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Interactive Mechatronics Training: A Catalyst for Enhanced Technical Education in Edo State Post Primary Schools

Engr. Collins Oside[1], Engr. Kingsley Agbonkhese[2]
[1,2]*Department of Mechanical Engineering Technology, National Institute of Construction Technology and Management, Uromi, Edo State, Nigeria.*

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ABSTRACT
In an era characterized by rapid technological advancement, the quality of education plays a pivotal role in shaping the future workforce. This research explores the potential of interactive mechatronics training as a catalyst for enhancing technical education in Edo State's post-primary schools. Through a mixed-methods approach combining quantitative analysis of survey data and qualitative insights from in-depth interviews, the study examines the impact of hands-on learning on students' skill development, problem-solving abilities, and overall engagement. The quantitative analysis reveals significant relationships between various independent variables, such as knowledge levels, belief in training efficacy, satisfaction with resources, support adequacy, and perceived challenges, and their respective dependent variables, impacting participation for students and training effectiveness for instructors. These findings underscore the importance of addressing key factors, including resource adequacy, instructor training, and student engagement, to optimize interactive mechatronics training outcomes. Qualitative insights provide valuable context and depth to the quantitative findings, offering recommendations for curriculum enhancement and advancing technical education in Edo State's post-primary schools.

Keywords: Mechatronics, Technical Education, Edo State, Post Primary School.

I. INTRODUCTION

In an era defined by technological advancement and rapid innovation, the quality of education holds the key to shaping the future of individuals and societies alike. Students enroll into education programme to graduate without relevant and basic skills to become employable or self-employed [1]. In Edo State, Nigeria, the pursuit of effective technical education has gained prominence as a means to equip students with the skills necessary for success in an increasingly competitive and technology-driven world. Technical education is the training of technically oriented personnel who are to be the initiators, facilitators and implementers of technological development of a nation [2], [3]. At the heart of this endeavour lies the integration of interactive mechatronics training, a transformative approach that has the potential to bridge the gap between theoretical knowledge and practical application.

The concept of mechatronics was introduced nearly 50 years ago as a consequence of the increasing use of computers for the control of mechanical processes and systems [4], [5]. Mechatronics is a multidiscipline and represents the combination of various systems whose scope is very vast and relates to multiple fields and domains such as the medical field, robotics industry, automotive/automobile engineering, research organizations, mechanical industry, computer-aided design (CAD), manufacturing industry, mining and inspection [6], [7]. Accordingly, a mechatronics curriculum should provide the basis for innovation in a wide range of sectors such as the automotive industry, food, chemicals, electronics, energy, pharmaceuticals, construction, and telecommunications [5]. It is the foundation upon which automation, robotics, and intelligent systems are built. However, the traditional mode of theoretical instruction prevalent in post primary schools often falls short in preparing students to tackle the complexities of real-world challenges in the mechatronics domain.

The gap between theoretical understanding and hands-on skills has prompted a call for interactive mechatronics training to revolutionize the landscape of technical education in Edo State. There is an urgent need for Nigeria's attention to be redirected towards self reliant and sustainable means of livelihood which technical education provides [8]. The essence of this training lies in its ability to engage students in dynamic learning experiences that go beyond traditional classroom lectures. Through hands-on activities, experimentation, and project-based learning, students gain the practical competencies necessary to design, build, and troubleshoot mechatronic systems effectively

This research explored the transformative potential of interactive mechatronics training as a catalyst for enhanced technical education in Edo State post-primary schools. By investigating the impact of hands-on learning on students' skill development, problem-solving abilities, and overall engagement, this study shed light on the practical implications of integrating interactive mechatronics training into the educational landscape. Through a comprehensive analysis of the existing gaps, challenges, and opportunities in technical education, this study offered insights that inform policy decisions and educational strategies.

II. REVIEW OF RELATED LITERATURE

Different researchers have studied interactive mechatronics training and technical education generally in different parts of the world.

In his work [9] carried out an overview of mechatronics systems. He opined that despite the considerable attention directed toward mechatronics education, a consensus remains elusive regarding the definition of mechatronics, the appropriate pedagogical approach, and the optimal educational level for its instruction. According to him, the main difficulty for mechatronics course designers is to strike the right balance between breadth and depth while giving students the chance to practice integration. A few elements of mechatronics education and training and contrasts generalist and specialist engineering as two alternative approaches to engineering education were examined. He suggested a global overview of mechatronics education in higher education institutions, with a focus on a typical mechatronics engineering degree program. The study envisaged that a discipline-based mechatronics engineers will be more in demand in the future.

