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Impact of Digital Media Instructional Method in Science On Secondary Level Students' Learning Accountability

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Abstract: *The increasing integration of digital technologies into school education has transformed classroom teaching and learning practices, particularly in Science education at the secondary level. The impact of digital media content in Science on secondary level students' Learning Accountability was examined. The investigation sought to determine whether the integration of digital media content into classroom instruction influences students' sense of responsibility, engagement, and commitment towards learning tasks, and whether such influence differs across sex and SES. A pre-test post-test experimental design was adopted, involving the classroom implementation of digital learning through a learning management system and the collection of quantitative evidence. The findings indicate that the use of digital media content in Science enhances students' Learning Accountability and supports more active and responsible participation in learning. Digital media content, therefore, emerges as an effective and inclusive instructional approach for improving Learning Accountability among secondary level students.*

Key Words: *Digital media content, Learning Accountability, Science education, Secondary school students.*

1. INTRODUCTION:

The growing presence of digital technologies has led to substantial changes in the field of education, particularly in the teaching and learning processes at the secondary school level. Instruction today extends beyond textbooks and traditional lecture methods, with multimedia tools, learning management systems, and interactive digital platforms becoming an integral part of everyday classroom practice. In Science education, where learners often struggle with abstract ideas and complex processes, digital media content enables visual representation, simulation, and interactive engagement, thereby making learning more meaningful and enriching. In addition to academic performance, modern education places considerable importance on student responsibility, engagement, and sustained participation in learning activities. These qualities are encompassed in the concept of Learning Accountability, which denotes students' sense of ownership, commitment, and responsibility for their learning tasks and outcomes. The development of Learning Accountability is especially relevant in technology-supported learning environments, where learners are expected to take an active role, manage learning resources effectively, and reflect on their own progress.

Equity and inclusiveness also occupy a central place in educational research. Variations in access to technology, learning styles, and patterns of classroom participation have frequently been discussed with reference to boy and girl students. Although a number of studies have examined the influence of digital learning on achievement and motivation, relatively limited attention has been given to Learning Accountability as an outcome variable in secondary level Science education. With this perspective, the focus is placed on analysis of the influence of digital media content in Science on the Learning Accountability of secondary school students, gains educational relevance. Such an inquiry helps to clarify whether instruction supported by digital media fosters responsible learning behaviours equally across sex and contributes to the broader objectives of inclusive and effective education.

2. Rationale for the Study:

The increasing focus on digitalisation in education indicates a movement toward learner oriented and technology enhanced teaching practices. In Science classrooms, digital media tools such as animations, simulations, videos, and interactive modules provide varied ways of presenting concepts and processes, thereby supporting meaningful participation and sustained learner interest. In addition to cognitive gains, these resources also have the potential to shape students' attitudes, motivation, and sense of responsibility toward learning.

Learning Accountability has gained importance as a key characteristic of modern educational contexts, especially those that promote self-directed and participatory learning. Nevertheless, much of the existing literature has primarily emphasised academic achievement and conceptual understanding, while comparatively limited attention has been given to behavioural and affective aspects such as responsibility, commitment, and accountability in learning.
Accordingly, a systematic examination of the influence of digital media content on Learning Accountability was explored. Such an investigation is expected to provide useful insights for teachers, curriculum developers, and policymakers concerning the effective and inclusive use of digital media resources in secondary level Science education.

3. Objectives:

The major objectives of the study were:

- To examine the effect of instructional method supported by digital media content verses traditional method, on secondary school students' Learning Accountability in Science.
- To determine whether the effect of digital media content on Learning Accountability varies with Sex.
- To determine whether the effect of traditional method of teaching on Learning Accountability varies with Sex.
- To examine the main and interaction effect of instructional method and Sex on Students' Learning Accountability.
- To examine the main and interaction effect of SES (Socio economic status) and teaching methods on Students' Learning Accountability.
- To determine whether SES has effect on relationship between Instructional method and Students' Learning Accountability

4. Hypothesis:

The following null hypotheses were formulated for the study:

1. There exists no statistically significant difference in Learning Accountability between students instructed through digital media content and those instructed through the traditional method of teaching.
2. There exists no statistically significant difference in Learning Accountability between boy and girl students instructed through digital media content.
3. There exists no statistically significant difference in Learning Accountability between boy and girl students instructed through the traditional method of teaching.
4. There exists no statistically significant main and interaction effect between the method of instruction and sex on students' Learning Accountability.
5. There exists no statistically significant difference in Learning Accountability among Students belonging to different SES.
6. There exists no statistically significant interaction effect between Instructional method and SES on students' Learning Accountability.

