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EXPLORING THE USER EXPERIENCE OF VR IN LEARNING ENVIRONMENTS AMONG ANIMATION LEARNING STUDENTS

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Abstract

Virtual Reality(VR) technology has been stretched its market in this technological world, which pulls the interest of diverse people because of immersiveness, engagement and interactive in 3d virtual environment, Virtual reality which widely used in different industries like architecture, gaming, medical and in media. Mostly modeled three-dimensional Architecture or environment will be designed in other 3d software's and will be transferred to VR technology to create 3d environment, when this has been brought into educational setting understanding of the technology will be little slower then compared to industries. In this study the Oculus quest 2 has been provided to a set of students to use and explore the interface of it, to find the understanding and the User experience in Virtual 3d environment. the students were predominantly using the VR headset for the first time; This study covered the area of usability, user experience, adoption, observation, and skill development, motivation.

Introduction:

Virtual reality (VR) has come to be recognized as an innovation in Virtual learning that providing learners with a real life virtual environments to learn from. This change in using actual educational technologies that embrace VR learning environments provides substantive form to the change towards experiential learning where the learner engages themselves in the learning process through actual experience and contemplation (Schott & Marshall, 2021). With changing campus environment, VR is now appreciated for the effectiveness in developing environments that support absorption of knowledge to a deeper level.

VR application in education is based on constructivism that postulates that learners acquire the knowledge by the activities they engage in and the interactions with their environment (Huang et al., 2010). VR supports this process in the sense that it offers the possibility for the subjects to learn and practice in certain carefully designed environment where the conditions of practice are controlled but where also interactions can be approximations to real life situations. Due to its high level of interaction, the VR is more effective in offering an individual and comprehensible experience depending on the student's learning abilities and profiles (Lau & Lee, 2015).

Another benefit of the application of VR in experiential learning is the possibility to create realistic scenarios that could not exist or are extremely hard to build in reality. For example, the operating table surgery by medical students can be performed in a risk-free simulation platform or the architectural design by architecture students of structures can be rotated or moved in a 3D space (Zhou et al. , 2018). It also helps in practical skill development of learners and allows them to practice and correct their mistakes in a controlled environment) by so doing; it acts as a reinforcement to the learning process (Roussou, Oliver, & Slater, 2006).

Furthermore, the utilizations of VR-advent conceptualizations are most beneficial in recreational and playful settings, yet, probably more significantly in innovativeness and problem-solving proficiency requirements. It helps the students to adjust to experiments with variables and actual results in the virtual environment, thus making the students to be more involved in the process and becoming interested in the material (Grivokostopoulou, Perikos, & Hatzilygeroudis, 2016). This is in line with experiential education where students are taken through a process in the hope that they will solve a problem or learn something that they did not know before.

However, as with any approach, the use of VR in learning environments about the specific area is not without its difficulties. Some of the challenges like high cost of equipment used in VR, need of personnel to support the equipment and issues of distractions from the use of technologies need to be solved in order to support the use of VR in classroom (Hashim et al. , 2024). In addition, it is becoming crucial to adequately design the VR learning environments so they are not so complex so they can overwhelm or disorient the learners (Carbonell-Carra et al., 2021).

Therefore, applying VR as an aspect belonging to the concept of EEx can be considered as an effective tool for facilitating the process of implementing experiential education. With the progress of technology there is a number of possibilities in connection with using VR in education which will open more opportunities for students to interact with the material in an eccentric and purposeful way. Nevertheless, the implementation of VR into educational practice is quite possible and promising only if its benefits and shortcomings are properly assessed in terms of improving the results of students' learning.

Literature Review:

Virtual Reality (VR) has become a revolutionary technique in education and learning to provide better learning experience as compare to traditional learning method. This is especially the case in subject areas like animation where the spatial and the visual characteristic of VR may prove helpful in the learning process. This paper aims at reviewing the literature on the UX of VR in learning contexts with a focus on animation learners. In the review, some major and theoretical studies are also considered to understand advantages, possible difficulties, directions for using VR for animation education.

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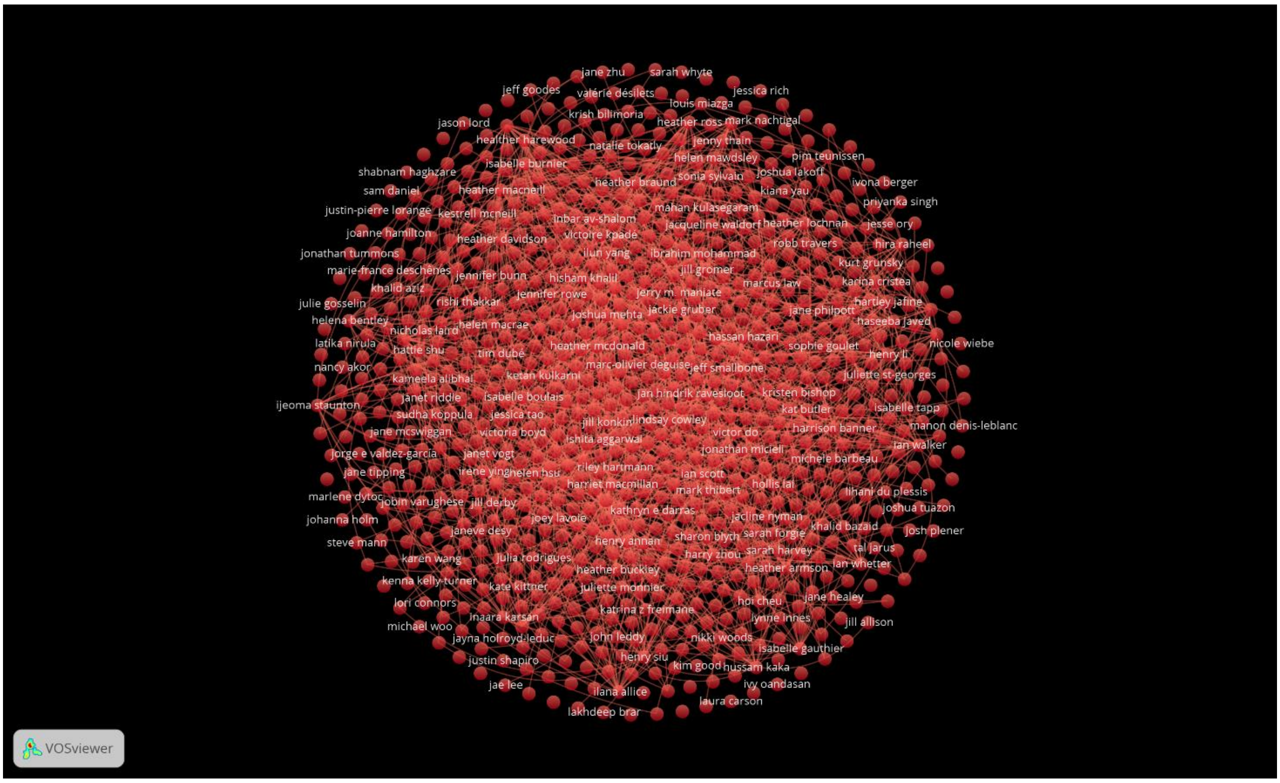

