

Exploring parents' perceptions of sex education pedagogy in Moroccan schools using an association rules mining-based algorithm

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ABSTRACT

Sex education is vital for promoting healthy relationships and preventing sexual exploitation by teaching boundaries, consent and abuse recognition. Customized strategies are needed for children, balancing age-appropriate content with parental and community perspectives. Our study assessed Moroccan parents' views on sex education's adoption in schools. Conducted in Taza city, the survey targeted 1946 parents of students over 7 years old. Using association rule mining (ARM), we analyzed their responses. Therefore, Apriori algorithm was implemented to discover strong association rules within parents' selected responses. Results showed that 74.53% of parents aged 19-30 support sexual education, citing its absence as a factor in child abuse. Meanwhile, 60.48% of those aged 31-59 with university education believe psychological disorders contribute to assaults. While some fathers (32.48%) and some mothers (67.52%) support sexual education, others don't, but all agree on restricting children's internet use until age 16 to avoid harmful content. These findings can inform comparative studies, aid decision-makers and enhance AI-based EdTech systems by offering insights into sex education perceptions.

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1. INTRODUCTION

Sexuality education goes beyond biological sex to include gender identity, sexual development, intimacy, and body image for all teenagers [1], [2]. It addresses attitudes and values around consent, gender, and relationships, influenced by ethnic, cultural, and personal factors [3]. Nonetheless, ethnic, racial, cultural, personal, religious, and moral considerations all have an impact on sexuality education [4], which may be overlooked by current school-based approaches [5].

In Moroccan society, strict views on sexuality and gender roles often render discussions of sex education and sexual abuse taboo [6], [7], making it a sensitive and rarely taught subject in schools [8]. For instance, 7% of boys and 24% of girls report sexual abuse [9], with 52% of perpetrators being family members and 80% known to the victims. Despite this, comprehensive sexuality education is not widely integrated into the national curriculum [10], and existing research primarily focuses on adolescents, often neglecting younger teenage children [11], [12].

Many studies in sex education and health well-being have examined how cultural and social contexts shape educational practices and perceptions. For instance, a previous research on Beijing parents [13] explored their responses to child sexual abuse, highlighting how cultural attitudes influence their approaches. A similar study on Bugis-Makassar communities [14] investigated how traditional norms impact parental strategies for sexual education. Meanwhile, several Moroccan literature reviews [6], [7], [15] discussed the challenges and barriers affecting sexual and reproductive health education such as stigma and resource limitations. Furthermore, Selmaoui *et al.* [16] conducted an analysis of Moroccan teachers' conceptions, revealing how cultural and social norms influence their attitudes and approaches to teaching sexuality education. Together, these studies emphasize the crucial role of cultural and societal factors in shaping effective sex education and health strategies. However, they primarily used simple analytical methodologies, such as traditional static data and qualitative analysis. Thus, the key limitation is the lack of integration of data mining which may result in missing hidden patterns and relationships, thus limiting the depth of insights. To address this gap and enhance their effectiveness, association rule is highly recommended to provide deeper and valuable insights for policymakers, by applying analytic methods such as association rules mining (ARM), to better understand parental perspectives on sexuality education and to inform policy decisions especially in the Moroccan context.

ARM is a rule-based machine learning (RBML) method for analyzing large datasets by identifying significant features within datasets and discovering hidden relationships between sets of items frequently occurring together [17] which allows businesses and researchers these insights to understand item associations and make informed decisions based on these insights [18]. In sales performance field [19]-[21], association rule mining reveals patterns and relationships in large datasets, leading to improved sales strategies and targeted marketing. In privacy preservation within cloud computing [22], they enable the analysis of encrypted data to uncover patterns while maintaining data security aiding in the development of better privacy protocols. In education, [23] these rules help analyze smartphone usage and student performance, providing insights that inform better management of technology in classrooms and tailored academic interventions. Across all these applications, association rules facilitate deeper understanding and actionable insights, enhancing effectiveness and decision-making. However, association rules have not yet been applied precisely to sex education, but integrating them could offer valuable insights.

This research aims to explore Moroccan parents' perspectives on educating their children about sexuality in Moroccan schools by evaluating how factors such as religion, age, education, and cultural beliefs influence their views. Using association rules, the study seeks to uncover key relationships between these factors to inform strategies for advocating the inclusion of sexual content in school curricula and to develop effective solutions for convincing parents of its importance.

The paper is organized as follows: section 2 outlines the research design and approach, detailing data collection and analysis methods, including the use of association rule mining and the Apriori algorithm. Section 3 summarizes and presents the results of the study. Section 4 discusses the findings results, followed by the conclusion in section 5.

2. METHOD

2.1. Data collection

a) Research design

Our research aims to deeply analyze various factors such as education, awareness, social aspects and religion tendency among others, that influence parents' acceptance or rejection of educating children about sex at a young age. Therefore, we have first conducted a field survey to gather data in the form parent's subjective assessment of sex education factors by means of an effective questionnaire. We implemented an adaptive Apriori algorithm to discover strong association rules between different attributes within parents' selected responses, leading to the acceptance or rejection of sex education for children. In the following subsection we present in details each instrument used in our methodology.

b) Targeted population

To conduct our research, we first aimed to gather data by conducting a field survey that included all the components required to collect data from two selected schools in Taza city (northeast Morocco). Data were collected from parents of students aged under 5 years old (the entire students were targeted). The children came from two kinds of primary schools, private and public, to get a clear view of both systems, since they use different education programs. Out of 1,946 participants, 61.46% were mothers and 38.54% were fathers. Among them, 55.19% were aged between 31 and 59 years, 30.37% were aged between 19 and 30 years, 9.97% were aged between 16 and 18 years, and 4.47% were older than 60 years.

