Consulting Report

Project 6 (Group A)

Consulting Team 7

Executive Summary

This report was commissioned to analyse the effect of students' clothing and gender on the student-teacher interaction in an educational institution. The research draws attention to the gender and clothing type of the student having a significant impact on the number and type of interactions between the student and the teacher. Male students are likely to have more interactions, as well as more positive interactions with the teacher, than female students. On the other hand, students wearing special clothing are likely to have more interactions with the teacher, while students wearing unisex clothing are likely to have more positive interactions with the teacher, compared to students wearing other types of clothing. Further investigations of the combined effect of the students' gender and clothing type on the student-teacher interactions reveal that male students wearing standard or unisex clothing are likely to have more interactions, as well as more positive interactions with the teacher.

*Page count (excluding the cover page and table of contents) = 10

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1. Introduction

An educational institution would like to understand the effect of students' clothing on the interaction between students and teachers, in order to formulate appropriate policies that would improve the quality of interaction between students and teachers. The institution has conducted a controlled experiment in which they observed the interaction between several students and a specific teacher, and collected data about the student's clothing type, gender, the number of interactions between that student and the teacher, and the type of interaction (from the perspective of the data collector). The main label of each interaction is the type of interaction, which is either classified as positive or negative.

Data Sapiens was contacted to analyse this data and answer the two main research questions: (I) **"What is the individual effect of a student's *gender* and *clothing type* on the count and the type of interaction with the teacher?"** And (II) **"Do the *gender* and *clothing type* of a student have a combined effect on the student's interaction with the teacher?"**

We will first conduct an exploratory data analysis to identify the underlying patterns between the students' gender and clothing type, and the number/type of interaction with the teacher, and then formulate our hypothesis based on these observations. Finally, we will generate a statistical model to answer our research questions.

1.1. Data Description

Our analysis is based on a dataset made available by the client himself. The data consists of a collection of 462 observations.

Each observation contains 4 different fields:

(1) The clothing type of the student - *special, standard or unisex*

(2) the interaction type - *positive or negative*

(3) the number of interactions between the student and the teacher (counted by the data collector)

(4) the gender of the student - *male or female*

1.2. Analysis Approach

We will use a two-step approach to analyse the data: (1) data exploration, and (2) the Analysis of Variance (ANOVA) model. In data exploration, we visualize the data to recognize any underlying patterns and use this to formulate our hypothesis. For example, we may observe that: "the teacher seems to have more positive interactions with male students than female students". Then we will use the ANOVA model to verify if our observations in the previous step were a coincidence or factual evidence establishing a statistical relationship between the variables and the student-teacher interaction.

*Note: We determine if an effect is statistically significant or not based on the margin of difference found in the ANOVA model. A hypothesis is considered statistically insignificant if we are not able to determine if the pattern observed is due to real statistical reasoning, or just a coincidence, with enough confidence using the given data.

2. Results

2.1. Primary Research Question

The first question we want to answer is: "**What is the individual effect of a student's *gender* and *clothing type* on the count and the type of interaction with the teacher?**" We will do this by analysing the (1) Effect of students' gender on the number of interaction, (2) Effect of students' gender on the type of interaction, (3) Effect of students' clothing type on the number of interaction, (4) Effect of students' clothing type on the type of interaction

2.1.1. Effect of Student's Gender on the number of interactions

We can observe from Figure 1 that there are slightly more observations of *male* students than *female* students in the collected dataset. Though the overall shape of the distribution of the number of interactions in Figure 2 seems to be similar for both genders, the peak of the distribution curve for *male* students seems to be higher than that of *female* students. This leads us to a **hypothesis that a *male* student, on average, has more interactions than a *female* student**. We can verify our hypothesis with the ANOVA model in Figure 3.