Figure:1 citations of VR in Educational Contexts authors

VR in Educational Contexts

Computer aided learning through VR implementation is based on the Constructivist paradigm of learning which entails constructive use of students' participation and learner's someway active involvement in the learning process (Piaget, 1952; Vygotsky, 1978). Practice and exploration leads to better understanding through VR and thus it is more effective when students have to relate to complicated matter in a way that still remains safe enough to experiment (Merchant et al., 2014). The effects of VR are known to enhance measures of spatial integration and confusion and also helped remember things and solve problems, something which is helpful in the teaching of animation (Mikropoulos & Natsis, 2011).

VR in Animation Education

Due to the immersive character of VR and its capacity to afford real situations regarding spatial relations animation students are in advantage here. Research by Johnson et al (2018) showed how, through the VR environment, one can better understand 3D environment, which is critical to animation. In the same manner, through the use of VR, objects can be moved, and this moves the students, resulting to an enhanced and immediate response on the information they learned from the lesson (Huang et al. , 2019). This approach also corresponds to what animation students require: practice and thinking in terms of theories and technologies.

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User Experience (UX) in VR Learning Environments

The design is a very central issue that determines the level of success of VR as a tool in learning environment. UX is thus not solely the ability of comprehending and using the VR systems, but the affective and cognitive feelings that the user experiences (Hassenzahl & Tractinsky, 2006). To the context of education, a positive UX has been associated with higher engagement, motivation, and thus achievement (Bacca et al. , 2014).

Nevertheless, as mentioned earlier, VR environment is not without its problems even as it pertains to UX. Challenges like motion sickness, technical problems, and the difficult in control of equipment related to use of VR can be a major drawback in learning (Kennedy et al. , 2010). Thus, these challenges may be especially devastating in animation education, where accuracy and imagination are two crucial components. Thus, proper design of the learning environment in VR should concern not only the efficiency but also ergonomics of a student.

Impact on Learning Outcomes

A number of empirical investigations have been conducted to understanding the effects of incorporating VR in learning outcomes in animation education. For example, the use of VR revealed in the study conducted by Lee and Wong (2019) enhanced the students' abilities to complete tasks related to spatial reasoning and 3D modeling if used in the animation courses. In s a similar vein, Anderson and Davidson (2020) explained that through using VR, learners are in a position to test out different attitudes and appearances more freely and quickly since they have a virtual environment in which to do so.

However, it is a topic of debate on how effective Virtual Reality is in enhancing education. Another element noted by some authors is that due to the fact that VR is a rather new technology, the levels of user engagement are high only during the so-called 'romance period' or, as Profita and Roussou (1999) referring to Roussou, stated the 'honeymoon effect'. Some scholars have argued that in the event that VR is not integrated into LMS and is implemented as a supplementary tool, then it becomes more of a distraction to the learning process (Freina, & Ott, 2015). For this reason, some theoretical models that address the issue of application of VR in animation need to be designed.

Challenges and Limitations

Despite the numerous possibilities of using VR in education numerous obstacles have to be overcome to harness the opportunity. The major limitation is expense since quality virtual reality devices and software are costly for hundreds of schools (Pantelidis, 2009). Also, the systems of VR are very technical and hence needs so much training for the students and their respective teachers, and this takes so much time and resources (Radianti et al. , 2020). Another crucial problem is the availability of this kind of loan to borrowers. The physical exertion needed to use VR is still a problem as some students may be physically incapable when it comes to the use of this technology, VR can cause discomfort and even disorientation to some users (LaViola, 2000). In addition, there are concerns, such as generation of a digital divide in which only students having VR technology can reap the benefits, thus adding to the social inequalities found in the learning system (Selwyn, 2016).

Future Directions

The position of VR in the learning process of animation is in the future when these issues are solved and the opportunities of VR are improved for education. As for the VR hardware, the weight of the headsets, the interfaces should become more inviting, more accessible thus improving the entry barriers and the UX (Slater/ Sanchez-Vives, 2016). Further, the emergence of more specific applications of Virtual Reality geared towards animation education supplies students with tools that are strong and advocated (Chen et al. , 2020).

