Exploring the Impact of Video-Based Assignments on Students Knowledge Retention and Insights from Qualitative Analysis

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Abstract : This research paper delves into the effectiveness of Video-based Assignments (VBA) as a pedagogical tool in improving student retention rates within higher education settings. The study employs a mixed method approach, assessing the student's retention after five months using objective tests for quantitative analysis and a questionnaire with polytomous responses for qualitative analysis. The study was conducted with over 1000 first-year engineering students. Based on the consent agreement respondents gave, 109 responses were recorded and used for research purposes. Quantitative analysis was done using classical statistical theory. Objective test reliability was determined by Cronbach's alpha coefficient, Pearson correlation coefficient and Biserial point correlation. Based on the mean score of 5 by each respondent and positive perspectives of majority of the respondents on VBA as per qualitative analysis it is recommended to equally assign VBA and conventional written assignments to students within higher education settings to enhance knowledge retention, creativity and innovative thinking.

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1. Introduction

In recent years, technology integration into education has transformed traditional teaching methodologies. One significant innovation in this domain is the utilization of VBA as a means to enhance students' learning experiences. This approach leverages multimedia resources to engage students in a dynamic learning environment, catering to diverse learning styles and fostering deeper comprehension. As the educational landscape evolves, it becomes imperative to investigate the efficacy of VBA in promoting meaningful learning outcomes. This research endeavours to explore the impact of VBA assignments on students' knowledge retention and student's perspective on VBA.

2. Literature Review

Thomas de Lange, Anne Møystad, Gerald Torgersen (2010) emphasize on VBA offers a promising avenue for integrating practical and conceptual knowledge in summative assessment. The longitudinal approach provides valuable insights into the sustained impact of such interventions on student's learning experience. However, the research findings are limited to qualitative analysis only.

Vincent Hoogerheidea, JoranVisee, Andreas Lachner, and Tamara van Gog (2019) addresses an interesting aspect of homework activities in education. However, research lacks a detailed exposition of the research methodology employed. There is insufficient information on sample selection, data collection procedures, and statistical analyses. This lack of transparency raises concerns about the validity and reliability of the findings.

AynurAksel, FatmaGürman-Kahraman (2013) presented quantitative analysis using the Statistical Packages for Social Sciences (SPSS) that helps to get an insight to students perspective about video project assignments.

This research focuses on qualitative analysis to get insights into students' perspectives on VBA and quantitative analysis for finding knowledge retention.

Keith S. Taber (2017) recommended authors should:

A. Represent how they understand internal consistency.

B. Precisely interpret the value of alpha as per the context of the study

C. Be clear about the limitations of alpha and provide other complementary statistical measures along with

In this research, an attempt is made to determine Cronbach's alpha to assess the internal consistency of the test. However, due to the following limitations of alpha mentioned by Keith S. Taber (2017)

A. It doesn't determine validity only assesses reliability

B. Only measures internal consistency

C. Assumes that items being measured are uni-dimensional; in fact, the test consists of a diverse set of questions based on lathe machine operations.

D. Alpha increases as the no. of items increases.

FahmiIshaq El-Uri, NaserMalas (2013) concluded that removal of items having negative point biserial and with the increase of the total number of items reliability of the examinations can be improved.

So, the reliability of the test is determined based based on Point Biserial Correlation γpb as well during this research.

Interesting studies are reported by researchers on the effectiveness of video-based lessons.

As a part of their study, R. Priyakanth (2020) uploaded the interactive videos on working in MATLAB environment into the LMS portal of a lab course and the participation and engagement of around 120 learners was examined by the way the questions were answered.

Another study was carried out with 240 number of first year engineering students for the course of Applied Physics by T. S. Desai and D. C. Kulkarni (2022). For the interactive type of videos, the average marks scored were reported to be about 83 % and for demonstrative type of videos, average marks obtained were only 64%. The researchers demonstrated the superiority of interactive video over linear, demonstrative video.

A Hemabala J, B ESM Suresh (2023) carried out research on the effectiveness of use of mobile technology on 506 students of second year engineering students at Chennai for teaching electromagnetism delivered through video lectures of 30 minutes duration.

Sachin K. More, Yashawant M. Patil, and Popat D. Kumbhar (2024) demonstrated that students who actively participate in interactive webinars exhibit higher levels of knowledge retention compared to conventional classroom instructions.

Denise Stanley and Yi Zhang (2018) carried out qualitative research and investigated that improvement in students learning most likely based on the content on which videos are produced by the students. The researchers presented that VBA could be a challenging activity for some groups. Students who lack technical skills or English as their primary language may feel less prepared at the start.

Schober (2018) discussed association of measures while correlating the variables. The researcher carried out in depth research and suggested the use of Pearson Correlation when there is a relationship between two continuous and random variables.