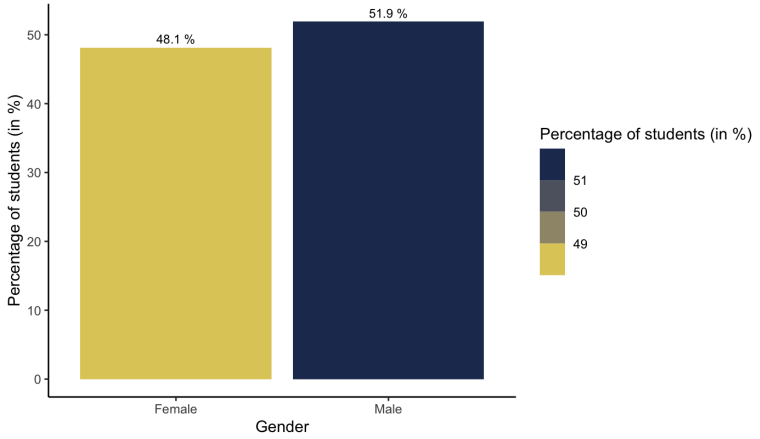

Figure 1: Distribution of Students' Gender in the dataset

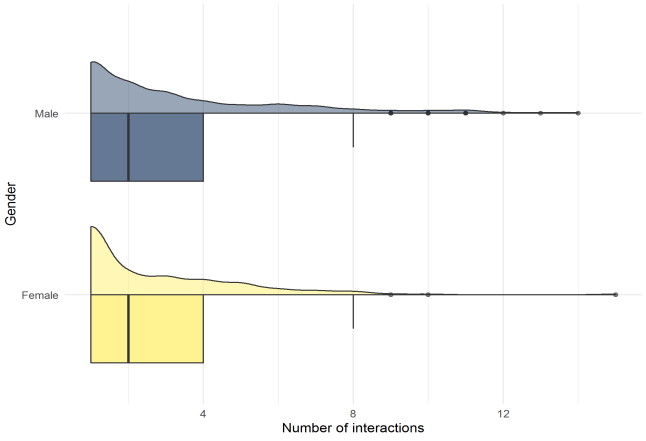

Figure 2: Distribution of the number of interactions by Gender

The ANOVA model in Figure 3 below shows that the average number of interactions for a woman is 2.59, whereas it is 3.27 for a man. This validates our hypothesis that **there is a significant difference in the average number of interactions between students based on their gender.** In other words, ***male* students have more chances of having an interaction with the teacher than *female* students.**

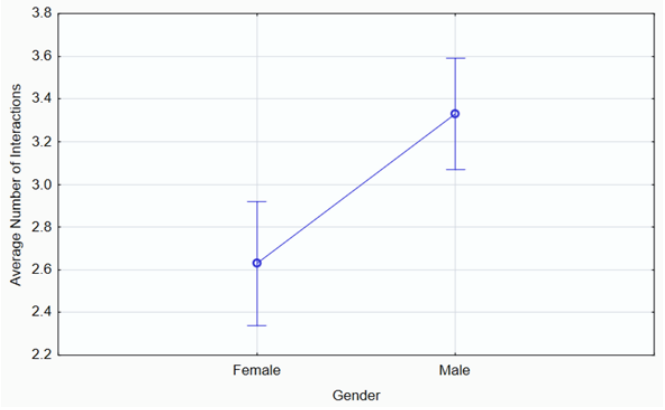

Figure 3: ANOVA analysis for Number of Interactions vs. student's Gender

2.1.2. Effect of Student's Gender on the type of interaction

Male students make up a larger proportion of interactions of both positive and negative types, as shown in Figure 4 and Figure 5 below.

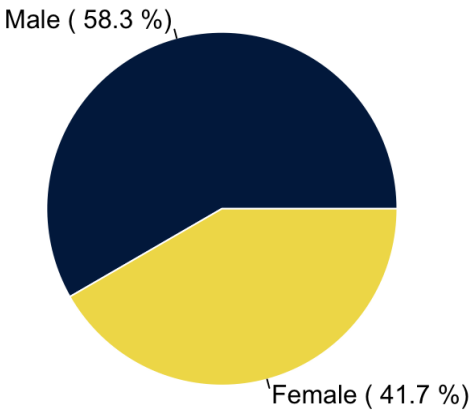

Figure 4: Distribution of positive interactions by Gender

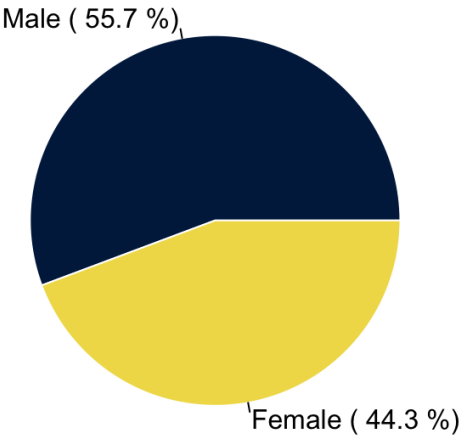

Figure 5: Distribution of negative interactions by Gender

Within each gender, the proportion of positive interactions is more than that of negative interactions, as shown in Figure 6 and Figure 7 below. However, the proportion of positive interactions within male students (75.3%) is still larger than the proportion of positive interactions within female students (73.3%). This leads us to a **hypothesis that male students are more likely to have positive interactions than female students**. We can verify our hypothesis with the ANOVA model in Figure 8.