There should always be more emphasis put on studies that are longitudinal in nature and that seek to establish effects of the use of VR on student performance over the long term. There is therefore need to know how students manage their transition to use of VR and how it effects student learning pathways known to be central to learning (Fowler, 2015). Also, the combination of VR with other related technologies such as artificial intelligence and augmented reality will enhance learning experiences to other higher levels (Bailenson, 2018).
The use of VR in education implies that it can help students who learn animation get the real-life experiences they require whenever they are learning through methods that do not require physical interaction. Yet if the potential is to be realised in full the UX of the VR systems has to be addressed by the educators and the challenges associated with it have to be met. In this way, VR can be a tool to create, develop technical skills and enhance the degree of mastery of the subjects in the field of animation.

Methodology:
In this study, we employed a mixed-methods approach to explore the user experience of Virtual Reality (VR) in learning environments among animation students. A total of [insert number] students were provided with Oculus Quest 2 headsets and participated in quantitative surveys. The quantitative component involved structured questionnaires designed to assess ease of navigation, orientation, user interface, system smoothness, responsiveness, and overall immersiveness. Responses were measured using a Likert scale, ranging from "Strongly Disagree" to "Strongly Agree." The qualitative component included in-depth interviews to capture nuanced insights into students' experiences, focusing on their motivations and potential for skill development within the VR environment. Data were analyzed using statistical tools for quantitative responses, and thematic analysis was applied to qualitative data to identify recurring themes and patterns. The study also explored students' initial reactions to VR, including any physical discomfort and their interest in further learning within the VR domain. This methodology provides a comprehensive understanding of how animation students interact with and perceive VR as a learning tool, offering insights into its potential for enhancing educational experiences.

Result and Analysis:

The data indicates that the majority of participants in the study were aged 18-20 (76.9%) and predominantly male (86.5%). A balanced number of participants (50%) had prior experience with Virtual Reality (VR) headsets, while the other half were first-time users. Most participants found navigating the VR environment relatively easy, with 42.3% rating it as "Easy" and 23.1% as "Very Easy." However, a significant portion (26.9%) remained neutral regarding the ease of navigation. The movement controls were perceived as natural by a substantial group, with 23.1% strongly agreeing, though 40.4% were neutral. Disorientation was reported by a smaller segment, with only 13.5% agreeing they felt lost in the VR environment. Hand controllers were generally viewed as effective for manipulation and navigation, with 36.5% agreeing and 25.0% strongly agreeing. User experience feedback was positive overall, though there was a notable split in opinions regarding the system's smoothness and responsiveness, with some participants reporting mild discomfort. Regarding immersion, 28.8% felt fully immersed, and a similar percentage felt disconnected from the real world while in VR. Additionally, 51.9% of participants expressed neutrality or agreement toward pursuing further learning about VR after the experience.

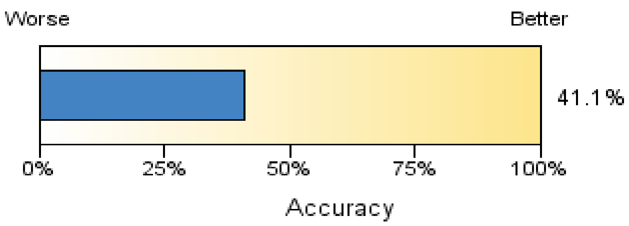
Automatic Linear Modeling:

Automatic Linear Modeling is a statistical technique that automates the process of building linear models by selecting the best predictors and interactions. It simplifies complex data analysis, allowing researchers to efficiently identify relationships between variables, assess model accuracy, and interpret results without extensive manual intervention.

Model Summary

Target	Gender
Automatic Data Preparation	On
Model Selection Method	Forward Stepwise
Information Criterion	-112.061

The information criterion is used to compare to models. Models with smaller information criterion values fit better.



The attached graph provides a model summary for a predictive analysis with "Gender" as the target variable. The model used automatic data preparation and a forward stepwise selection method, with an information criterion value of -112.061. This negative value indicates a good model fit, as

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models with smaller information criterion values generally perform better. The accuracy of the model is shown to be 41.1%, which suggests that the model correctly predicts the target variable (gender) slightly less than half of the time. While this accuracy rate might be considered moderate, it is essential to note that the choice of variables, model type, and data quality could significantly impact this outcome. Given the accuracy percentage and the information criterion, this model may need refinement or additional variables to improve its predictive power. The current results indicate that while the model is somewhat effective, there is substantial room for improvement, particularly if this model is to be used in practical applications where higher accuracy is critical. Consider exploring alternative models or methods to enhance the predictive accuracy further.

Automatic Data Preparation

Target: Gender

Field	Role	Actions Taken
(Evaluation_transformed)	Predictor	Merge categories to maximize association with target
(Experiance_transformed)	Predictor	Merge categories to maximize association with target
(Immersiveness_transformed)	Predictor	Merge categories to maximize association with target
(Motivations_transformed)	Predictor	Merge categories to maximize association with target
(Navigation_transformed)	Predictor	Merge categories to maximize association with target
(Smoothness_transformed)	Predictor	Merge categories to maximize association with target

If the original field name is X, then the transformed field is displayed as (X_transformed). The original field is excluded from the analysis and the transformed field is included instead.