Vincent LeBlanc and Michael A. A. Cox presented

cases of Biserial Point Correlation to interpret the success of a question, and the number of questions correctly answered. Researchers also discussed general rule of thumb for interpreting the results from correlation value of r.

The present research focuses on knowledge retention analysis based on quantitative analysis after five-months on fundamentals of lathe operations as well as qualitative analysis to get insights into students experiences and perspectives on VBA.

3. Methodology

The research question is about understanding how video-based assignments impact students' learning outcomes and knowledge retention. The study was conducted on first-year undergraduate students at an engineering institute during the second semester of their academics. There were 1000 students in total in the first year of engineering. For the present study, 109 students from three different classes were selected based on the consent agreement given by them. Students were clearly instructed that participation in the survey is entirely voluntary and that they have a right to decline participation or withdraw from the survey. The estimated time of 20 minutes required to complete the survey was mentioned on the consent form.

Fig.1 : Pedagogical Strategies for Implementing Video-Based Assignments

A detailed video demonstration of lathe machine was produced, to all 1000 students providing clear instructions for the students to make video-based lathe demonstrations of their own as a part of an assignment. This was an alternative to the conventional written assignment.

All respondents submitted their recorded video links on Google Classroom. All the respondents were graded based on the quality of evidence-based video assignments they completed on time. After a five-month period, students were surveyed in real time without any prior notification after obtaining their consent in participation. In-class surveys that consisting of questions having polytomous responses and objective test consisting of 10 multiple objective questions based on fundamentals of lathe machine operations were conducted in the presence of the instructor using google form.

Data was collected using Google Forms consisting of a set of qualitative questions having polytomous response items and quantitative objective questions.

4. Data Analysis

1) Qualitative Analysis

Qualitative data obtained from the in-class survey analyzed to gather insights into the students experiences and perceptions about VBA. Following questions were included to collect qualitative data and the students responses are presented and interpreted with the help of Pie Chart.

Q1. Have you completed both VBA and conventional written assignments during your academic experience?
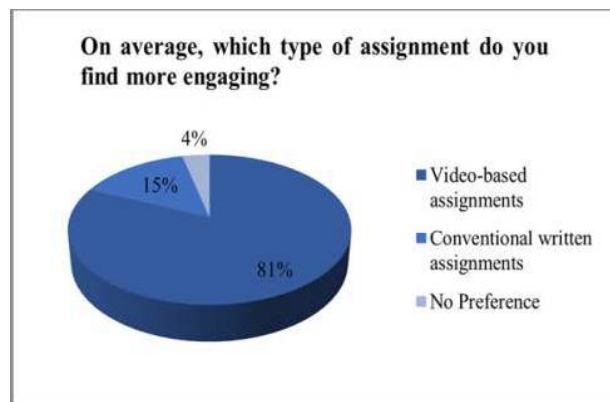
a) Yes

b) No
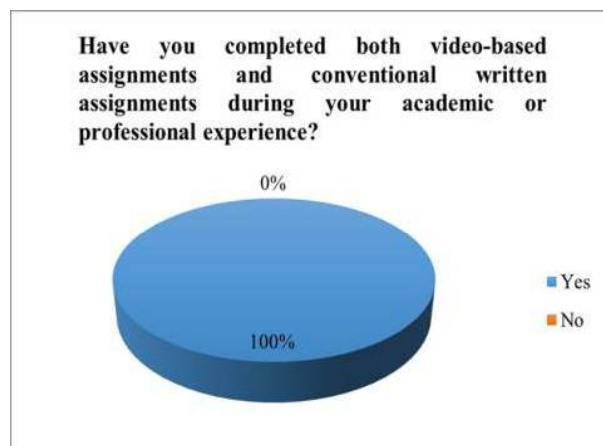
All the respondents have completed both VBA and conventional written assignments during their academic experience.

Q2. On average, which type of assignment do you find more engaging?

a) VBA

b) Conventional written assignments

c) No preference

81% of the respondents find VBA more engaging, 15% of them thinks that conventional written assignments are more engaging and only 4% of the respondents gave no preference.

Q3. Which type of assignment do you believe promotes a deeper understanding of the subject matter?

a) VBA

b) Conventional written assignments

c) No significant difference
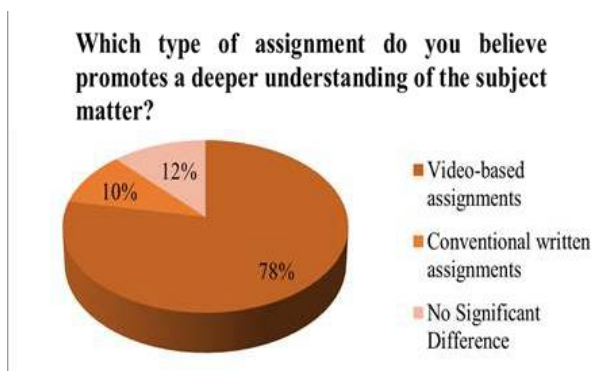
78% respondents believe that VBA promote deeper understanding of the subject matter. 10% thinks that conventional written assignments promote a deeper understanding of the subject matter. Whereas 12% of the respondents recorded that there is no significant difference the way both types of assignments promoting understanding of the subject matter.