c) Questionnaire

Our survey was created using Google forms tool and was sent via social media applications to targeted audience using the following link: <https://shorturl.at/jCH38>. The survey asked different types of questions namely; i) closed single-choice such as the age range, ii) multiple-choice questions such as the factors leading to sexual assault of children, iii) open-ended questions such as the name of parents, iv) qualitative data such as the religious practice of the participants, v) simple, short and easy questions like the opinion of the parents about religion and sexual education, and finally vi) direct questions that provide complete and accurate information to ensure that the research objectives were reached like asking the parents if they educated their children about sexual health. The prepared questionnaire was tested by the manager and pedagogic council in the targeted schools prior to the participating parents, to answer our main question on whether the parents think that the sex education of their children is necessary or not.

d) Sampled data

The collected data were gathered and organized in Excel files. Then, they were prepared for statistical analysis (i.e. people with positive and negative opinions). The obtained Excel file contained 1946 participants. The data were organized as explained in Table 1. Then, each question-response was converted to simple attributes, which were described and contributed with values to facilitate their statistical analysis.

Table 1. Description of attributes used in the survey

Category	Attribute	Description	Value
Parent's personal information	Sex	Gender	M: Man W: Women
	Age	Age of participants	Age1: >16 < 18 Age2: >19 < 30 Age3: > 31 < 59 Age4: >60
	Level	Educational level	Level_primary level_college level_highschool Level_university
	Religious practice	Do parents practice their religion	Practitioner Not_practitioner
	Religious tendency	The tendency of parent's religion	T_muslim: muslim T_FM: Muslim brother T_salafist: Salafist T_secular: secular
Parent's opinion about sex education	Factors	The factors that lead to sexual assault	F1_sexuel F2_psychological F3_mores
	Parents awareness	Have parents ever talked to or educated their child about sexual health	Parents_awareness NO_awareness
	Age SE	Age should sex education be discussed	Age_SE1: Never Age_SE2: < 11 years old Age_SE3: >12 <16 years old Age_SE4: >=16 years old
	Islam SE	Does our religion (Islam) address this subject	Islam_SE_Yes Islam_SE_No
	Treat SE	The relevant way to deal with sex education	Treat_SE_Public Treat_SE_Private
	Awareness respo	The responsible of sex education sensitization and instruction	Respo_parents Respo_teachers Respo_doctors Respo_media Respo_friends Respo_religioux
	Age Internet	The appropriate age to use the internet without parental controls	Age1_internet: >12 & <16 Age2_internet: >=16
	Awareness biology	Is the subject of biology that is programmed at school sufficient for raising awareness	Awareness_biolgie_Yes Awareness_biolgie_No
	Awareness school	Does your school use effective means and techniques to help young people to protect their emotional and sexual life	Awareness_school_Yes Awareness_school_No
	Target attribute	RightSE	Right to sex education

2.2. Data management and analysis

The New York Times' Steve Lohr wrote: "data scientists, agreeing to meetings and expert approximations, spend 50% to 80% of their time delayed in the mundane labor of collecting and formulating unruly digital data before it can be explored for useful nuggets" [24]. Prior to data exploration, up to 80% of the time is spent on the data mining of this later. This pre-processing step consists of four tasks to clean the data and ensure its suitability for further analysis and modeling. The tasks include first, i) data profiling, which involves examining the data by creating charts and graphs for visualization and analyzing the quality of this data. In our case, while checking the major feature, an imbalanced classification problem was detected, thus we used the up-sampling technique to improve the performance of the model, by increasing its resolution as [25] it is illustrated in Figure 1. Secondly, ii) the data cleaning task involves identifying and removing records that are identical in a dataset while handling missing values and identifying and correcting inconsistent data. This step helped us handle all missing values by filling their spots with the most dominant value (for both variables: religious tendency, age internet). iii) The data transformation task includes structuring unstructured data, combining salient variables when it makes sense, or identifying important ranges to focus on. Finally, iv) the data enrichment step is important as it helps applying the various feature engineering libraries to the data, to effect the desired transformations. The aim of this step is to have an organized data set to achieve the optimal balance between the training time for a new model and the required computing. In this step, we create new features from raw data (i.e., extract three new features from 'factors', 'F1_sexuel', 'F2_psychological', 'F3_mores') using Apriori python's library.

2.3. ARM

Agrawal *et al.* [18] introduced frequent item sets, ARM has developed into a potent data mining technique. It is applied to a dataset to find intriguing correlations between features. Additionally, there are normally two significant steps in the ARM process. Finding groups of items that frequently exist in the dataset is the first phase in the process, known as frequent item set generation.

In order to filter out infrequent items, minimum support and minimum confidence values user-defined thresholds are specified in order to do this. In actuality, the selection of these criteria has a significant impact on the process performance and quality. The confidence value of the rules, a measurement of the conditional probability that the rule's consequent holds given the antecedent is used to evaluate them. Strong association rules are those that have high confidence values and they are frequently employed to direct decision-making in a variety of applications.

There are two components to an association rule: (i) an antecedent (if) and (ii) a consequent (then). An item found in data is called an antecedent and an item found in combination with an antecedent is called a consequent. Several metrics are used to assess the quality and significance of association rules in order to choose the most pertinent rules for a given application, including:

(1) Support, which gauges the frequency of an item in the dataset, such as in a rule $A \rightarrow B$. Support is the percentage of transactions that include both $A \rightarrow B$ and it is determined:

$$\text{Support}(\{X\} \rightarrow \{Y\}) = \frac{\text{Transaction containing both } X \text{ and } Y}{\text{Total number of transactions}} \quad (1)$$

In (2) confidence, which indicates how frequently the transactions between two items. In other words, it means how many times it appears in the dataset and it is calculated:

$$\text{Confidence}(\{X\} \rightarrow \{Y\}) = \frac{\text{Transactions containing both } X \text{ and } Y}{\text{Transactions containing } X} \quad (2)$$