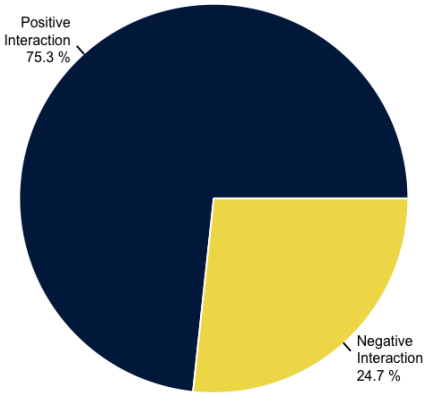

Figure 6: Distribution of type of interaction for Male students

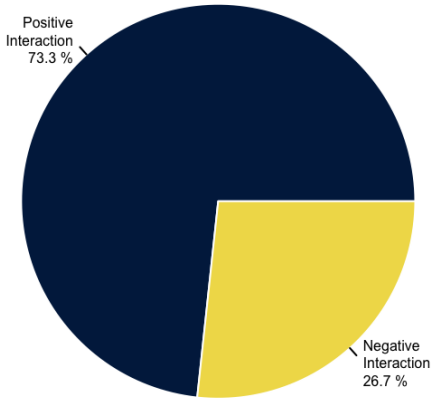

Figure 7: Distribution of type of interaction for Female students

The ANOVA model in Figure 8 below shows that there is indeed a significant impact of a student's gender on the interaction type. **A *male* student has, on average, a better chance of having a *positive* interaction with the teacher, than a *female* student.** However, when it comes to the students having a negative interaction with the teacher, the gender of the students does not have a statistically significant effect.

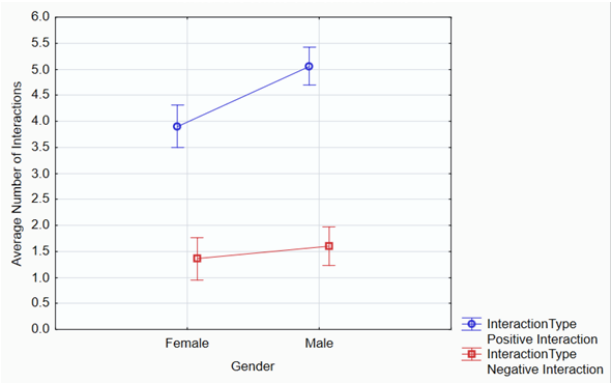

Figure 8: ANOVA analysis for the Type of Interaction vs. student's Gender

2.1.3. Effect of Student's Clothing type on the number of interactions

As seen in Figure 9 below, the students with a *special* type of clothing have the maximum number of interactions, followed by those with a *standard* type of clothing, and finally, those with *unisex* clothing have the least number of interactions. This leads us to the **hypothesis that the type of clothing has an impact on the number of interactions between the student and the teacher**. We can verify our hypothesis with the ANOVA model in Figure 10.

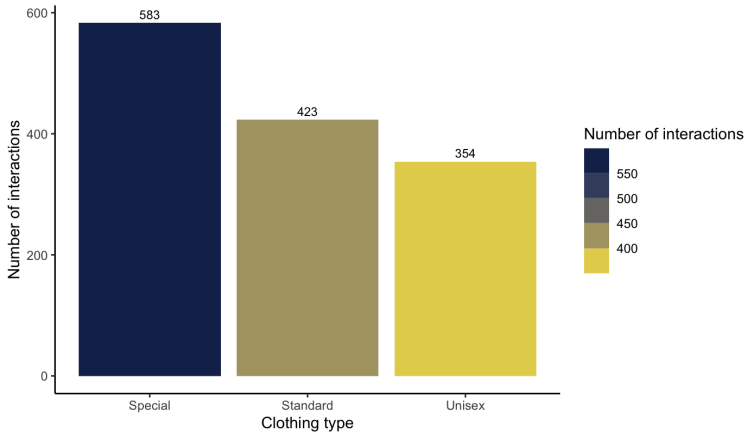

Figure 9: Number of Interactions by students' Clothing Type

The ANOVA model in Figure 10 below proves that there is a difference between the average number of interactions for each clothing type. However, this difference between each clothing type is not statistically significant. Hence, we can conclude that **though the student's clothing type affects the number of interactions they have with the teacher, the effect is not very significant.**