Q4. In terms of time spent, do you think VBA require more, less, or about the same amount of time as conventional written assignments?

a) More time

b) Less time

c) About the same amount of time
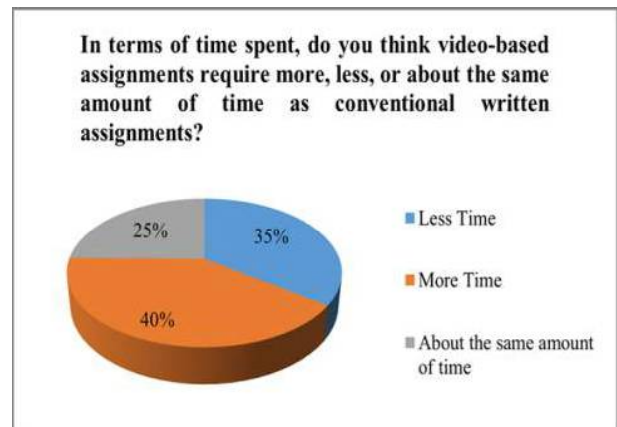
40% of the respondents recorded that more time is required for completion of video-based assignment, 25% recorded that same amount of time is required for completion of the video-based assignment and 35% respondents experiences that less time is required to complete VBA compared to conventional written assignments.

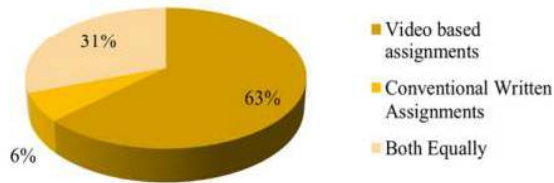Q5. Which type of assignment do you find more accessible for different learning styles and abilities?

a) VBA

b) Conventional written assignments

c) Both equally

63% of the respondents find VBA are more accessible for different learning styles and abilities. 6% respondents believe in conventional written

Which type of assignment do you find more accessible for different learning styles and abilities?

assignments and 31 % of them thinks that both type of assignments are equally accessible for different learning styles and abilities.

Q6. When it comes to assessing your own performance, which type of assignment do you believe provides clearer feedback?

a) VBA

b) Conventional written assignments

c) Both equally

When it comes to assessing your own performance, which type of assignment do you believe provides clearer feedback?
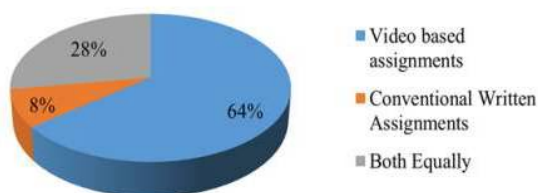
According to academic experience of 64% respondents VBA provides clearer feedback. 8% of respondents thinks that conventional assignments provide clearer feedback and 28% of them consider that both VBA and conventional written assignments provide clearer feedback on their performance.

Q7. Which type of assignment do you think encourages creativity and innovative thinking more effectively?

a) VBA

b) Conventional written assignments

c) No significant difference

Which type of assignment do you think encourages creativity and innovative thinking more effectively?
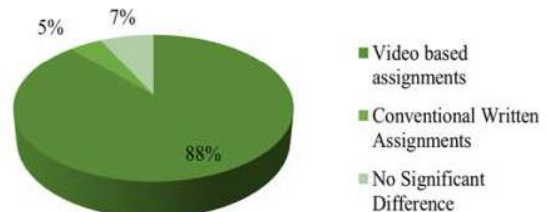
88% of the respondents thinks that VBA encourages creativity and innovative thinking more effectively compared to conventional assignments. Only 5% of respondents believe that traditional written assignments are creativity and creative thinking. However, 7% of them think that type of assignment has no significant impact on enhancing creativity and innovative thinking.