In (3) lift is the percentage of transactions that include the two goods when the frequency of the two things is taken into account. The formula to calculate it is:

$$\text{Lift}(\{X\} \rightarrow \{Y\}) = \frac{\text{Transaction containing both } X \text{ and } Y}{\text{Fraction of transactions containing } Y} \quad (3)$$

In (4) leverage is a metric used to evaluate the strength of an association rule. It measures the difference between the observed support of the rule and the expected support if the antecedent and consequent were independent of each other. It is calculated as:

$$\text{Leverage}(X \rightarrow Y) = \text{Support}(X \rightarrow Y) - (\text{Support}(X) \times \text{Support}(Y)) \quad (4)$$

In (5) conviction, which indicates how much more likely the consequent is to occur when the antecedent is present compared to when it is not. The formula for conviction is:

$$Conviction(X \rightarrow Y) = \frac{1 - Support(Y)}{1 - Confidence(X \rightarrow Y)} \tag{5}$$

Overall, association rule mining is a useful technique for identifying intriguing connections and patterns in datasets and it may be used in a variety of fields (Figure 1). We employed the Apriori technic in our data set association rule mining to locate common item sets and reveal hidden information. The Apriori method is a popular technique for association rule mining that, through iterative database discovery of frequent item sets, successfully generates rules [26].

The basic of the classical Apriori algorithm is presented in Figure 2. In our data collection, association rule mining is used to determine parents’ opinions about sex education, including whether they favor it or believe that their children do not need to be sexually educated. In our model we used the minimum support (20%) and minimum threshold (90%), the rest parameters are described in Table 2.

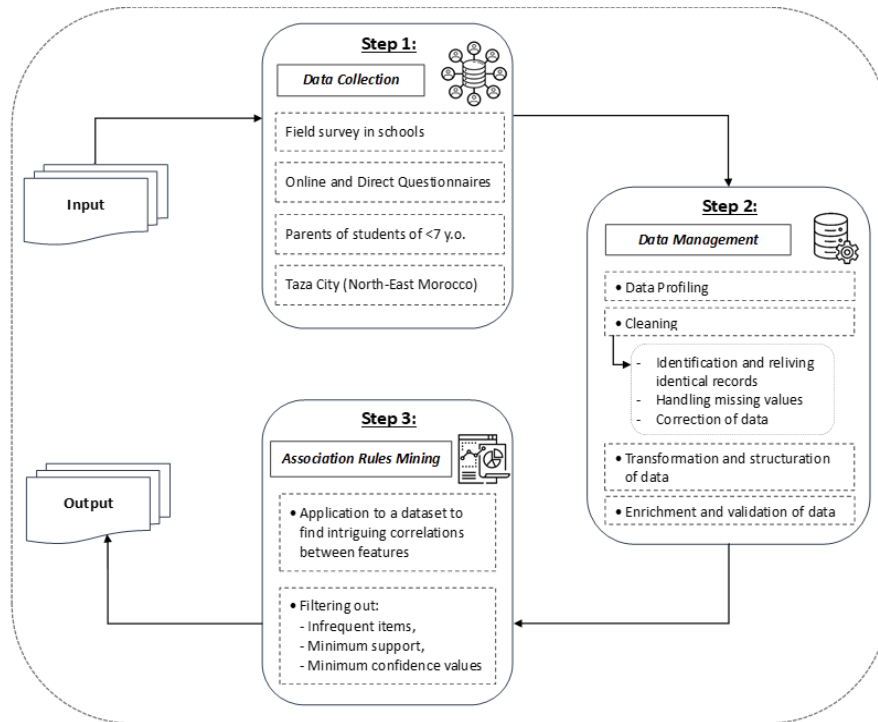


Figure 1. Steps of the ARM

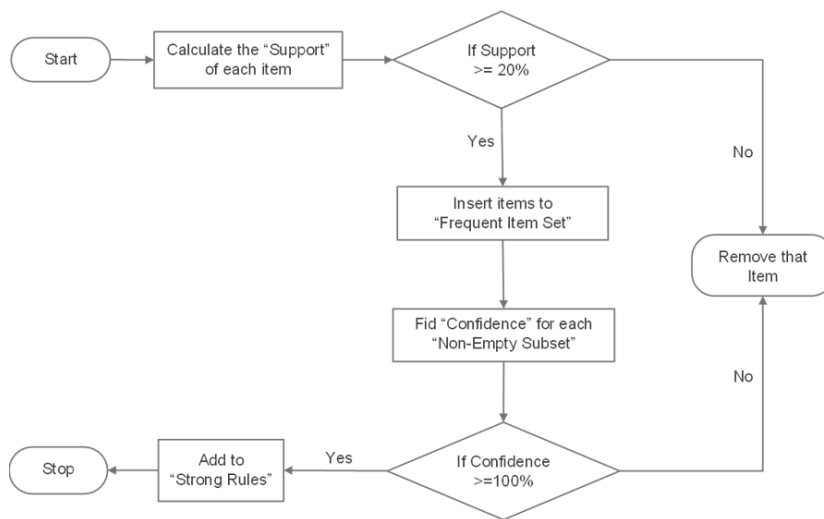


Figure 2. Flow chart of Apriori algorithm

Table 2. Description of parameters used in Apriori algorithm

Parameter	Value
Data analysis method	ARM
Coding language	Python
Library	Apriori
Minimum support	20%
Minimum threshold	90%
Confidence	100%

2.4. Generating association rules

According to our research design, we have generated our adapted Apriori model 8 times, based on filters involving parent’s gender, age, stance on sex education, as described in the Figure 3. To evaluate each filter results, we have considered the following metrics, described in details in section 2.4: support, confident, lift, leverage, conviction.