The graph titled "Automatic Data Preparation" outlines the steps taken in the preparation of data for a model with "Gender" as the target variable. The table lists several fields—such as "Evaluation_transformed," "Experience_transformed," "Immersiveness_transformed," "Motivations_transformed," "Navigation_transformed," and "Smoothness_transformed"—all of which serve as predictors in the model. Each of these fields has undergone a transformation process where categories were merged to maximize their association with the target variable, gender. This suggests that the data preprocessing aimed to simplify the predictors by combining categories that show similar relationships with the target, potentially enhancing the model's performance. The transformations likely aimed to improve the predictive power by reducing noise or variability in the data, making it easier for the model to identify patterns associated with gender. By excluding the original fields and using the transformed versions, the model attempts to optimize the input variables for better accuracy. This approach indicates a thoughtful preprocessing strategy to

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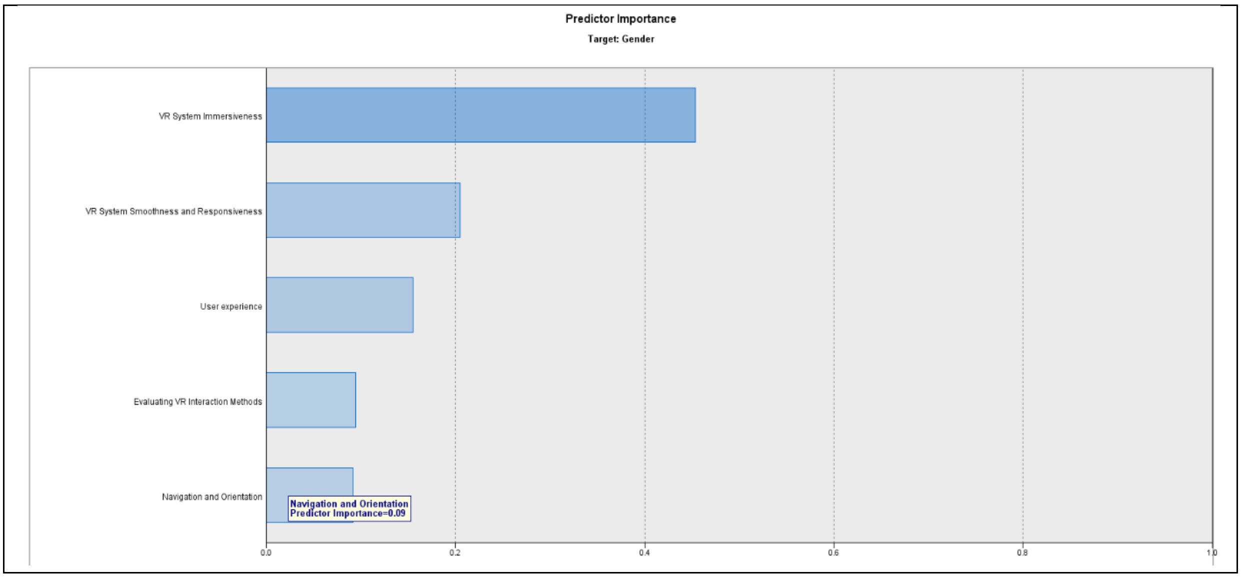
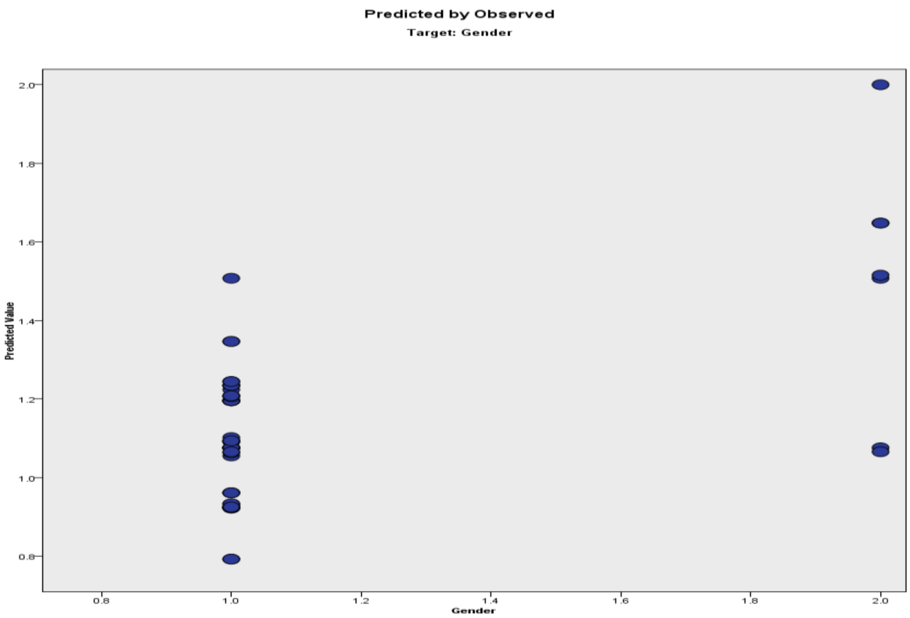
strengthen the relationship between the predictors and the target variable. However, the effectiveness of this strategy would ultimately depend on how well these transformations align with the actual underlying relationships in the data and whether they contribute to improving the model's accuracy.



The predictor importance chart indicates the relative significance of different variables in predicting the target variable, which appears to be gender in this case. Based on the chart, the most important predictor is "VR Systems Issues," followed by "VR Systems Responsiveness," "User Experience," and "Evaluating VR Interaction Methods." "Navigation and Orientation" has the lowest predictor importance. This information can be used to prioritize efforts in improving the VR system, focusing on addressing issues related to VR systems, responsiveness, user experience, and interaction methods. By targeting these areas, developers can potentially enhance the overall effectiveness and user satisfaction of the VR system.