5. Methodology:

A pre-test-post-test control group experimental design was employed to examine the influence of digital media content on Learning Accountability among secondary school students in Science. The sample consisted of 74 students selected from a secondary school and assigned to two groups, namely an experimental group and a control group, with 37 students

in each (N=37). To ensure equivalence between the groups, the groups were matched on key factors such as intelligence, socio-economic background, and previous academic performance. Instruction for the experimental group was carried out using digital media content delivered through a learning management system and supported by multimedia resources including videos, animations, simulations, and interactive learning materials, whereas the control group was taught the same content using the conventional classroom approach.

Students' Learning Accountability was assessed using a standardized tool SLA Scale(Students' Learning Accountability Scale) developed by Monisha K H and Dr.HaseenTaj (2024) before and after the instructional intervention. The teaching programme was implemented over a specified duration, during which both groups covered identical curricular content, differing only in the mode of instruction. The quantitative data obtained were analysed using statistical techniques such as the t-test and two-way analysis of variance (ANOVA) to examine the significance of differences and to determine the interaction effect of instructional method along with sex and SES on Learning Accountability. In addition, qualitative information was gathered through student feedback and teacher interviews to gain a more comprehensive understanding of learners' experiences and perceptions of instruction supported by digital media. The use of both quantitative and qualitative methods enabled a broader and more balanced evaluation of the effectiveness of digital media content in promoting Learning Accountability among secondary school students in Science.

6. Findings:

Table 1: Equating the Control and Experimental Groups

GROUPS		N	Mean	SD	t value	Level of significance
Raven's Progressive Matrices	Control	37	41.35	7.617	1.281	Not Significant
	Experimental	37	39.08	7.624		
Socio Economic Status	Control	37	77.89	14.545	1.189	Not Significant
	Experimental	37	82.24	16.867		
Previous Achievement in Science	Control	37	53.64	6.286	0.298	Not Significant
	Experimental	37	54.10	6.939		

Table 2: Comparison of Pre-Test Students' Learning Accountability Scores of Experimental and Control Groups

Groups	N	Mean	SD	t value	Level of Significance
Control	37	281.97	48.930	1.083	Not Significant
Experimental	37	292.57	33.869		

Table 3: Comparison of Post-Test Students' Learning Accountability Scores of Experimental and Control Groups

Groups	N	Mean	SD	t value	Level of Significance
Control	37	290.43	44.365	2.244	0.05
Experimental	37	310.00	29.075		

Table 4: Comparison of Retention-Test Students' Learning Accountability Scores of Experimental and Control Groups

Groups	N	Mean	SD	t value	Level of Significance
Control	37	285.05	44.879	3.061	0.01
Experimental	37	310.92	25.040		

Table 5: Observed Data for Learning Accountability (Sex & Teaching Method)

Sex	Teaching Method	Number of Students	Mean	Standard Deviation
Boys	Traditional	21	284.33	36.679
	Digital	18	305.83	30.664
Girls	Traditional	16	298.44	53.006
	Digital	19	313.95	27.728

Table 6: Two-way ANOVA for Learning Accountability (Sex & Teaching Method)

Source of Variation	Sum of Squares	Df	Mean Squares	F-Value	Significance
Sex	2261.267	1	2261.267	1.601	Not Significant
Teaching Method	6274.354	1	6274.354	4.442	0.05
Sex × Teaching Method	164.364	1	164.364	0.116	Not Significant
Error	98874.052	70	1412.486		

Table 7: Observed Data for Learning Accountability (SES & Teaching Method)

SES	Teaching Method	Number of Students	Mean	Standard Deviation
Low	Traditional	11	272.00	57.390
	Digital	13	301.54	20.529
Medium	Traditional	14	303.64	33.079
	Digital	10	316.50	34.320
High	Traditional	12	289.17	41.136
	Digital	14	313.21	31.957

Table 8: Two-way ANOVA for Learning Accountability (SES & Teaching Method)

Source of Variation	Sum of Squares	Df	Mean Squares	F-Value	Significance
SES	5680.530	2	2840.265	2.039	Not Significant
Teaching Method	8147.486	1	8147.486	5.850	0.05
SES × Teaching Method	628.093	2	314.046	0.225	Not Significant
Error	94708.969	68	1392.779		

7. Major findings of the Study:

The results indicate clear differences in Learning Accountability between students taught through traditional instruction and those taught using digital media content supported instruction. For boys, the mean score increased from 284.33 under the traditional method to 305.83 under the digital method, while for girls it increased from 298.44 to 313.95. These descriptive findings show that students exposed to digital media content demonstrate higher levels of Learning Accountability regardless of sex. Although girls obtained slightly higher mean scores than boys under both instructional conditions, these differences are relatively small when compared to the differences observed between the two teaching methods, suggesting that the instructional approach plays a more prominent role than sex.