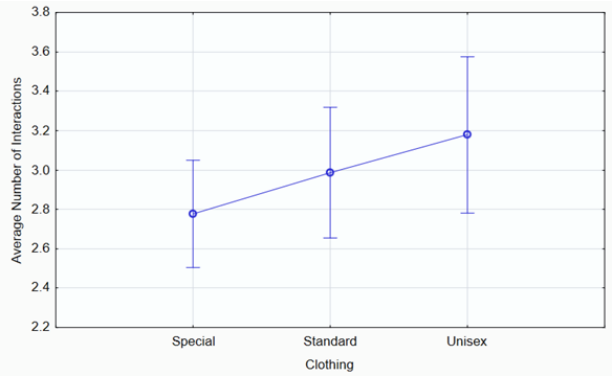

Figure 10: ANOVA analysis for the number of interactions by students' Clothing Type

2.1.4. Effect of Student's Clothing type on the type of interaction

From Figures 11 and 12 below, we can see that students with *special* clothing types make up the largest share of both positive and negative interactions. Conversely, students with *unisex* clothing type make-up the smallest share of both positive and negative interactions. In order to delve deeper into the relationship between the student's clothing type and the type of interaction they have with the teacher, let us also analyze the distribution of positive and negative interactions for students of each clothing type.

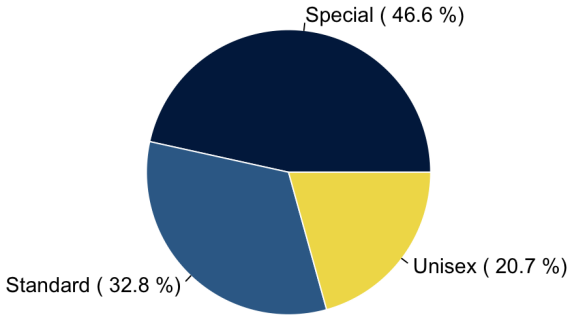

Figure 11: Distribution of positive interactions by students' Clothing Type

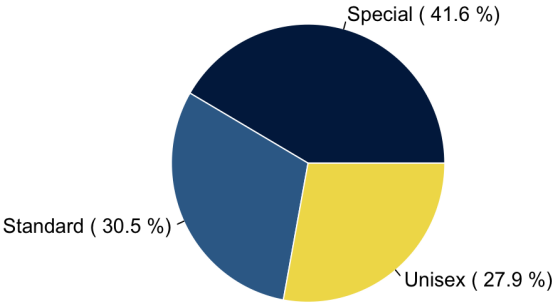

Figure 12: Distribution of negative interactions by students' Clothing Type

Students with *unisex* clothing type have the largest share of *positive* interactions (79.7%) as seen in Figure 15, followed by those with *standard* clothing type (73%) as seen in Figure 14. Finally, those with *special* clothing type (72.2%) have the least share of *positive* interactions as seen in Figure 13. An interesting point to note here is that though students with *special* clothing type make up the largest proportion of students in the data, they have the least share of *positive* interactions, compared to the students of other clothing types. Likewise, students with *unisex* clothing type make up the smallest proportion of students in the data, however, they have the largest share of positive interactions, compared to the students of other clothing types. This leads us to the **hypothesis that students with *unisex* clothing type (though lesser in number) have more chances of having a positive interaction with the teacher, than those with *standard clothing* type, who in turn have more chances of positive interaction with the teacher than those with *special* clothing type**. We can verify our hypothesis from the ANOVA model in Figure 16.