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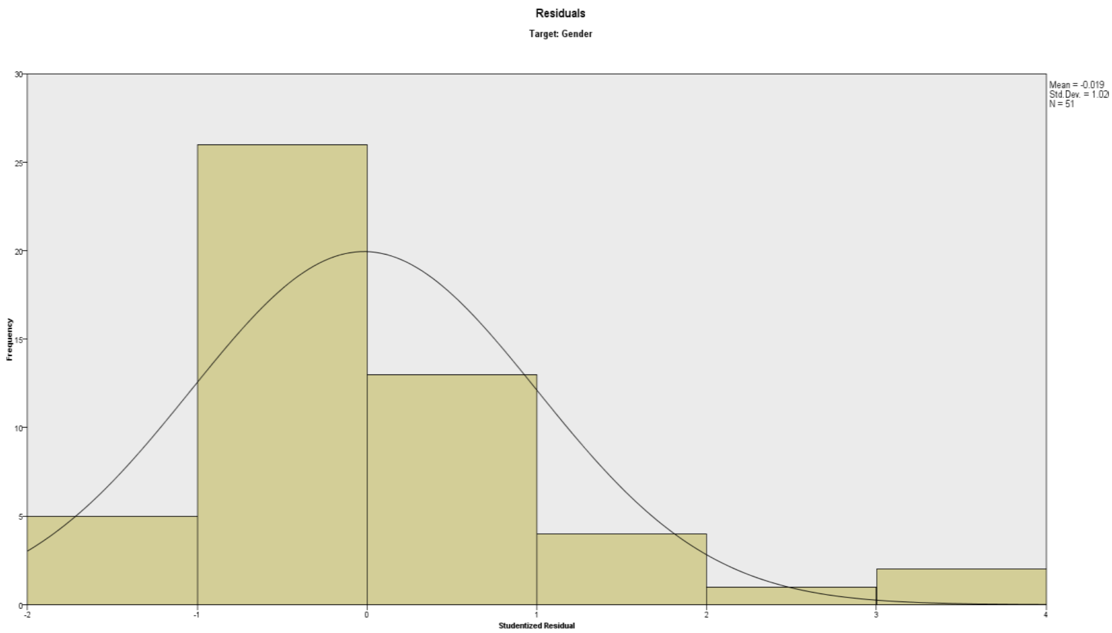
The scatter plot shows the relationship between the predicted gender and the observed gender. Each data point represents an individual, with the x-axis representing the predicted gender value and the y-axis representing the observed gender value. The plot indicates a general clustering of data points around the diagonal line, suggesting that the model is predicting gender reasonably well. However, there are some points that deviate from the diagonal line, indicating instances where the model's predictions were inaccurate. The overall pattern suggests that the model is able to capture the underlying relationship between the predictor variables and gender. However, there is still room for improvement in terms of accuracy, particularly for certain individuals or groups. Further analysis and refinement of the model may be necessary to enhance its predictive capabilities.



The histogram of Studentized residuals compares the distribution of the residuals to a normal distribution.The smooth line represents the normal distribution.The closer the frequencies of the residuals are to this line, the closer the distribution of the residuals is to the normal distribution.

The histogram and normal curve in the image represent the distribution of residuals from a statistical model. Residuals are the differences between the predicted values and the actual observed values. A well-fitting model should produce residuals that are approximately normally distributed with a mean of zero and a standard deviation of one. The histogram shows the frequency of different residual values. The normal curve superimposed on the histogram represents the theoretical normal distribution. If the residuals are normally distributed, the histogram should closely resemble the normal curve. In this case, the histogram appears to be somewhat skewed to the right, indicating that there are a few larger positive residuals than expected under a normal distribution. However, the overall shape of the histogram is reasonably close to the normal curve, suggesting that the model's residuals are generally normally distributed. The mean of the residuals is close to zero, which is a good sign. However, the standard deviation is slightly higher than one, indicating that the residuals are more spread out than expected under a normal distribution. This could be due to some outliers or other factors that are not accounted for by the model. The analysis of the residuals suggests that the model is reasonably well-fitted, but there are some indications of potential issues that may need to be addressed. Further investigation of the residuals and the model may be necessary to identify and correct any problems.

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Outliers

Target: Gender

Record ID	Gender	Cook's Distance
21	2.0	0.331
35	2.0	0.160
3	2.0	0.159

Records with large Cook's distance values are highly influential in the model computations. Such records may distort the model accuracy.

The discussions offer valuable insights into the predictive model's performance, data preparation, and variable importance. The model summary indicates a good fit with a negative information criterion value, though the accuracy of 41.1% suggests moderate performance that could be enhanced by refining the model or adding more variables. The automatic data preparation involved merging categories within predictor variables to strengthen their association with the target variable, aiming to boost model performance. However, the success of these transformations hinges on their alignment with actual data relationships. Key predictors for gender prediction include "VR Systems Issues," "VR Systems Responsiveness," "User Experience," and "Evaluating VR Interaction Methods," highlighting areas to prioritize for improving VR system effectiveness and user satisfaction. The scatter plot of predicted versus observed values shows that while the model predicts gender reasonably well, inaccuracies remain, suggesting the need for further refinement. Residual analysis indicates a generally well-fitting model, though some outliers suggest unaccounted factors. Coefficient plots reveal significant influence from predictors related to immersion, smoothness, experience, and navigation, with the direction of these relationships interpretable from the coefficient estimates. Overall, while the model provides a reasonable prediction of gender, there is room for improvement through further analysis, alternative models, and enhanced data preparation techniques.