The inferential analysis further substantiates these observations. The two-way ANOVA reveals a statistically significant main effect of teaching method at the 0.05 level ($F = 4.442$), confirming that the mode of instruction significantly influences students' Learning Accountability. In contrast, the main effect of sex is not statistically significant ($F = 1.601$), indicating that boys and girls do not differ significantly in their levels of Learning Accountability. Moreover, the interaction effect between sex and teaching method is also not significant ($F = 0.116$), which suggests that the advantage of instruction method supported by digital media content, over the traditional method is consistent for both sex.

The two-way ANOVA on SES reveals a statistically significant main effect of teaching method at the 0.05 level ($F = 5.850$), confirming that the mode of instruction significantly influences students' Learning Accountability. In contrast, the main effect of SES is not statistically significant ($F = 2.039$), indicating that Socio Economic Status do not differ significantly in their levels on Learning Accountability. Moreover, the interaction effect between SES and teaching method is also not significant ($F = 0.225$), which suggests that the advantage of instruction method supported by digital media content, over the traditional method is consistent for Low, Medium and High Socio Economic Status of students.

The obtained findings demonstrate that instruction method supported by digital media content, is more effective than conventional teaching in enhancing students' Learning Accountability at the secondary level. The absence of significant interaction effects of Sex and SES further implies that this instructional approach functions as an equitable pedagogical strategy, benefiting Students belonging to both sex and different levels of SES in a comparable manner. Thus, the results highlight the central role of instructional design, rather than learner SEX and SES in promoting responsible, engaged, and accountable learning in secondary school Science classrooms.

8.Educational Implications:

The findings highlighting the significant influence of teaching method on students' Learning Accountability carry important implications for classroom practice, curriculum design, teacher preparation, and educational policy. The demonstrated effectiveness of instruction method supported by digital media content, suggests that systematic integration of digital resources in secondary level Science classrooms can play a vital role in strengthening students' sense of responsibility, engagement, and commitment towards learning tasks. Schools and educational institutions may therefore consider prioritising the incorporation of multimedia materials, learning management systems, and interactive digital content as regular components of instructional practice rather than treating them as supplementary or optional tools.

From a pedagogical perspective, teachers may be encouraged to redesign instructional strategies in ways that make purposeful use of digital media to promote learner accountability. Features such as structured online materials, clear task sequencing, timely feedback, and opportunities for self-paced learning can help students monitor their own progress and take greater ownership of their learning. The consistent improvement observed across both boys and girls indicates that the instruction method supported by digital media content, can be adopted confidently in mixed-sex classrooms without concern for differential impact based on sex or SES.

Educational administrators and policymakers may focus on ensuring that infrastructure, devices, and connectivity are made available to all students so that the benefits of digital instruction are not limited to specific groups. Professional development programmes for teachers may include training on the effective pedagogical use of digital media, with emphasis on strategies that foster student responsibility, active participation, and sustained engagement. At the curriculum level, the results suggest the need to embed digital learning activities within the regular instructional

framework of Science education. Curriculum planners may incorporate tasks that require students to interact with digital content, complete structured assignments, and reflect on their learning progress, thereby reinforcing habits of accountability. Assessment practices may also be aligned to support this approach by including components that evaluate not only content mastery but also students' consistency, task completion, and learning responsibility.

The findings point towards the broader role of digital pedagogy in supporting learner-centred education. By promoting higher levels of Learning Accountability through technology-supported instruction, schools can contribute to the development of self-directed, responsible learners who are better prepared to meet the academic demands of higher education and lifelong learning. Thus, the integration of digital media content in Science instruction holds significant promise for enhancing the quality and effectiveness of secondary school education.

9.CONCLUSION:

The findings indicate that the method of instruction exerts a significant influence on students' Learning Accountability at the secondary level. The instruction method supported by the Digital media content, results in higher levels of Learning Accountability when compared to the traditional classroom approach, highlighting the pedagogical value of integrating digital resources into Science teaching. In contrast, no significant differences are observed between SEX and SES, and no interaction effect is found between both sexes and SES with teaching method, indicating that the effectiveness of digital instruction is consistent across sex and all levels of SES groups. These results imply the importance of instructional design over learner sex and socio economic status in promoting responsible and engaged learning. This also support the adoption of pedagogical strategies based on digital, as an effective and equitable approach in secondary school Science education.

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