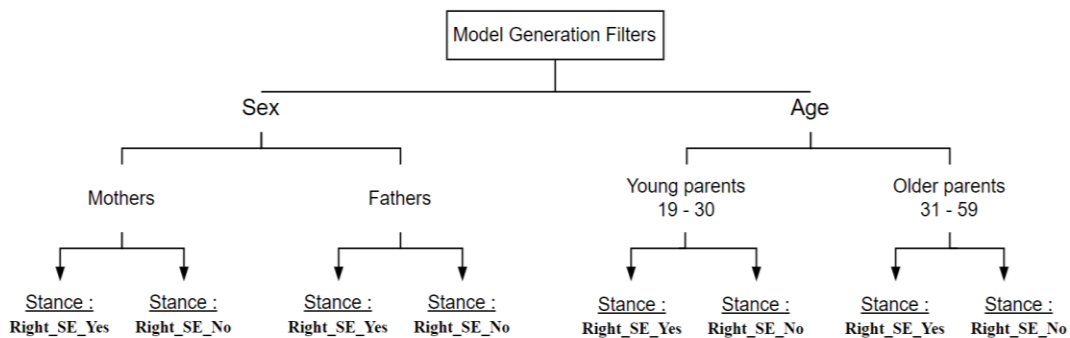


Figure 3. Model generation filters

3. RESULTS

As outlined in the previous section, we engineered features from the parent responses to improve predictive accuracy and applied the Apriori algorithm for robust association rules. The structure of results presentation within this section corresponds to the four filters used in model generation (shown in Figure 3): parents’ sex (mothers in section 3.1 and fathers in section 3.2) and age groups (young parents in section 3.3 and older parents in section 3.4). For each filter, we identified thousands of association rules hence we have selected between 6 to 8 relevant rules only with the most attributes and strong support values and we discarded the rest of the results having fewer attributes and weak support. Since the totality of results had perfect accuracy in terms of confidence (equal to 1), lift (> 1), leverage (positive) and conviction (infinite), it was not necessary to present those three metrics within the results’ tables so we chose to present only the rules and their supports. In the following result’s parts, we intentionally provide a reading of a sample from each table of two association rules having Right_SE_Yes and two rules having Right_SE_No as a consequent, demonstrating how the rest of the rules can be read in the same manner.

3.1. Mothers

Due to vital roles and perceptions of responsibility within our communities, mothers are often seen as the primary caregivers in their children’s education. In our survey 1196 out of 1946 of parents were mothers, we have selected 8 rules, 5 out of 807 with consequent=Right_SE_Yes and 3 out 1679 with consequent=Right_SE_No. Association rules included presented in Table 3. However, we chose to read a sample of 2 of Right_SE_Yes rules (R1, R2) and 2 of Right_SE_No (R6, R7) the rest of the rules could be read on the same manner.

R1: The practicing mothers of Islam with a university education level, consider their responsibility to initiate their children into sexual education in public. They also insist on the responsibility of teachers, in order to prevent sexual assaults resulting from inadequate education. They consider that the young can use the internet without parental control from the age of 16. They support the right to sexual education (support 30% and confidence 100%).

R2: Practicing mothers with a university education level, consider their responsibility with teachers to initiate their children into sexual education. They aim to prevent sexual assaults resulting from inadequate education and believe that the main factors leading to sexual assaults are psychological

disorders. They consider that young children can use the internet without parental control from the age of 16. These cited mothers support the right to sexual education (support 36% and confidence 100%).

R6: Practicing mothers with a university education level, consider their responsibility with teachers to initiate their children into sexual education. They aim to prevent sexual assaults resulting from inadequate education and believe that Islam addresses sexual education topics. They consider that the young can use the internet without parental control from the age of 16. These mothers do not support the right to sexual education (support 35% and confidence 100%).

R7: The practicing mothers with a university education level, consider it their responsibility to initiate their children into sexual education. They believe that the sexual topics must be discussed in private in order to prevent sexual assaults resulting from inadequate education. They believe that the main factors leading to sexual assaults are psychological disorders and consider that the young children can use the internet without parental control from the age of 16. These practicing mothers do not support the right to sexual education (support 30% and confidence 100%).

Table 3. Association rules of mothers

Rules	Antecedents	Consequents	Support
R1	Treat_SE_public, Practitioner, Level_university, Respo_teachers, Age2_internet, Respo_parents	Right_SE_Yes	0,304414003
R2	Practitioner, Level_university, Respo_teachers, F2_psychological, Age2_internet, Respo_parents	Right_SE_Yes	0,365296804
R3	Practitioner, Level_university, Respo_teachers, F1_sexuel, Age2_internet, Respo_parents	Right_SE_Yes	0,403348554
R4	Respo_media, Practitioner, Respo_teachers, Respo_parents, Age2_internet	Right_SE_Yes	0,301369863
R5	Practitioner, Age_SE2, Level_university, Respo_teachers, Respo_parents	Right_SE_Yes	0,307458143
R6	Respo_teachers, Age2_internet, Respo_parents, Practitioner, Level_university, Islam_SE	Right_SE_No	0,35621521
R7	Treat_SE_private, Level_university, Age2_internet, Respo_parents, Practitioner, F2_psychological	Right_SE_No	0,30426716
R8	T_muslim, Age2_internet, Respo_parents, Practitioner, Level_university, Age3	Right_SE_No	0,38404453

3.2. Fathers

Fathers also play a significant and supportive role in their children's learning and development. Their perspectives on their children's education should not be overlooked. In our survey 750 out 1946 of parents were fathers, we have selected 8 rules: 5 out of 5167 with consequent=Right_SE_Yes and 3 out 2965 with consequent=Right_SE_No. Table 4 presents these association rules. However, we reviewed 2 rules from "Right_SE_Yes" (R1, R2) and 2 from "Right_SE_No" (R6, R7), with the remaining rules analyzed similarly.