Figures 13-15: Distribution of positive and negative interactions by students' Clothing Type

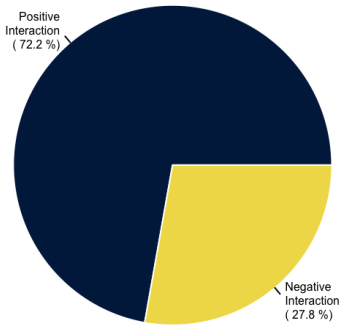

Figure 13: Special Clothing

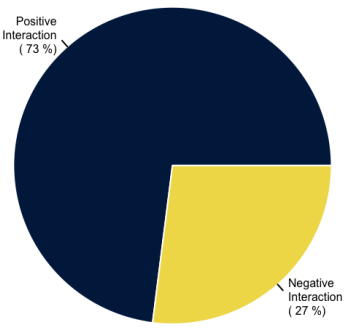

Figure 14: Standard Clothing

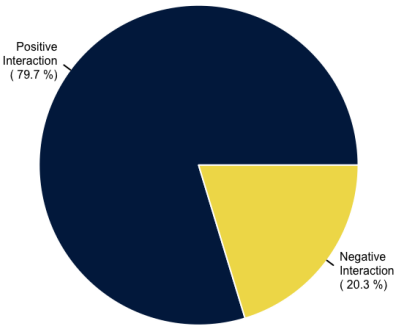

Figure 15: Unisex clothing

The ANOVA model in Figure 16 **confirms our hypothesis that the students wearing unisex clothing are more likely to have a positive interaction with the teacher.** Though we can observe differences in the type of interactions even for students wearing other types of clothing, the difference is not statistically significant enough to be taken into consideration.

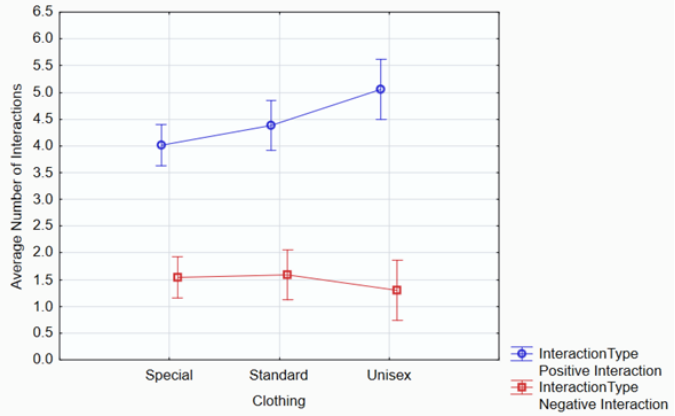

Figure 16: ANOVA analysis for the type of interaction by students' Clothing Type

2.2. Secondary Research Question

The second question we want to answer is: "**Do the *gender* and *clothing type* of a student have a combined effect on the student's interaction with the teacher?**" To do this, we will first analyze the combined effect of the students' gender and clothing type on the number of interactions with the teacher, and then we will analyze the combined effect of the students' gender and clothing type on the type of interaction with the teacher.

2.2.1. Combined effect of Student's Gender and Clothing Type on the number of interactions

In Figure 17, we can see that for all clothing types, **male students are more likely to interact with the teacher** than female students. The **difference in the number of interactions between the male and female students is bigger for those with unisex and standard clothing than with special clothing**. Another observation is that both males and females with special clothing are more likely to interact with the teacher than the other students. Amongst the students with special clothing, male students have slightly better chances of interacting with the teacher than female students.

We can verify our hypotheses with the ANOVA model in Figure 18.