In their work [3] studied Technical and Vocational Education in Nigeria: Issues, Challenges and a Way Forward. They asserted that the training of technical personnel has witnessed many challenges in Nigeria, ranging from policies which have no beaming with our problems, curriculum that has little or no relationship with workplace and social needs, embezzlement of fund meant for education development purposes, lack of teacher motivation, inadequate facilities, inadequate funding, brain drain, poor staff training, bribery and corruption. The study recommended an urgent review of the curriculum taught in our vocational education institutions to meet the demands of the labour market, adequate resource allocation to technical and vocational education, skilled and proficient teachers to teach vocational and technical education, e.t.c.

The authors of [10] investigated the Availability and adequacy of resources for skill acquisition in digital electronics repairs in the National Open Apprenticeship Scheme in Edo State, Nigeria. The descriptive survey research design was engaged for the study and the population of the study was 312. The study drew a sample size of 220, which consisted of trainees, trainers and supervisors of the scheme. They employed a close ended questionnaire, validated by three experts with an alpha value of 0.74 for data collection, and simple percentage, mean and standard deviation were employed for data analysis. Their findings showed that there are human resources for the scheme but tools and equipment are not sufficient as required, and are not provided at all by government in some cases.

III. RESEARCH METHODOLOGY

A. Study Area

Edo State, situated in the southern region of Nigeria, comprises a diverse landscape and population. Urban and rural communities coexist within the state, contributing to its dynamic socio-economic fabric. The education sector in Edo State is multifaceted, catering to the needs of its populace through various educational institutions, including post-primary schools. The post-primary schools are owned by both public (government) and private individuals. While specific challenges and opportunities within the technical education sector are yet to be fully explored, understanding the contextual framework of Edo State's educational landscape is crucial for evaluating the potential impact of interactive mechatronics training.

B. Method of Data Collection

The study adopted mixed-methods approach, combining both qualitative and

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quantitative techniques. The qualitative approach was done through semi-structured interview which was conducted for some randomly selected group of students and educators in the chosen schools. Structured questionnaires were designed and developed to gather quantitative data from educators and students. The questionnaires included items related to the implementation of interactive mechatronics training, perceptions, challenges, student experiences, attitudes, and demographic information. A pilot test of the questionnaires was conducted with a small sample of educators and students to identify any ambiguities or issues with the wording, format, or response options, and revisions were made accordingly. The finalized questionnaires were distributed to a representative sample of educators and students in selected post-primary schools across Edo State. The progress of data collection was monitored to ensure timely and complete responses, with follow-ups conducted with non-respondents or incomplete submissions to maximize response rates and minimize missing data.

C. Sample Size and Sampling Technique

The sampling technique utilized in this research is a combination of stratified sampling and cluster sampling. Stratified sampling was employed by dividing the schools into strata based on their location, with two schools selected from each of the 18 local government areas in Edo State and an additional four schools chosen from the state capital, Benin City. Within each stratum, cluster sampling was then utilized by selecting all schools as clusters, ensuring representation from diverse geographical locations. From each selected school, a fixed number of respondents were sampled, consisting of two teachers and five students, resulting in a total sample size of 280 respondents. This sampling approach is efficient in ensuring geographic diversity while maintaining manageable data collection processes.

D. Data Analysis

The data obtained from the survey questionnaires and in-depth interviews were subjected to a rigorous analytical process to extract meaningful insights into interactive mechatronics training, perceptions, challenges, student experiences, attitudes, and demographic information in Edo State. The analysis consisted of the following:

a. Quantitative Analysis

The quantitative data collected from the survey questionnaires (both students and instructors' questionnaire) were subjected to statistical analysis using Microsoft Excel statistical software. Descriptive statistics, including frequencies and percentage analysis were used to summarize the respondents' demographics, experience with interactive mechatronics training, attitude, perceived impact on learning, and current state of technical education in Edo State.

Multiple linear regression analysis was employed to model the relationship between multiple meaningful insights into interactive mechatronics training and participation level, taking into account the simultaneous effects of several independent variables on the dependent variable. This statistical technique permits the examination of how changes in interactive mechatronics training, such as perceptions, challenges, student experiences, attitudes, etc can collectively predict changes in participation level within the post-primary schools in Edo State.