Table 4. Association rules of fathers

Rules	Antecedents	Consequents	Support
R1	Practitioner, T_muslim, Level_university, Respo_teachers, Mr, Islam_SE, Age3, Age2_internet	Right_SE_Yes	0,303797468
R2	Practitioner, Level_university, T_muslim, Respo_teachers, Islam_SE, Age2_internet, Respo_parents	Right_SE_Yes	0,370253165
R3	Respo_media, Level_university, Respo_teachers, Mr, Islam_SE, Age2_internet, Respo_parents	Right_SE_Yes	0,306962025
R4	Practitioner, Level_university, Respo_teachers, Mr, Islam_SE, Respo_doctors, Age2_internet	Right_SE_Yes	0,303797468
R5	Treat_SE_public, Practitioner, Level_university, Respo_teachers, Mr, Islam_SE, Age2_internet	Right_SE_Yes	0,332278481
R6	Treat_SE_private, Respo_parents, Practitioner, F2_psychological, Awarness_biologic	Right_SE_No	0,3202765
R7	Age2_internet, Respo_parents, Practitioner, F2_psychological, Islam_SE	Right_SE_No	0,35714286
R8	T_muslim, Practitioner, Level_university, Age3, Islam_SE	Right_SE_No	0,34331797

R1: The practicing fathers with a university education level and a Muslim tendency consider it their responsibility with teachers to initiate their children into sexual education. These fathers aged between 31 to 59 years old and they think that the sexual must be discussed in order to prevent sexual assaults resulting from inadequate education. They believe that Islam addresses sexual education topics and they insist on that the young can use the internet without parental control from the age of 16. The cited fathers do not support the right to sexual education (support 30% and confidence 100%).

R2: The practicing fathers with a university education level and a Muslim tendency, consider it their responsibility with teachers to initiate their children into sexual education, in order to prevent sexual assaults resulting from inadequate education. They believe that Islam addresses sexual education topics and considerate that the young can use the internet without parental control from the age of 16. These fathers support the right to sexual education (support 37% and confidence 100%).

R6: Practicing fathers consider it their responsibility to initiate their children into sexual education, in order to prevent sexual assaults resulting from inadequate education in private. They believe that the main factors leading to sexual assaults are psychological disorders and think also that the subject of biology which is programmed at school, is sufficient for raising awareness. These fathers do not support the right to sex education with a support of 32% and a confidence of 100% (support 32% and confidence 100%).

R7: Practicing fathers who consider their responsibility to initiate their children into sexual education, in order to prevent sexual assaults resulting from inadequate education. These fathers believe that the main factors leading to sexual assaults are psychological disorders and the Islam addresses sexual education topics. They consider that the young can use the internet without parental control from the age of 16. These fathers do not support the right to sex education with a support of 35% and a confidence of 100% (support 35% and confidence 100%).

3.3. Parents aged between 19 to 30 years old

Concerning the age, due to its substantial presence among the respondents, we selected the 19–30 age group, which accounted for 30.37% of the parents surveyed. We have selected 7 longest rules: 4 out of 4295 with consequent=Right_SE_Yes and 3 out 2663 with consequent=Right_SE_No. Table 5 describes the association rules. Nonetheless, we opted to peruse a sample of two Right_SE_Yes (R1, R2) and two Right_SE_No (R5, R6) rules; the remaining rules might be perused in the same manner.

Table 5. Association rules of parents between 19 to 30 years old

Rules	Antecedents	Consequents	Support
R1	Level_university, Respo_parents, Age2_internet, Practitioner, Respo_media, Islam_SE, Respo_teachers, F1_sexuel	Right_SE_Yes	0,22012579
R2	Level_university, Respo_parents, Age2_internet, Practitioner, F2_psychological, Islam_SE, Respo_teachers, F1_sexuel	Right_SE_Yes	0,21069182
R3	Level_university, Respo_parents, Age2_internet, Practitioner, Treat_SE_public, Islam_SE, T_muslim, Respo_teachers	Right_SE_Yes	0,22012579
R4	Age2, Age2_internet, Age_SE3, Practitioner, Islam_SE, Respo_teachers, F1_sexuel	Right_SE_Yes	0,20125786
R5	Age2_internet, Respo_parents, Level_university, Practitioner, Islam_SE, F2_psychological, Awarness_biologie, Respo_doctors	Right_SE_No	0,2014652
R6	Age2_internet, Level_university, Practitioner, Islam_SE, Age_SE4, Respo_doctors, Treat_SE_private	Right_SE_No	0,20879121
R7	Respo_parents, Level_university, Practitioner, F2_psychological, Awarness_biologie, Respo_doctors, Mr	Right_SE_No	0,22710623

R1: The practicing parents aged between 19 to 30 years, with a university education level, consider the responsibility to initiate their children into sexual education, as their own with teachers and media, in order to prevent sexual assaults resulting from inadequate education. These parents recognize the absence of comprehensive sexual education as the main factor contributing to sexual assaults. These parents believe that Islam addresses sexual education topics and consider that the young can use the internet without parental control from the age of 16. These parents support sex education (support 22% and confidence 100%).

R2: The practicing parents aged between 19 to 30 years, with a university education level, consider themselves and the teachers in the school as responsible to initiate their children into sexual education, in order to prevent sexual assaults resulting from inadequate education. They recognize the absence of comprehensive sexual education and psychological disorders as the main factors contributing to sexual assaults. These parents believe that Islam addresses sexual education topics and consider that the young can use the internet without parental control from the age of 16. They support sex education (support 21% and confidence 100%).

R5: The practicing parents aged between 19 to 30 years old, with a university education level, consider themselves and the teachers as responsible to initiate their children into sexual education, in order to prevent sexual assaults resulting from inadequate education. They recognize that the main factors contributing to sexual assaults are psychological disorders. They also believe that the subject of biology which is programmed at school is sufficient for raising awareness. These parents also think that the Islam addresses sexual education topics and consider that the young can use the internet without parental control from the age of 16. The cited parents do not support sex education (support 20% and confidence 100%).