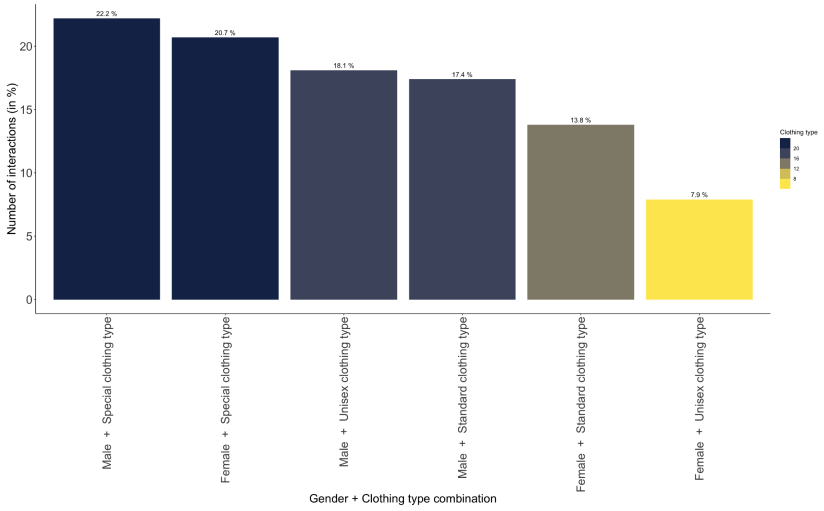

Figure 17: Number of interactions by the student's Gender + Clothing Type

The ANOVA model in Figure 18 below **proves our hypothesis that male students are likely to have more interactions with the teacher than female students**, irrespective of their clothing type. However, the **difference in the average number of interactions between male and female students wearing special clothing** is so small

that it **is statistically not significant**. The combined effect of gender and clothing type is stronger for students wearing standard clothing, followed by those wearing unisex clothing.

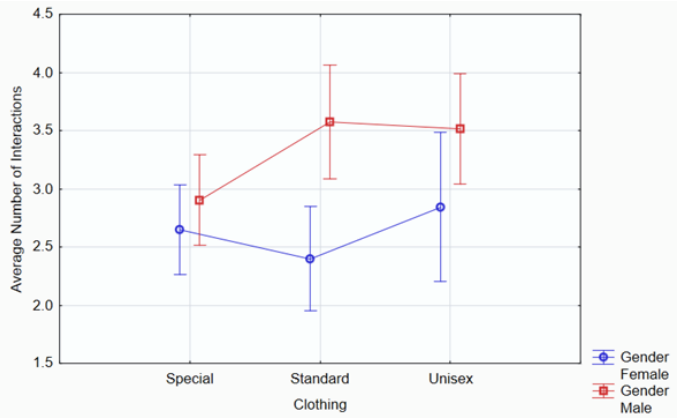

Figure 18: ANOVA analysis for the number of interactions by students' Gender and Clothing Type

2.2.2. Combined effect of Student's Gender and Clothing Type on the type of interaction

In Figure 19, we can see that the pattern of students' clothing type and gender for positive interactions is exactly the same as that of the pattern of a number of interactions, clothing type, and gender in Figure 17 (though the percentage values are different).

However, the pattern of students' clothing type and gender for negative interactions is quite different, as observed in Figure 20. **Students with special clothing are more likely to have a negative interaction with the teacher, followed by those with standard clothing and unisex clothing (for both genders)**. **Within each gender, male students are more likely to have a negative interaction with the teacher than female students for those with special and unisex clothing.** Only for **standard clothing**, the **female students are more likely to have a negative interaction** with the teacher than the male students. We can verify our hypotheses using the ANOVA model in Figure 21.

Figures 19-20: Distribution of the number of interactions based on students' gender+clothing type

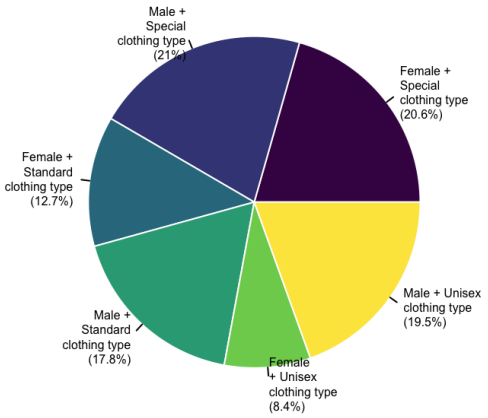

Figure 19: Positive Interactions

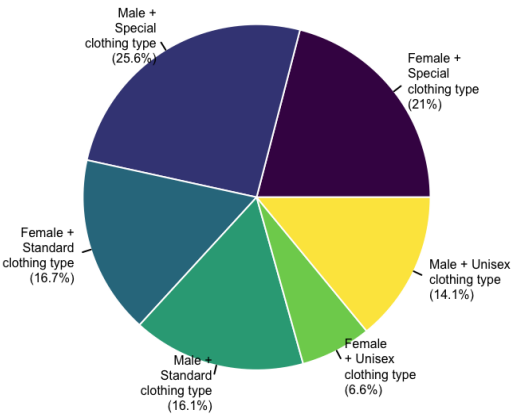

Figure 20: Negative Interactions

The ANOVA model in Figure 21 shows that the **combined effect of gender and clothing type on the type of interaction is statistically significant only for students wearing standard clothing and unisex clothing** (also **only for positive interactions**). For the rest, though the combined effect of gender and clothing type on the type of interaction is visible. However, it is not enough to be taken into consideration.