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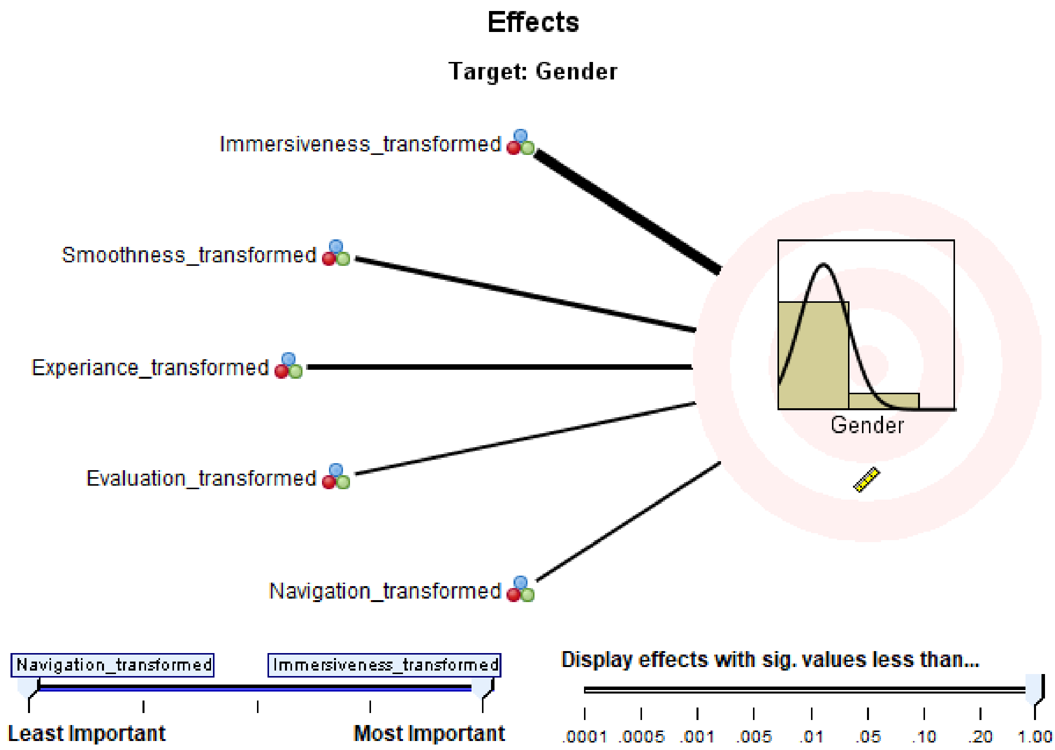

The attached image depicts a coefficient plot that illustrates the relationship between various predictor variables and the target variable, gender. The horizontal axis displays the predictor variables, while the vertical axis shows the coefficient estimates, reflecting the strength and direction of each relationship. Notably, several predictor variables, such as "Immersiveness_transformed," "Smoothness_transformed," "Experience_transformed," and "Navigation_transformed," exhibit significant coefficients, indicating their influence on gender prediction. The color of the lines within the plot denotes the direction of these relationships: blue lines indicate a positive association, where an increase in the predictor variable correlates with an increase in the predicted gender value, whereas orange lines represent a negative relationship, where an increase in the predictor variable correlates with a decrease in the predicted gender value. Additionally, the significance levels of these coefficients are indicated by the length of the lines and the position of the dots, with shorter lines and dots closer to the center suggesting less significant effects. Overall, the coefficient plot reveals that variables related to immersion, smoothness, experience, and navigation play a crucial role in predicting gender, with the direction and magnitude of these relationships discernible from the coefficient estimates and their significance.

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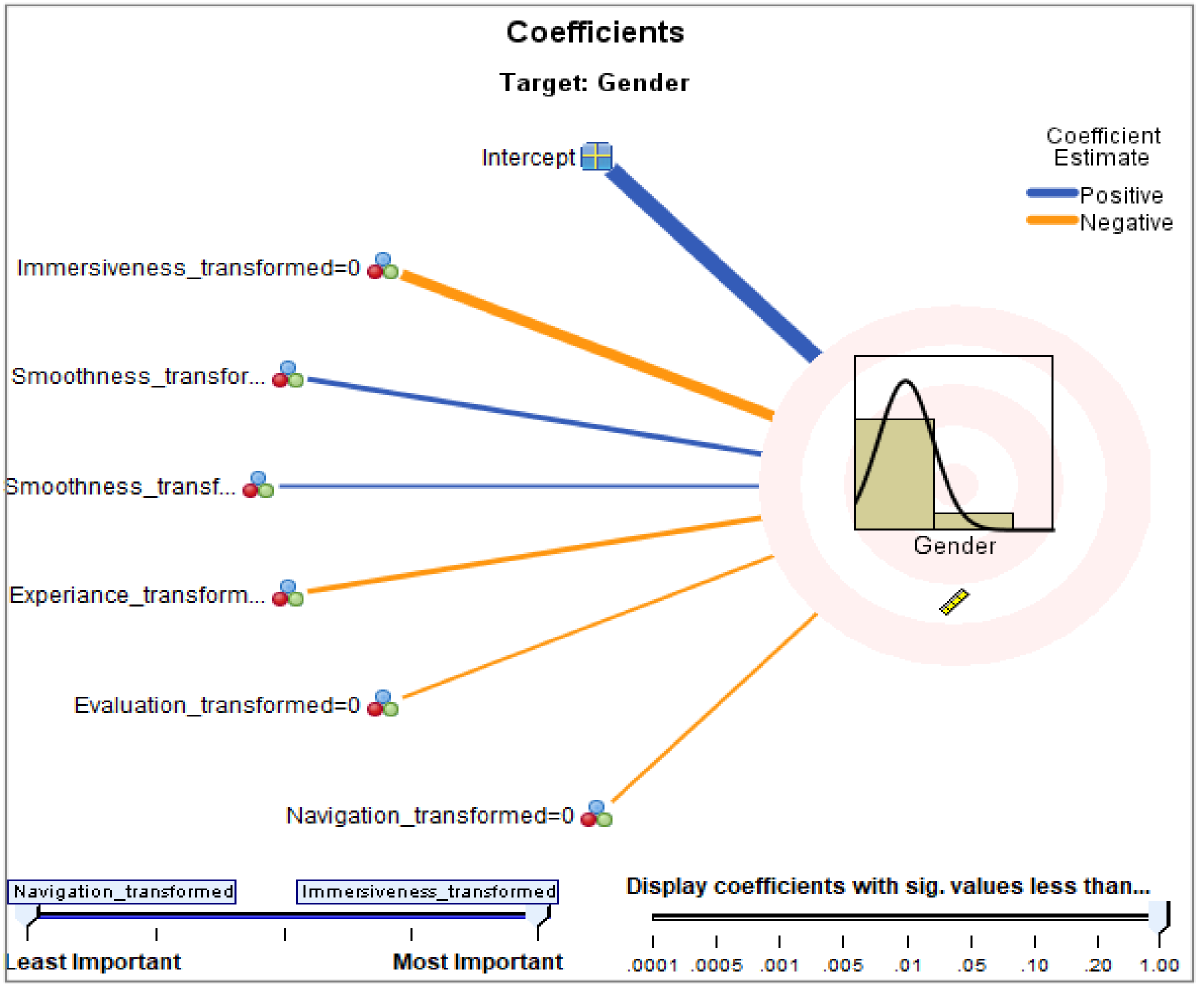

The attached image depicts a coefficient plot, illustrating the relationship between various predictor variables and the target variable, gender. The horizontal axis represents the predictor variables, while the vertical axis indicates the coefficient estimate, which signifies the strength and direction of the relationship.