R6: The practicing parents aged between 19 to 30 years old, with a university education level, consider doctors as responsible to initiate their children into sexual education, in order to prevent sexual assaults resulting from inadequate education. They insist on the discussion of sexual topics in private and this must begin at 16 years old. These parents believe that Islam addresses sexual education topics and consider that the young can use the internet without parental control from the age of 16. The cited parents do not support sex education (support 20% and confidence 100%).

3.4. Parents aged between 31 to 59 years old

55,19%. of parents investigated aged between 31 and 59 years old. We have selected 6 longest rules with high support, 3 out of 6877 with consequent=Right_SE_Yes and 3 out 2541 with consequent=Right_SE_No. Association rules included described in Table 6. However, we chose to read a sample of 2 of Right_SE_Yes rules (R1, R2) and 2 of Right_SE_No (R4, R5) rules, the remaining rules may be read, in the same way.

Table 6. Association rules of parents between 31 to 59 years old

Rules	Antecedents	Consequents	Support
R1	Level_university, Respo_parents, Age2_internet, Parents_awareness, Practitioner, F2_psychological, Islam_SE, T_muslim, Respo_teachers	Right_SE_Yes	0,200367647
R2	Level_university, Respo_parents, Age2_internet, Practitioner, Respo_doctors, Islam_SE, T_muslim, Respo_teachers	Right_SE_Yes	0,242647059
R3	Level_university, Respo_parents, Age2_internet, Practitioner, Treat_SE_public, Islam_SE, T_muslim, Respo_teachers	Right_SE_Yes	0,222426471
R4	Age2_internet, T_muslim, Respo_parents, Level_university, Practitioner, Respo_teachers, F2_psychological, Respo_doctors	Right_SE_No	0,20754717
R5	Age2_internet, T_muslim, F3_mores, Respo_parents, Level_university, Practitioner, Islam_SE	Right_SE_No	0,203773585
R6	Age2_internet, T_muslim, Respo_parents, Level_university, Practitioner, F2_psychological, Treat_SE_private	Right_SE_No	0,294339623

R1: The practicing parents aged between 31 to 59 years old, with a university education level and a Muslim tendency, who consider it their responsibility to initiate their children into sexual education, as well as the responsibility of teachers, in order to prevent sexual assaults resulting from inadequate education and who recognize that the main factors contributing to sexual assaults are the psychological disorders and who believe that Islam addresses sexual education topics and who considerate that the young can use the internet without parental control from the age of 16, support sex education (support 20% and confidence 100%).

R2: The practicing parents aged between 31 to 59 years old, with a university education level and a Muslim tendency, consider themselves in addition to teachers and doctors as responsible to initiate children into sexual education, to prevent sexual assaults resulting from inadequate education. They believe that Islam addresses sexual education topics and consider that the young can use the internet without parental control from the age of 16. These parents support sex education (support 24% and confidence 100%).

R4: The practicing parents aged between 31 to 59 years old, with a university education level and a Muslim tendency, who consider it their responsibility to initiate their children into sexual education, as well as the responsibility of teachers, in order to prevent sexual assaults resulting from inadequate education and who recognize that the main factors contributing to sexual assaults are the psychological disorders and who considerate that the young can use the internet without parental control from the age of 16, do not support sex education (support 20% and confidence 100%).

R5: The practicing parents aged between 31 to 59 years old, with a university education level and with a Muslim tendency, consider themselves as responsible to initiate their children into sexual education, in order to prevent sexual assaults resulting from inadequate education. They believe that the main factors

leading to sexual assaults is a moral crisis. These parents think that the Islam addresses sexual education topics and consider that the young children can use the internet without parental control from the age of 16. The cited parents do not support sex education (support 20% and confidence 100%).

4. DISCUSSION

This study investigated parents' views on sexual education for young children and the factors influencing these opinions using association rules mining. While earlier studies on sex education and health have explored the role of cultural and social contexts in shaping educational practices. However, their reliance on basic analytical methods limits their capacity to uncover deeper insights through data mining.

A significant divide emerged between supporters and non-supporters of comprehensive sex education. We found that parents' stance on sex education correlates with different factors such as age, education level, cultural background. The experiment's association rules, set with a 20% minimum support and a 90% minimum threshold, all showed 100% confidence, indicating perfect accuracy. The proposed method in this study tended to have an inordinately higher lift values that have all exceeded (>1), which indicates the antecedent and consequent of each rule occur together more often than by chance, suggesting a strong positive association. In our discussion we focus on rules with consequents of "Right_SE_Yes" and "Right_SE_No" mainly having the highest number of frequent itemset and high support association.

The proposed method in this study revealed that parents aged of 19 to 30 who support sexual education favor early, public education by parents, teachers, and media (Table 5). Conversely, those in the same age group who oppose sexual education view psychological problems as the main cause of sexual abuse and prefer private education during teenage years, emphasizing parental and medical roles (Table 6, rule with support $>29\%$). Parents aged 31 to 59 who support sexual education emphasize educational and psychological factors, while their counterparts who do not support it attribute sexual abuse to moral crises and prefer private education. Mothers generally support sex education before age 11 (Table 3, 30% support), while fathers prefer it to start at age 12 and consider both Islamic teachings and current school resources sufficient (Table 4, 37% support).

Our study is comprehensive in its approach, offering robust results and addressing a range of aspects. In one hand, our results uncovered hidden patterns and strong correlations (100% confidence, lift >1 and conviction $=\infty$) in parental attitudes toward sex education using association rules and Apriori algorithm, revealing complex motivations and barriers that impact their decisions. While many studies in education have employed these algorithms, they often report lower support or confidence levels (confidence $<93\%$) [5], (75% confidence) [27]. On the other hand, unlike related Moroccan studies that overlooked the gender as a factor of sex education acceptance our findings indicate that while mothers generally support sex education, a significant portion prefers it to begin from age 12 in private, with a support value of 38% which aligns with the output of Pownall *et al.* [28], where mothers also discussed fewer sexual topics with their children privately.