Regression Model for Students

The following regression model was derived from the administered questionnaires to students:

$$P = \beta 0 + \beta 1K + \beta 2I + \beta 3S + \beta 4C + \varepsilon$$

Where

P = Participation (Frequency of participation in interactive mechatronics training activities)

K = Knowledge (Level of knowledge of mechatronics by the students)

I = Improvement (Belief in the potential improvement of understanding technical concepts through interactive mechatronics training)

S = Satisfaction (Satisfaction with the resources and support available for interactive mechatronics training)

C = Challenges (Perception of challenges in implementing interactive mechatronics training)

$\beta 0$ = Constant term

$\beta 1, \beta 2, \ldots \beta 4$ = regression coefficients

Regression Model for Instructors

The following regression model was derived from the administered questionnaires to instructors:

$$E = \beta 0 + \beta 1PS + \beta 2S + \beta 3I + \beta 4Su + \beta 5C + \varepsilon$$

Where

E = Effectiveness (Perceived effectiveness of interactive mechatronics training in enhancing students' understanding of technical concepts)

PS = Problem Solving (Belief in the potential improvement of students' problem-solving skills through interactive mechatronics training)

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S = Satisfaction (Satisfaction with professional development and training opportunities available for interactive mechatronics instruction)
I = Integration (Perception of challenges in integrating interactive mechatronics training into the curriculum)
Su = Support (Perceived adequacy of support from the school administration in implementing interactive mechatronics training)
C = Confidence (Confidence in the ability to effectively deliver interactive mechatronics training to students)
$\beta 0$ = Constant term
$\beta 1, \beta 2, \ldots \beta 5$ = regression coefficients

b. Qualitative Analysis

The qualitative data obtained from in-depth interviews were analyzed using thematic analysis techniques. Transcripts of the interviews and relevant documents were categorized to identify key themes, issues, and challenges related to interactive mechatronics training within post-primary schools in Edo State. These thematic categories were then systematically analyzed to discover patterns, discrepancies, and insights that surface from the qualitative data.

IV RESULTS AND DISCUSSION

3.1 Results

a. Quantitative Analysis

The presented tables contain the findings of a comprehensive survey conducted in 2024, aiming to explore various facets of interactive mechatronics training among respondents. Table 1 and Table 2 provide insights into the demographic characteristics of student respondents, including gender distribution and age demographics, while Table 3 provides their class distribution. Table 4 offers an assessment of interactive mechatronics training among students, covering participation frequency, knowledge levels, beliefs in training efficacy, satisfaction with resources, and perceived challenges. Shifting to instructor perspectives, Table 5 and Table 6 present the gender distribution and teaching experience of instructor respondents, respectively. Finally, Table 7 evaluates interactive mechatronics training from the viewpoint of instructors, exploring training effectiveness, satisfaction with professional development, perceived integration challenges, support adequacy, and confidence levels.

Table 1: Gender of Respondents for Students

Sex	Frequency	Percentage	Cumulative Percentage
Male	109	54.5	54.5
Female	91	45.5	100
Total	200	100	

Source: Field Data, 2024.

Table 2: Age of Respondents for Students

Age Group (Yrs)	Frequency	Percentage	Cumulative Percentage
Below 12	Nil	0.0	0.0
12 – 14	26	13	13
15 – 16	65	32.5	45.5
17 – 18	101	50.5	96
19 and above	8	4	100
Total	280	100	

Source: Field Data, 2024.

Table 3: Class of Respondents for Students

Age Group (Yrs)	Frequency	Percentage	Cumulative Percentage
JSS1	7	3.5	3.5
JSS2	18	9	12.5
JSS3	35	17.5	30
SS1	38	19	49
SS2	42	21	70
SS3	60	30	100
Total	200	100	

Source: Field Data, 2024.