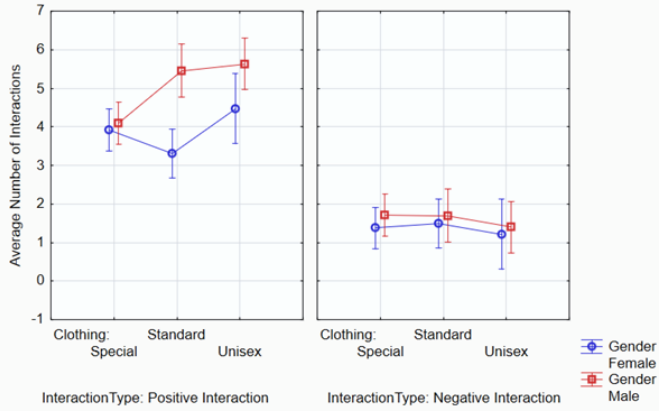

Figure 21: ANOVA analysis for Type of Interaction based on students' Clothing Type + Gender

2.3. Additional Remarks

Having observed the relationship between the student's characteristics and the number/type of interaction, let us also analyse the number and type of interactions to see if there is any significant relationship between the two. (Note: This is an additional analysis, not related to our primary/secondary research questions).

From Figure 22, we can see that **as the number of interactions with the teacher increases the proportion of *positive* interactions increases as well. If a student has had more than 6 interactions with the teacher, then all of his interactions are positive in nature.** We can verify our hypothesis using the ANOVA model in Figure 23 below.

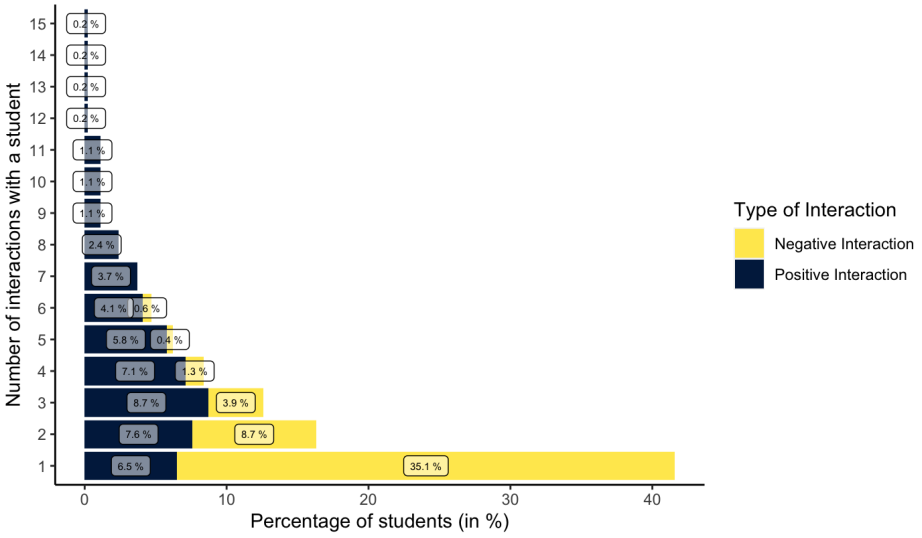

Figure 22: Relationship between the Type and Number of interactions

The ANOVA model in Figure 23 confirms our hypothesis that **there is a (positive) relationship between the number and type of interactions**. This means that as the number of interactions increases, more proportion of the interactions become positive.

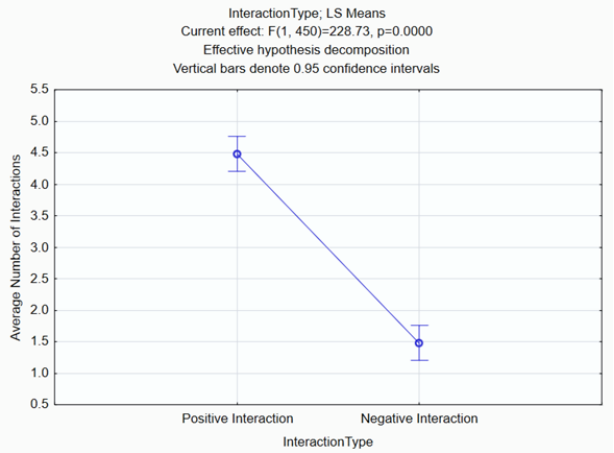

Figure 23: ANOVA analysis of Number of Interactions vs. Type of Interaction

3. Conclusion

The main purpose of this research was to identify the key factors that affect the interactions between students and teachers in an educational institution. In order to carry out this analysis in a scientific manner, we had first identified 2 research questions that need to be answered. We will formulate our recommendations and possible improvements for the research, based on the findings for these 2 research questions.