All supporting parents consider it as vital for preventing abuse and improving overall health outcomes as was investigated in [29], they assume their responsibility for providing, age-appropriate information supported by teachers, doctors, and media (Tables 3-6). This aligns with [13], which emphasizes the need to understand parents' views for effective abuse prevention, however, parents may face challenges due to limited information, highlighting the need for better support and community engagement to improve sexual education and address gaps. Conversely, non-supporting parents prefer private sexual education during teenage years and find school books adequate. This may reflect cultural sensitivities and limitations in resources and teacher training in Morocco [6].

This study explored that sex education initiatives are more relevant, effective, and likely to gain widespread acceptance within the discovered sets of correlated factors. However, further and in-depth investigation using different techniques of association rule mining like FP-growth (frequent pattern growth) which builds a compact data structure called the FP-tree (frequent pattern tree) to store itemset information and identify patterns quickly, may be needed to enhance its understanding and effectiveness especially regarding the efficient mining of frequent patterns, data compression, minimizing database scans, and managing long item sets without generating candidate item sets.

Our study demonstrates that the output association rules are more resilient than in terms of lift and confidence compared to related studies based on FP-Growth algorithm. Further research involving more detailed categorical or ordinal data could explore parents' acceptance and behavior towards various sex education topics. This could help build decision trees to select specific and appropriate sex education approaches for Moroccan schools.

Our findings provide conclusive evidence that the demographic characteristics are associated with parental sex education perception change, due to the strength of associations generally having high support values exceeding 20%, 100% of confidence, and frequent item sets. By highlighting these hidden patterns, the study underscores the importance of developing tailored policies and educational programs that address the diverse concerns and values of different parent groups. This approach ensures that sex education initiatives are not only more relevant and effective but also more likely to gain acceptance and support across a broad spectrum of the community.

5. CONCLUSION

This study aimed to disclose the relationship among various parents related factors on accepting or refusing the insertion of sex education in Moroccan schools using a rule-based ARM technique, namely Apriori algorithm. Our results revealed new data on the sexual education of young children in Morocco and the factors that influence it, the variation of parent views was dependent on the age, gender, religious and education levels of participants. The output association rules, highlighted strong correlations among frequent itemsets and revealed patterns of how demographic characteristics influence parental attitudes toward sex education. In summary, some Moroccan parents support public sexual education for children at a young age to prevent sexual abuse, while others oppose it, preferring that sexual education be conducted privately. By highlighting the hidden patterns, the association rules underscore a portion of fathers believe that Islamic teachings and current school resources are sufficient. Although field interviews and association rule mining provide valuable insights, employing advanced data analysis methods like FP-growth for association rule mining can offer significant insights, to provide a comprehensive understanding of stakeholder perspectives, leading to more targeted and effective sexual education programs.




REFERENCES

- [1] C. C. Breuner and G. Mattson, "Sexuality education for children and adolescents," *Pediatrics*, vol. 138, no 2, p. e20161348, 2016, doi: 10.1542/peds.2016-1348.
- [2] R. Cacciatore, E. K-Poikela, and R. Kaltiala, "The steps of sexuality—a developmental, emotion-focused, child-centered model of sexual development and sexuality education from birth to adulthood," *International Journal of Sexual Health*, vol. 31, no 3, p. 319-338, 2019, doi: 10.1080/19317611.2019.1645783.
- [3] V. A. Cırık, E. Efe, and S. Velipaşaoğlu, "Educating children through their parents to prevent child sexual abuse in Turkey," *Perspectives in Psychiatric Care*, 2019, doi: 10.1111/ppc.12461.
- [4] M. A. Levand, "Sexuality education as developmentally appropriate in the American Catholic Higher Education Curriculum," *Sexuality, Gender & Policy*, vol. 5, no 2, pp. 122-139, 2022, doi: 10.1002/sgp2.12052.
- [5] H. Leung, D. Shek, E. Leung, and E. Shek, "Development of contextually-relevant sexuality education: lessons from a comprehensive review of adolescent sexuality education across cultures," *International Journal of Environmental Research and Public Health*, vol. 16, no 4, p. 621, 2019, doi: 10.3390/ijerph16040621.
- [6] R. ELghazoui and K. Anass, "Exploring sexual and reproductive health education in Morocco: an overview of the literature," *International Journal of Language and Literary Studies*, vol. 6, no. 3, pp. 271–280, Aug. 2024, doi: 10.36892/ijlls.v6i3.1776.
- [7] S. Belkadi, "Sex education in Morocco (research paper)," p. 27, 2019, Accessed: Aug. 14, 2023. [Online]. Available: https://www.academia.edu/38474911/Sex_Education_in_Morocco_research_paper_.
- [8] N. Kadri, K. Mchichi Alami, et S. Berrada, "La sexualité au Maroc: point de vue de sexologues femmes," *Sexologies*, vol. 19, no 1, p. 53-57, janv. 2010, doi: 10.1016/j.sexol.2009.03.004.
- [9] K. Mchichi Alami and N. Kadri, "Moroccan women with a history of child sexual abuse and its long-term repercussions: a population-based epidemiological study," *Archives of Women's Mental Health*, vol. 7, no 4, p. 237-242, 2004, doi: 10.1007/s00737-004-0061-9.
- [10] Z. Gassim, "Gender and sexual education in Morocco," *International Conference on Studies in Education and Social Sciences, ICSES 2023*, Antalya, Türkiye, p. 77-85, 2024. [Online]. Available : https://www.researchgate.net/profile/Istes-Publication/publication/378708001_Proceedings_of_International_Conference_on_Studies_in_Education_and_Social_Sciences_2023_Volume_I/links/65e60042e7670d36abfd13de/Proceedings-of-International-Conference-on-Studies-in-Education-and-Social-Sciences-2023-Volume-I.pdf#page=86
- [11] R. Benharrouse, "Towards sexual education: moroccan youth's perception between globality and islam," *Pacha*, vol. 1, no 3, pp. 26-38, 2020, doi: 10.46652/pacha.v1i3.34.
- [12] H. Chafai, "Everyday gendered violence: women's experiences of and discourses on street sexual harassment in Morocco," *Journal of North African Studies*, vol. 26, no 5, pp. 1013-1032, 2021, doi: 10.1080/13629387.2020.1743184.
- [13] Q. W. Xie, D. P. Qiao, and X. L. Wang, "Parent-involved prevention of child sexual abuse: a qualitative exploration of parents' perceptions and practices in Beijing," *Journal of Child and Family Studies*, vol. 25, no. 3, pp. 999–1010, Mar. 2016, doi: 10.1007/s10826-015-0277-5.
- [14] A. O. T. Awaru, "The social construction of parents' sexual education in Bugis-Makassar Families," *Society*, vol. 8, no 1, pp. 175-190, juin 2020, doi: 10.33019/society.v8i1.170.
- [15] N. Kadri, R. Benjelloun, I. Kendili, A. Khoubila, and D. Moussaoui, "Internet and sexuality in Morocco, from cyber habits to psychopathology," *Sexologies*, vol. 22, no 2, p. e49-e53, 2013, doi: 10.1016/j.sexol.2012.08.006.
- [16] S. Selmaoui, B. Agorram, K. S-Eddine, T. el. Abboudi, and D. Berger, "Sexuality education: analysis of Moroccan teachers' and future teachers' conceptions," *Online Submission*, vol. 7, no. 8, pp. 28–36, 2010.
- [17] H. Yan, N. Yang, Y. Peng, and Y. Ren, "Data mining in the construction industry: present status, opportunities, and future trends," *Automation in Construction*, vol. 119, p. 103331, Nov. 2020, doi: 10.1016/j.autcon.2020.103331.