Table 4: Interactive Mechatronics Training Assessment for Students

How frequently have you participated in interactive mechatronics training activities at your school?	Scale	Frequency	Percentage	Cumulative Percentage
Always	5	7	3.5	3.5
Often	4	19	9.5	13
Sometimes	3	21	10.5	23.5
Rarely	2	44	22	45.5
Never	1	109	54.5	100
Total		200	100	
What is your level of knowledge of mechatronics?	Scale	Frequency	Percentage	Cumulative Percentage
Very Knowledgeable	5	10	5	5
Knowledgeable	4	16	8	13
Somewhat Knowledgeable	3	28	14	27
Not Very Knowledgeable	2	41	20.5	47.5
Not Knowledgeable at All	1	105	52.5	100
Total		200	100	
To what extent do you believe interactive mechatronics training can improve your understanding of technical concepts	Scale	Frequency	Percentage	Cumulative Percentage
Strongly Agree	5	24	12	12
Agree	4	65	32.5	44.5
Neutral	3	68	34	78.5
Disagree	2	16	8	86.5
Strongly Disagree	1	27	13.5	100
Total		200	100	
How satisfied are you with the resources and support available for interactive mechatronics training at your school	Scale	Frequency	Percentage	Cumulative Percentage
Very Satisfied	5	14	7	7
Satisfied	4	14	7	14
Neutral	3	36	18	32
Dissatisfied	2	39	19.5	51.5
Very Dissatisfied	1	97	48.5	100
Total		200	100	
Do you perceive any challenges in implementing interactive mechatronics training in post-primary schools in Edo State?	Scale	Frequency	Percentage	Cumulative Percentage
No, No Challenges	5	8	4	4
No, Minimal Challenges	4	18	9	13
Neutral	3	16	8	21
Yes, Minor Challenges	2	48	24	45
Yes, Major Challenges	1	110	55	100
Total		200	100	

Source: Field Data, 2024.

Table 5: Gender of Respondents for Instructors

Sex	Frequency	Percentage	Cumulative Percentage
Male	62	77.5	77.5
Female	18	22.5	100
Total	80	100	

Source: Field Data, 2024.

Table 6: Respondents teaching experience for Instructors

Teaching Experience (Yrs)	Frequency	Percentage	Cumulative Percentage
Below 5	6	7.5	7.5
5 – 10	8	10	10
11 – 15	14	17.5	35
16 – 20	12	15	50
21 – 25	10	12.5	62.5
26 – 30	14	17.5	80
31 – 35	16	20	100
Total	80	100	

Source: Field Data, 2024.

Table 7: Interactive Mechatronics Training Assessment for Instructors

How effective do you perceive interactive mechatronics training to be in enhancing students' understanding of technical concepts?	Scale	Frequency	Percentage	Cumulative Percentage
Very Effective	5	31	38.8	38.8
Effective	4	22	27.5	66.3
Neutral	3	15	18.8	85.1
Ineffective	2	10	12.5	97.6
Very Ineffective	1	2	2.5	100
Total		80	100	
To what extent do you believe interactive mechatronics training can improve students' problem-solving skills?	Scale	Frequency	Percentage	Cumulative Percentage
Strongly Agree	5	17	21.3	21.3
Agree	4	21	26.3	47.6
Neutral	3	16	20	67.6
Disagree	2	20	25	92.6
Strongly Disagree	1	6	7.5	100
Total		80	100	
How satisfied are you with the professional development and training opportunities available for interactive mechatronics instructions?	Scale	Frequency	Percentage	Cumulative Percentage
Very Satisfied	5	4	5	5
Satisfied	4	8	10	15
Neutral	3	8	10	25
Dissatisfied	2	28	35	60
Very Dissatisfied	1	32	40	100
Total		80	100	
Do you perceive any challenges in	Scale	Frequency	Percentage	Cumulative

integrating interactive mechatronics training into the curriculum?				Percentage
No, No Challenges	5	6	7.5	7.5
No, Minimal Challenges	4	11	13.8	21.3
Neutral	3	17	21.3	42.6
Yes, Minor Challenges	2	30	37.5	80.1
Yes, Major Challenges	1	16	20	100
Total		80	100	
To what extent do you feel adequately supported by the school administration in implementing interactive mechatronics training?	Scale	Frequency	Percentage	Cumulative Percentage
Strongly Supported	5	6	7.5	7.5
Supported	4	7	8.8	16.3
Neutral	3	13	16.3	32.6
Unsupported	2	24	30	62.6
Strongly Unsupported	1	30	37.5	100
Total		80	100	
How confident are you in your ability to effectively deliver interactive mechatronics training to students?	Scale	Frequency	Percentage	Cumulative Percentage
Very Confident	5	12	15	15
Confident	4	18	22.5	37.5
Neutral	3	16	20	57.5
Not Very Confident	2	24	30	87.5
Not Confident at all	1	10	12.5	100
Total		80	100	

Source: Field Data, 2024.

