratan, R., Blair, D., & Fordham, J. (2019). The effects of gender role stereotypes in digital learning games on motivation for STEM achievement. *Journal of science education and technology*, 28 (6), S. 628-637. <https://doi.org/10.1007/s10956-019-09792-w>
- [19] İncikabı, L., & Ulusoy, F. (2019). Gender bias and stereotypes in Australian, Singaporean and Turkish mathematics textbooks. *Turkish Journal of Education*, 8 (4), S. 298-317. <https://doi.org/10.19128/turje.581802>
- [20] Islam, K. M. M.; Asadullah, M. N. (2018). Gender stereotypes and education: A comparative content analysis of Malaysian, Indonesian, Pakistani and Bangladeshi school textbooks. *PLoS ONE*, 13 (1): e0190807. <https://doi.org/10.1371/journal.pone.0190807>
- [21] Kerger, S., Martin, R., & Brunner, M. (2011). How can we enhance girl's interest in scientific topics? *Brit J Educ Psychol.*, 81 (4), S. 606-628. <https://doi.org/10.1111/j.2044-8279.2011.02019.x>
- [22] Kerkhoven, A., Russo, P., Land-Zandstra, A., Saxena, A., & Rodenburg, F. (November 2016). Gender Stereotypes in Science Education Resources: A Visual Content Analysis. *PLoS ONE*, 11 (11), S. e0165037. <https://doi.org/10.1371/journal.pone.0165037>
- [23] Law, F., McGuire, L., Winterbottom, M., & Rutland, A. (2021). Children's Gender Stereotypes in STEM Following a One-Shot Growth Mindset Intervention in a Science Museum. *Frontiers in Psychology*, 12, 641695. <https://doi.org/10.3389/fpsyg.2021.641695>
- [24] Lumerding, B. (2020). Geschlechterstereotype und Diskriminierung in Schulbüchern unter Bezugnahme auf die UN-Frauenrechtskonvention/eingereicht von Mag Birgit Lumerding (Doctoral dissertation, Universität Linz). <https://epub.jku.at/obvulihs/download/pdf/5118218?originalFilename=true>
- [25] MacKenzie, D.; Wajcman, J. (1999). *The social shaping of technology*. Buckingham: Open University Press.
- [26] Masters, A. (2021). Gender Stereotypes Influence Children's STEM Motivation. *Child Development Perspectives* 15 (3). <https://doi.org/10.1111/cdep.12424>
- [27] Moser, F., & Hannover, B. (2014). How gender fair are German schoolbooks in the twenty-first century? An analysis of language and illustrations in schoolbooks for mathematics. *Eur J Psychol Educ.*, 29 (3), S. 387-407. <https://doi.org/10.1007/s10212-013-0204-3>
- [28] Mulvey, K., & Irvin, M. (2018). Judgements and reasoning about exclusion from counter-stereotypic STEM career choices in early childhood. *Early Child. Re. Q.*, 44, S. 220-230. <https://doi.org/10.1016/j.ecresq.2018.03.016>
- [29] Narahara, M. (1998). Gender stereotypes in children's picture books. East Lansing, MI: National Center for Research in Teacher Learning. (ERIC Document Reproduction Service No. ED419248).
- [30] Schmidthaler, E., Andic, B., Schmollmüller, M., Sabitzer, B., and Lavicza, Z. (2023). Mobile Augmented Reality in Biological Education: Perceptions of Austrian Secondary School Teachers', *Journal on Efficiency and Responsibility in Education and Science*, vol. 16, no. 2, pp. 113–127. <https://doi.org/10.7160/eriesj.2023.160203>
- [31] Schmidthaler, E., Hörmann, C., Rottenhofer, M., Sabitzer, B., and Lavicza, Z. (2023). The implementation of learning apps in biological education: a quantitative study of the current situation in Austria, *Journal of Research in Innovative Teaching & Learning*, Vol. ahead-of-print No. ahead-of-print. <https://doi.org/10.1108/JRIT-12-2022-0094>
- [32] OeAD (Agency for Education and Internationalization). *Learning App*. (2021). Retrieved 08.08.2022 from [LernApps \(oead.at\)](https://lernapps.oead.at).
- [33] Reuben, E., Sapienza, P., & Zingales, L. (2014). How stereotypes impair women's careers in science. *Proc. Natl. Acad. Sci.*, 111, S. 4403-4408. <https://doi.org/10.1073/pnas.1314788111>
- [34] Sadker, D., Zittleman, K., Earley, P., McCormick, T., Strawn, C., & Preston, J. (2007). The treatment of gender equity in teacher education. In B. R. S. S. Klein, *Handbook for achieving gender equity through education*. (S. 131-149). Routledge.
- [35] Schuster, C., & Martiny, S. E. (2017). Not feeling good in STEM: effects of stereotype activation and anticipated effect on women's career aspirations. *Sex Roles*, 76, S. 40-55. <https://doi.org/10.1007/s11199-016-0665-3>
- [36] Sheldon, J. P. (2004). Gender Stereotypes in Educational Software. *Sex Roles*, 51 (7-8), S. 433-444. <https://doi.org/10.1023/B:SERS.0000049232.90715.d9>
- [37] Singh, V. K., Chayko, M., Inamdar, R., & Floegel, D. (2020). Female librarians and male computer programmers? Gender bias in occupational images on digital media platforms. *Journal of the Association for Information Science and Technology*, 71 (11), S. 1281-1294. <https://doi.org/10.1002/asi.24335>
- [38] Spencer, S., Steele, C., & Quinn, D. (1998). Stereotype threat and women's maths performance. *J. Exp. Soc. Psychol.*, 35, S. 4-28. <https://doi.org/10.1006/jesp.1998.1373>
- [39] Strauss, A. & Corbin, J. (1990). *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Newbury Park, CA: Sage Publications.
- [40] Steinke, J., & Long, M. (1996). A lab of her own? Portrayals of female characters on children's educational science programs. *Science Communication*, 18 (2), S. 91-115. <http://dx.doi.org/10.1177/1075547096018002001>
- [41] Thelwall, M., & Mas-Bleda, A. (2018). YouTube science channel video presenters and comments: Female friendly or vestiges of sexism?. *Aslib journal of information management*. <https://doi.org/10.1108/AJIM-09-2017-0204>
- [42] Ullah, H.; Skelton, C. (2013). Gender representation in the public sector schools textbooks of Pakistan. *Educational Studies*, 39 (2), S. 183-194. <https://doi.org/10.1080/03055698.2012.702892>
- [43] Vetter, T. R. (2017). Descriptive Statistics: Reporting the Answers to the 5 Basic Questions of Who, What, Why, When, Where, and a Sixth, So What? *Anesth Analg*. 125 (5). 1797-1802. <https://doi.org/10.1213/ANE.0000000000002471>
- [44] Yücel, Y., & Rızvanoğlu, K. (2019). Battling gender stereotypes: A user study of a code-learning game, "Code Combat," with middle school children. *Computers in Human Behavior*, 99, S. 352-365. <https://doi.org/10.1016/j.chb.2019.05.029>

- [45] Zammuner, (1993). Bulletin of the Psychonomic Society /993, 3/ (2), 87-90 Perception of male and female personality attributes and behaviors by Dutch children; BF03334147.pdf (springer.com).
- [46] Zittleman K, Sadker D. (2002). Gender bias in teacher education texts: New (and old) lessons. J Teach Educ., 53 (2), S. 168-180. <https://doi.org/10.1177/0022487102053002008>