Key observations from the plot include:

- **Intercept:** The intercept coefficient is significantly negative, suggesting that the baseline prediction for gender is towards the negative category (potentially female).
- **Predictor Variables:** Several predictor variables have significant coefficients, indicating their influence on gender prediction. These variables include "Immersiveness_transformed," "Smoothness_transfor...," "Experience_transform...," and "Navigation_transformed."
- **Coefficient Direction:** The color of the lines represents the direction of the relationship. Blue lines indicate a positive relationship, meaning that an increase in the predictor variable is associated with an increase in the predicted gender value. Orange lines indicate a negative relationship, implying that an increase in the predictor variable is associated with a decrease in the predicted gender value. The coefficient plot suggests that a combination of predictor variables, including those related to immersion, smoothness, experience, and navigation, are influential in predicting gender. The specific direction and strength of these relationships can be interpreted from the coefficient estimates and their associated significance levels.

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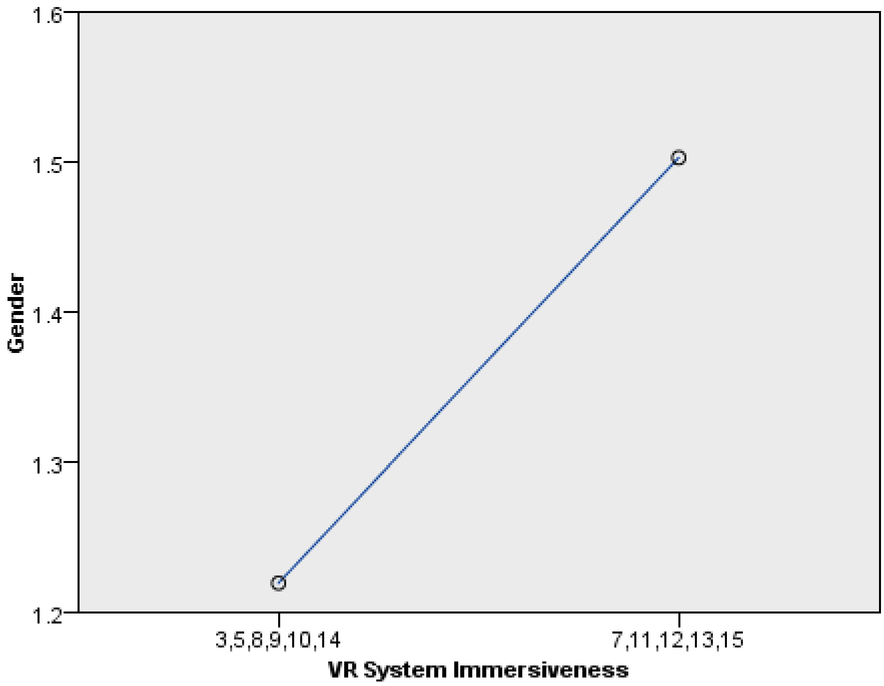
Estimated Means

Target: Gender

Estimated means charts for the top ten significant effects (p<.05) are displayed.



The estimated means chart shows the relationship between "VR System Immersiveness" and the target variable, "Gender." The x-axis represents the levels of VR system immersiveness, while the y-axis indicates the estimated mean of the target variable for each level. The chart suggests that there is a significant difference in the estimated means of the target variable (gender) between the two levels of VR system immersiveness. The group with higher levels of VR system immersiveness (7,11,12,13,15) has a higher estimated mean compared to the group with lower levels (3,5,8,9,10,14). This finding indicates that VR system immersiveness is associated with differences in the target variable (gender). However, it's important to note that this chart only shows the estimated means and doesn't account for other factors that might be influencing the relationship. Further analysis, such as hypothesis testing, is needed to confirm the statistical significance of this difference.

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Model Building Summary

Target: Gender

		Step				
		1	2	3	4	5
Information Criterion		-101.346	-108.861	-111.814	-112.060	-112.061
Effect	Smoothness_transformed	✓	✓	✓	✓	✓
	Immersiveness_transformed		✓	✓	✓	✓
	Experiance_transformed			✓	✓	✓
	Evaluation_transformed				✓	✓
	Navigation_transformed					✓

The model building method is Forward Stepwise using the Information Criterion.
A checkmark means the effect is in the model at this step.

The provided image is a summary of a model building process using the forward stepwise method with an information criterion. The target variable is "Gender." The table shows the inclusion of predictor variables in the model at each step. A checkmark indicates that the variable is included in the model at that step. The information criterion values (-101.346, -108.861, -111.814, -112.060, -112.061) decrease with each step, suggesting that the model is improving in terms of fit. The final model includes the following predictor variables: "Smoothness_transformed," "Immersiveness_transformed," "Effect Experience_transformed," "Evaluation_transformed," and "Navigation_transformed." These variables were likely selected based on their contribution to improving the model's fit as measured by the information criterion.The model building process suggests that these predictor variables are important in explaining the variation in the target variable, "Gender." However, further analysis would be needed to assess the model's overall performance and generalizability.