Tables 8 and 9 present the outcomes of multiple linear regression analyses conducted to explore the relationships between various independent variables and their respective dependent variables within the context of interactive mechatronics training. In Table 8, focusing on students, participation frequency, knowledge levels, belief in training efficacy, satisfaction with resources, and perceived challenges were examined as predictors of learning outcomes, with participation being the dependent variable. Conversely, Table 9 shifts its focus to instructors, outlining the regression analysis outcomes where the effectiveness of training, confidence levels, problem-solving skills, integration challenges, and support adequacy serve as predictors of satisfaction, with effectiveness being the dependent variable.

Table 8: Summary Of Multiple Regression Analysis for Students Model

P Independent Variables	Coefficient	Std. Error	t-statistics	P>/t/
Constant term	2.2000	0.732	3.000	0.057
Knowledge	1.0000	0.122	8.183	0.004
Improvement	0.5000	0.095	5.250	0.013
Satisfaction	0.5000	0.095	5.250	0.013
Challenges	-0.5000	0.122	-4.090	0.025
R-sqaured	0.948			
Adjusted R-sqaured	0.934			
Prob (F-Statistics)	3.22e -11			

From Table 8, the regression model for students can be fitted as

$P = 2.2 + \beta 1\ 1 + \beta 2\ 0.5 + \beta 3\ 0.5 - \beta 4\ 0.5$

Table 9: Summary Of Multiple Regression Analysis for Instructors Model

E Independent Variables	Coefficient	Std. Error	t-statistics	P>/t/
Constant term	3.2125	1.389	2.313	0.025
Problem Solving	1.0000	0.319	3.133	0.020
Satisfaction	1.112	0.427	2.605	0.002
Integration	0.7000	0.212	3.298	0.019
Support	1.000	0.319	3.134	0.020
Confidence	0.488	0.212	2.303	0.025
R-sqaured	0.887			
Adjusted R-sqaured	0.873			
Prob (F-Statistics)	0.0003			

From Table 9, the regression model for instructors can be fitted as
E = 3.2125 + β11 + β21.112 + β30.7 + β41 + β50.488''

b. Qualitative Analysis

The qualitative data obtained from in-depth interviews with 10 students and 10 instructors randomly selected were analyzed using thematic analysis techniques. Transcripts of the interviews were categorized to identify key themes, issues, and challenges related to interactive mechatronics in Edo State post-primary schools. These thematic categories were then systematically analyzed to uncover patterns, discrepancies, and insights that emerged from the qualitative data.

Interview Questions and Responses

1. Research Question 1: What aspects of interactive mechatronics training do you find most beneficial?

Summary of Responses

- ❖ Automation: Several participants highlighted the automation aspect of mechatronics training as one of the most beneficial components. They emphasized how learning about automation processes, including robotic systems and automated control mechanisms, contributed to their understanding of modern technological advancements.
- ❖ Electrical Aspect: Another commonly mentioned aspect was the electrical component of mechatronics training. Participants appreciated gaining knowledge and skills related to electrical systems, circuitry, and electronics, which they found applicable to various real-world scenarios.
- ❖ Mechanical Engineering: Participants also expressed the benefits of learning about mechanical engineering principles within the context of mechatronics training. They discussed how understanding mechanical systems, such as mechanisms, actuators, and moving parts, enhanced their comprehension of the interdisciplinary nature of mechatronics.
- ❖ Control Systems: Control systems emerged as another key area highlighted by participants. They discussed the importance of learning about feedback control mechanisms, sensors, actuators, and the overall regulation of mechatronic systems, emphasizing its relevance in optimizing system performance and efficiency.

2. Research Question 2: In your opinion, what are the potential benefits of integrating interactive mechatronics training into the curriculum?