- [18] R. Agrawal, T. Imieliński, and A. Swami, "Mining association rules between sets of items in large databases," *ACM SIGMOD Record*, vol. 22, no. 2, pp. 207–216, Jun. 1993, doi: 10.1145/170036.170072.
- [19] R. M. T. Nursansongka, I. Fahrurrozi, U. Y. Oktiawati, U. Taufiq, U. Farooq, and G. Alfian, "Utilizing association rule mining for enhancing sales performance in web-based dashboard application," *Indonesian Journal of Electrical Engineering and Computer Science (IJECS)*, vol. 36, pp. 1105–1113, 2024, doi: 10.11591/ijeecs.v36.i2.pp1105-1113.
- [20] M. El Mahjoub, M. Taj bennani, M. Lamrini, and M. El Far, "Association rules forecasting for the foreign exchange market," *International Journal of Electrical and Computer Engineering (IJECE)*, vol. 14, no. 3, pp. 3443–3454, 2024, doi: 10.11591/ijece.v14i3.pp3443-3454.
- [21] G. Kuang and Y. Li, "Using fuzzy association rules to design e-commerce personalized recommendation system," *TELKOMNIKA Indonesian Journal of Electrical Engineering*, vol. 12, no. 2, Feb. 2014, doi: 10.11591/telkomnika.v12i2.3983.
- [22] R. A. Mustafa, H. S. Chyad, and J. R. Mutar, "Enhancement in privacy preservation in cloud computing using apriori algorithm," *Indonesian Journal of Electrical Engineering and Computer Science (IJECS)*, vol. 26, no. 3, p. 1747–1757, 2022, doi: 10.11591/ijeecs.v26.i3.pp1747-1757.
- [23] S. Karabatak and M. Alanoğlu, "Investigation of university students' in-class smartphones usage with association rules," *International Journal of Progressive Education*, vol. 17, no. 2, pp. 55–68, Apr. 2021, doi: 10.29329/ijpe.2021.332.4.
- [24] S. Lohr, "For big-data scientists, 'janitor work' is key hurdle to insights," *New York Times*, vol. 17, p. B4, 2014.
- [25] R. Shafique *et al.*, "Breast cancer prediction using fine needle aspiration features and upsampling with supervised machine learning," *Cancers*, vol. 15, no. 3, p. 681, 2023, doi: 10.3390/cancers15030681.
- [26] R. Agrawal and R. Srikant, "Fast algorithms for mining association rules in large databases," in *Proc. of the 20th International Conference on Very Large Data Bases (VLDB'94)*, 1994, pp. 487–499, [Online]. Available: citeseer.ist.psu.edu/agrawal94fast.html.
- [27] P. Frawley and N. J. Wilson, "Young people with intellectual disability talking about sexuality education and information," *Sexuality and Disability*, vol. 34, no. 4, pp. 469–484, Dec. 2016, doi: 10.1007/s11195-016-9460-x.
- [28] J. D. Pownall, A. Jahoda, and R. P. Hastings, "Sexuality and sex education of adolescents with intellectual disability: mothers' attitudes, experiences, and support needs," *Intellectual and Developmental Disabilities*, vol. 50, no. 2, pp. 140–154, Apr. 2012, doi: 10.1352/1934-9556-50.2.140.
- [29] L. J. East and T. R. Orchard, "Somebody else's job: experiences of sex education among health professionals, parents and adolescents with physical disabilities in southwestern Ontario," *Sexuality and Disability*, vol. 32, no. 3, pp. 335–350, Sep. 2014, doi: 10.1007/s11195-013-9289-5.

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