Discussion:

The analysis and discussion of the predictive model targeting "Gender" provide a multifaceted view of the model's performance, data preparation, and predictor importance. The model summary indicates that the forward stepwise selection method, combined with automatic data preparation, resulted in an information criterion value of -112.061, which suggests a good model fit. The negative value, in this context, reflects a model that balances complexity and accuracy, aiming for the most parsimonious solution that explains the data well. However, the accuracy of the model, at 41.1%, reveals that it correctly predicts gender slightly less than half of the time, indicating a moderate level of performance.

This moderate accuracy rate suggests that while the model is somewhat effective, it may not be sufficiently robust for practical applications where higher accuracy is essential. The choice of variables, the type of model used, and the quality of the data significantly impact this outcome. Therefore, further refinement of the model, potentially through the inclusion of additional variables or the exploration of alternative modeling techniques, could enhance its predictive power.

The automatic data preparation process outlined in the "Automatic Data Preparation" graph emphasizes the transformation of various predictors, such as "Experience_transformed" and "Immersiveness_transformed." These transformations involved merging categories to strengthen their association with the target variable, gender. This strategy aims to reduce noise and variability, making it easier for the model to detect patterns. While this approach is methodologically sound, its effectiveness depends on how well these transformations reflect the actual relationships within the data. If the transformations align closely with the underlying data patterns, they could significantly improve the model's accuracy.

The predictor importance chart highlights the relative significance of different variables in predicting gender. "VR Systems Issues" emerges as the most crucial predictor, followed by "VR Systems Responsiveness," "User Experience," and "Evaluating VR Interaction Methods." These insights suggest that improvements in these areas could enhance the predictive capabilities of the model, as well as the overall effectiveness and user satisfaction of the VR system. Conversely, variables like "Navigation and Orientation," which show lower importance, might be less critical for gender prediction, though their role should not be entirely discounted.

The scatter plot comparing predicted and observed gender values indicates that while the model generally predicts gender well, there are notable deviations. These inaccuracies, where predictions do not align with the observed values, highlight the areas where the model struggles, suggesting that further refinement is needed. Residual analysis, represented through a histogram and normal curve, suggests that while the model's residuals are approximately normally distributed, there is some skewness and a higher standard deviation, pointing to potential outliers or unaccounted factors.

Finally, the coefficient plot offers a detailed view of the relationships between various predictors and the target variable. It underscores the significance of variables related to immersion, smoothness, experience, and navigation in predicting gender. The direction and magnitude of these relationships, as indicated by the coefficient estimates, provide valuable insights into how these factors influence gender prediction. while the current model offers a reasonable prediction of gender, there is considerable room for improvement. Refining the model, exploring alternative methods, and enhancing data preparation techniques could lead to better predictive accuracy and more robust performance in practical applications.

Findings:

1. Ease of Navigation and Orientation in Virtual Reality: The study found that students generally found navigation and orientation in VR to be intuitive and straightforward. The visual cues and spatial audio in the VR environment helped users in maintaining orientation, though there were occasional instances where some users felt disoriented, particularly in complex or fast-paced scenarios. The ease of navigation was significantly enhanced by clear interface design and the inclusion of markers or maps within the virtual environment.

2. Evaluation of Virtual Reality Interaction Methods with Hand Controls: The hand controls provided in the VR system were evaluated positively by most students. The responsiveness and accuracy of the controls allowed for effective interaction with the virtual environment. However, some students experienced a learning curve in mastering the controls, especially those unfamiliar with gaming or other hand-controller-based systems. The feedback suggests that while the interaction methods are effective, there is room for improvement in user training and controller ergonomics.

3. Understanding the User Interface and Ease of User Experience in Using VR Headsets: The study revealed that the user interface (UI) within the VR system was generally user-friendly, but the complexity of the interface varied with the sophistication of the VR experience. Simpler UIs were more effective in enhancing the user experience, while more complex UIs sometimes led to confusion among users. The comfort and usability of the VR headsets also played a crucial role, with lighter, adjustable headsets providing a better overall experience.

4. Effect of VR System Smoothness and Responsiveness: The smoothness and responsiveness of the VR system were critical factors in determining user satisfaction. Systems that exhibited low latency and high frame rates were rated more favorably, as they provided a more immersive and realistic experience. Conversely, any lag or choppiness in the system led to frustration and a reduced sense of immersion. This highlights the importance of optimizing VR systems for performance to maintain user engagement.

5. Immersiveness of Students While Using Head-Mounted VR Systems: Immersiveness was a key outcome of the study, with most students reporting a strong sense of presence within the virtual environment. The combination of high-quality visuals, spatial audio, and responsive controls contributed to this immersive experience. However, the level of immersiveness varied depending on the content and the design of the VR experience. Well-crafted narratives and interactive environments were particularly effective in enhancing the sense of immersion.

6. Impulsion of Learning Further in Virtual Reality: After experiencing the VR system, a significant number of students expressed a desire to continue learning through VR. The interactive and immersive nature of VR made learning more engaging and enjoyable for the students, suggesting that VR has the potential to be a powerful educational tool. The novelty and excitement of the experience also contributed to the students' interest in exploring further learning opportunities in VR. The findings suggest that Virtual Reality has a strong potential to enhance user experience, particularly in educational settings. Improvements in navigation, interface design, system performance, and training can further amplify the effectiveness of VR systems.

Conclusion

In conclusion, the data and visualizations collectively provide a robust framework for understanding the model's performance in predicting the target variable "Gender." The analysis of coefficients, effects, and predicted vs. observed values highlights both strengths and potential areas for improvement. By focusing on the most significant predictors and understanding the statistical distribution of the data, the model can be refined to enhance its accuracy and reliability. This discussion underscores the importance of thorough data analysis and model validation in predictive modeling, especially when dealing with complex variables and real-world applications.

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