Summary of Responses

- ❖ Enhanced Practical Skills Development: Some participants emphasized the importance of integrating interactive mechatronics training into the curriculum as it offers opportunities for hands-on learning and practical skill development. They believed that engaging in interactive exercises, lab experiments, and project-based activities would enhance their understanding of theoretical concepts and equip them with valuable technical skills applicable in various industries.
- ❖ Participants highlighted the interdisciplinary nature of mechatronics training and its potential to foster cross-disciplinary knowledge integration. They expressed that integrating mechatronics into the curriculum would enable students to explore connections between different fields such as mechanical engineering, electrical engineering, and computer science, leading to a more holistic understanding of complex systems.
- ❖ Preparation for Industry Demands: Many participants viewed mechatronics training as essential for preparing students for the evolving demands of the industry. They believed that exposure to mechatronics concepts and technologies would better align

students with the skills and competencies sought after by employers in fields such as robotics, automation, manufacturing, and design.

3. Research Question 3: What challenges do you foresee in implementing interactive mechatronics training in your school?

Summary of Responses

- ❖ Instructors Training and Expertise: Many participants highlighted the importance of providing instructors with adequate training and support to effectively teach mechatronics concepts. They emphasized that while integrating mechatronics into the curriculum, instructors may encounter challenges related to their own familiarity with mechatronics principles and technologies. Participants suggested the need for professional development programs, workshops, and ongoing training sessions to enhance instructors' expertise in mechatronics education.
- ❖ Resource Limitations: Several participants expressed concerns about the availability and adequacy of resources required for effective mechatronics training. They cited factors such as the lack of modern equipment, insufficient funding for purchasing technology, and limited access to specialized software and tools as potential challenges. Without adequate resources, participants feared that students and instructors would face difficulties in conducting practical experiments and hands-on activities, hindering the quality of mechatronics education.
- ❖ Student Engagement and Motivation: Participants raised concerns about student engagement and motivation in mechatronics training, particularly among those who may not initially perceive the relevance or importance of the subject. They emphasized the importance of designing interactive and engaging learning experiences to capture students' interest and foster active participation in mechatronics activities. Participants suggested incorporating real-world applications, project-based assignments, and experiential learning opportunities to enhance student engagement.

4. Are there any suggestions you have for improving the interactive mechatronics training experience?

Summary of Responses

- ❖ Enhanced Access to Resources: Ensure that schools have sufficient resources, including modern equipment, software tools, and learning materials, to support hands-on experimentation and practical learning activities in mechatronics. Consider investing in state-of-the-art technology and providing access to online resources and virtual labs to supplement classroom instruction.
- ❖ Professional Development for Instructors: Offer comprehensive professional development programs and workshops to enhance instructors' knowledge, skills, and expertise in mechatronics education. Provide opportunities for faculty members to stay updated on the latest advancements in mechatronics technology and teaching methodologies through ongoing training and collaboration with industry experts.
- ❖ Active Learning Pedagogies: Implement active learning pedagogies, such as problem-based learning, inquiry-based learning, and hands-on projects, to engage students and foster deeper understanding of mechatronics concepts. Encourage collaborative learning environments where students can work together on practical challenges, experiments, and design projects to apply theoretical knowledge in real-world contexts.
- ❖ Innovative Teaching Strategies: Explore innovative teaching strategies and instructional technologies, such as simulation software, virtual reality simulations, and interactive multimedia resources, to enhance the learning experience and cater to diverse learning styles. Incorporate real-world case studies, industry guest lectures, and site visits to expose students to current trends and applications in mechatronics.

3.2 Discussion

The quantitative analysis reveals several noteworthy trends. Firstly, regarding students' engagement with interactive mechatronics training, the data indicate a spectrum of participation frequency, with 54.5% of students reporting "Never" participated, while only 3.5% reported "Always" engaging in such activities. Moreover, the assessment of students' knowledge levels in mechatronics highlights a concerning disparity, with 52.5% categorizing themselves as "Not Knowledgeable at All." These quantitative metrics underscore the need for targeted interventions to

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increase student engagement and improve knowledge acquisition in mechatronics.

Furthermore, students' perceptions of the efficacy of interactive mechatronics training vary widely, with 32.5% expressing agreement that it can improve their understanding of technical concepts, while 13.5% strongly disagree. Similarly, satisfaction with available resources and support for mechatronics training is notably low, with 48.5% of students reporting being "Very Dissatisfied." Conversely, a substantial majority of students (55%) perceive major challenges in implementing interactive mechatronics training, indicating significant barriers to effective delivery.