3.1. Summary of findings

1. What is the individual effect of a student's gender and clothing type on the number and type of interaction with the teacher?
    - The **gender** of the student is important to the interaction he/she has with the teacher. **Male students** are likely to have **more interactions**, as well as, **more positive interactions** than female students.
    - The **clothing type** of the student is also important to the interaction he/she has with the teacher. While the students wearing ***special* clothing** are likely to have **more interactions** with the teacher, they are also **least likely to have positive interactions** with the teacher, compared to students wearing other types of clothing. Conversely, while the students wearing ***unisex* clothing** are **most likely to have positive interactions** with the teacher, they are also likely to have **lesser interactions** with the teacher, compared to students wearing other types of clothing.
2. Do the gender and clothing type of a student have a combined effect on the student's interaction with the teacher?
    - Only students wearing standard/unisex clothing face a significant effect of their gender and clothing type on the interactions they have with the teacher.
    - **Male students wearing standard or unisex clothing are likely to have more interactions, as well as more positive interactions** with the teacher than the female students wearing the same type of clothes.

3.2. Recommendations

Based on the research findings, we would like to propose the following recommendations to improve the quality of student-teacher interactions in the educational institute:

1. Communicate about the underlying gender bias in student-teacher interactions with the faculty and encourage them to maintain equality in their interactions with the students (i.e. split their time equally between male and female students, and also consciously stop any gender-bias from affecting the type of interaction they have with the student)
2. Analyse the performance of the students (especially male students with special clothing) in their course, to see if the less number of positive interactions with the teacher affects their learning.

3.3. Limitations and further improvements in the research

The potential of this study can be improved by addressing the following limitations in the current research:

1. **Limitation:** The student-teacher interaction has been assessed by a single observer, in the current dataset. The interpretation of variables such as the student's clothing type, and type of interaction between the student and the teacher, is highly subjective and may also be influenced by personal bias of the observer. As such, the trends observed in the dataset may be influenced by the observer's interpretations of the interactions, which in turn reduces the reliability of the dataset.

   Improvement: Perform the data collection with multiple observers of diverse backgrounds. This randomized approach would improve the reliability of the dataset and reduce the effect of individual biases of any one specific observer.

2. **Limitation:** The existing dataset does not have any information regarding the day/time when the interaction was recorded. There may be trends in the student-teacher interaction caused by the day/time when they interacted, which is not taken into account in the current research. Identification of such trends would be helpful to the educational institution while reasoning out any specific behaviour of the students/teacher.

   Improvement: Perform the data collection across different days, with the same set of students and teacher (with a randomly assigned observer). This would allow us to recognize any time-based patterns in the behavior of the student/teacher that influences their interactions, and also removes any bias caused by the situation in which the data was collected (if it was collected only on a single day). Include information about the day/time of the interaction in the dataset.

3. **Limitation:** There is no unique identifier (e.g. student code) for each student in the existing dataset. There may be confounding factors such as the teacher's like or dislike towards a specific student, influencing the type and number of interactions between the teacher and the student. However, since we have no information regarding the student's identity, we cannot account for the presence of any outliers (i.e. special students who are affected by a strong like/dislike by the teacher) that may sway the overall results.

   Improvement: The observer can either include a unique identifier (such as the student code or a specific number assigned to each student for the purpose of this research) in the dataset during data collection, or simply record each student as a unique row in the dataset (thereby, removing the need for a unique identifier). In either of the two scenarios, we can segregate the observations based on the student, and identify any extreme observations made for a single/subset of students, that influences the overall analysis.

Additional remark: If the institution wants to make institute-wide policies based on this experiment, it is strongly advised that more teachers (of diverse backgrounds) are included in the data-collection, to avoid individual bias. All the results and conclusions of this report is based, and restricted, on the data collected using a single teacher, by the institute.