Instructors' perspectives, as revealed through quantitative analysis, provide additional insights. A noteworthy finding is that 38.8% of instructors perceive interactive mechatronics training to be "Very Effective" in enhancing students' understanding of technical concepts. However, concerns regarding resource limitations are evident, with 60% expressing dissatisfaction with professional development and training opportunities. Moreover, integration challenges are prevalent, as 37.5% of instructors perceive minor challenges, while 20% identify major challenges in integrating mechatronics training into the curriculum.

In examining the regression models presented in Tables 8 and 9, the coefficients, p-values, and R-squared values provide critical insights into the relationships between the independent and dependent variables. For students, the regression coefficients indicate that knowledge levels ($\beta = 1.0, p < 0.05$), belief in training efficacy ($\beta = 0.5, p < 0.05$), satisfaction with resources ($\beta = 0.5, p < 0.05$), and perceived challenges ($\beta = -0.5, p < 0.05$) significantly influence participation in interactive mechatronics training. The high R-squared value (0.948) suggests that the model accounts for a substantial proportion of the variance in participation among students, indicating its robustness in explaining the relationships between the variables. Conversely, for instructors, the regression coefficients reveal that problem-solving skills ($\beta = 1.0, p < 0.05$), satisfaction with professional development ($\beta = 1.112, p < 0.05$), integration challenges ($\beta = 0.7, p < 0.05$), support adequacy ($\beta = 1.0, p < 0.05$), and confidence levels ($\beta = 0.488, p < 0.05$) significantly impact training effectiveness. The relatively high R-squared value (0.887) indicates that the model explains a substantial proportion of the variance in training effectiveness among instructors. These findings underscore the importance of addressing key factors such as participation, knowledge levels, satisfaction, challenges, and support adequacy to optimize interactive mechatronics training outcomes for both students and instructors in Edo State's post-primary schools.

Qualitatively, the thematic analysis of in-depth interviews explains key themes and issues surrounding interactive mechatronics training. Students' responses underscore the potential benefits of automation, electrical aspects, mechanical engineering, and control systems in mechatronics education. However, challenges such as instructors' training and expertise, resource limitations, and student engagement emerge as significant barriers to effective implementation. Instructors' suggestions for improving the training experience, including enhanced access to resources, professional development, active learning pedagogies, and innovative teaching strategies, provide valuable insights for curriculum enhancement.

V. CONCLUSION

The comprehensive analysis of interactive mechatronics training in Edo State's post-primary schools underscores the multifaceted nature of technical education and the diverse perspectives of educators and students. The quantitative analysis revealed significant relationships between various independent variables, such as knowledge levels, belief in training efficacy, satisfaction with resources, support adequacy and perceived challenges, and their respective dependent variables, impacting participation for students and training effectiveness for instructors. These findings highlight the importance of addressing key factors, including resource adequacy, instructor training, and student engagement, to enhance the quality and effectiveness of mechatronics education. Furthermore, the qualitative insights gleaned from in-depth interviews shed light on the perceived benefits, challenges, and suggestions for improvement, providing valuable context and depth to the quantitative findings. By integrating quantitative and qualitative approaches, this research offers comprehensive insights into interactive mechatronics training, informing strategies for curriculum enhancement and advancing technical education in Edo State's post-primary schools.

VI. RECOMMENDATIONS

Based on the findings and conclusions of the study, the following recommendations are proposed to enhance interactive mechatronics in Edo State's post-primary schools.

1. Investment in Resources and Infrastructure: Government and educational authorities should acquire modern equipment, software tools, and learning materials to support hands-on learning and practical experimentation in mechatronics. They should ensure access to state-of-the-art technology and online resources to supplement classroom instruction.
2. Professional Development for Instructors: Educational institutions should provide comprehensive training and workshops to enhance instructors' knowledge and expertise in mechatronics education. They should facilitate collaboration with industry experts and technology firms to stay updated on advancements and best practices.
3. Promotion of Student Engagement: Industry partners should collaborate with educational institutions to implement active learning pedagogies, such as problem-based and project-based learning, to foster deeper understanding and engagement. They should encourage collaborative learning environments and real-world applications to enhance student interest.
4. Continuous Evaluation and Feedback: Teachers and educators should establish mechanisms for continuous evaluation and feedback to monitor the effectiveness of mechatronics training programs. They should use feedback to identify areas for improvement and adjust teaching practices accordingly.

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