Q8. Do you believe that VBA are more enjoyable to complete than conventional written assignments?

a) Yes

b) No

c) No preference

Do you believe that video-based assignments are more enjoyable to complete than conventional written assignments?
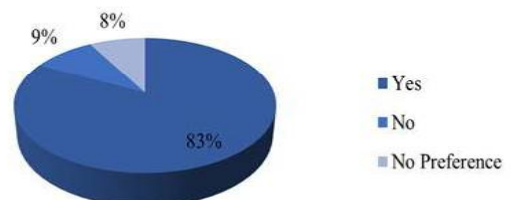
Q9. Overall, which type of assignment do you prefer as a method of learning and assessment?

a) VBA

b) Conventional written assignments

c) Both equally
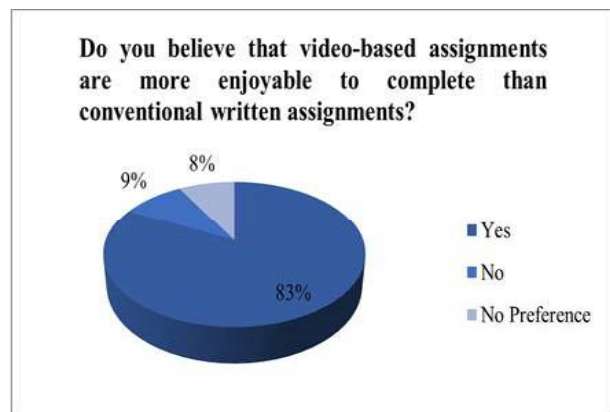
Recorded survey responses were categorized based on the Likert scale. A higher number represents a more favourable response.

Table 1 :
Likert Scale of Responses

Response	Likert Scale
Video -based Assignment s	3
Both	2
Conventional Assignments	1

Internal consistency and reliability of the questionnaire was calculated using a traditional Cronbach's Alpha formula using Microsoft Excel functions AVERAGE and VAR.S for the statistical analysis.

Cronbach's Alpha Coefficient

$$\alpha = \frac{k}{k-1}\left(1 - \frac{Varience\ of\ individual\ items}{Varience\ of\ total\ score}\right)$$
     Equation (1)

Where,

α = Cronbach's alpha coefficient, a measure of internal consistency reliability

k = No. of items in the test

Variance of individual items = variance of scores on each question

Variance of total score = Variance of sum of scores across all items

Table 2 :
Conversion of Responses into Likert Scale
for Qualitative Analysis

Sr. No.	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
I	1	3	1	1	1	3	3	1
II	3	3	3	3	3	3	3	2
III	3	2	3	2	2	3	3	3
IV	3	3	3	2	3	3	2	2
V	3	3	3	3	3	3	3	3
VI	3	3	1	2	2	3	2	2
VII	1	3	1	1	1	1	3	1
VIII	3	3	1	3	3	3	3	3
IX	3	3	3	3	2	3	3	3
X	3	3	3	3	2	3	3	3
XI	3	3	1	3	3	3	3	3
XII	1	2	3	2	2	3	2	2
XIII	1	1	1	2	2	3	2	3
XIV	3	2	3	3	2	2	3	3
XV	3	3	3	3	3	3	3	3
XVI	3	3	3	2	2	3	2	2
XVII	1	1	3	3	3	1	3	3
XVIII	3	1	1	1	3	3	3	1
XIX	3	3	2	3	2	3	3	3
XX	3	3	3	3	3	3	3	3
XXI	3	3	1	2	3	3	3	1
XXII	3	3	1	3	2	3	3	3
XXIII	3	3	1	3	2	3	3	3
XXIV	3	2	2	2	3	3	3	2
XXV	3	2	3	2	3	3	3	2
XXVI	3	1	1	2	2	3	2	2
XXVII	3	3	2	2	2	3	3	2
XXVIII	3	3	2	3	3	3	3	3
XXIX	3	3	2	2	2	3	1	2
XXX	3	3	1	3	3	3	3	3
XXXI	3	2	3	3	3	3	3	2
XXXII	3	3	1	2	2	3	3	2
XXXIII	3	2	3	2	1	3	3	2
XXXIV	3	1	1	1	1	1	1	1
XXXV	3	3	3	3	3	3	3	2
XXXVI	3	3	2	3	3	3	3	3
XXXVII	1	1	1	2	1	3	1	2
XXXVIII	3	3	1	3	3	3	3	3
XXXIX	2	2	2	2	2	2	3	2
XL	1	3	1	2	3	3	3	2
XLI	3	3	1	3	3	3	3	3
XLII	1	3	1	3	3	2	2	1
XLIII	3	3	3	3	3	3	3	3
XLIV	3	3	1	3	3	1	3	3

Sr. No.	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
XLV	3	3	1	3	3	3	3	3
XLVI	3	3	2	3	2	2	3	2
XLVII	1	1	1	2	1	1	1	1
XLVIII	1	2	2	2	3	2	3	2
XLIX	3	2	2	3	3	3	3	2
L	3	3	3	3	3	3	3	3
LI	3	3	3	3	2	3	3	2
LII	3	2	2	2	3	3	3	2
LIII	3	3	3	3	3	3	3	3
LIV	2	3	2	2	3	3	3	3
LV	3	1	3	3	3	3	1	3
LVI	3	3	2	3	3	3	3	3
LVII	1	3	2	3	2	3	3	2
LVIII	3	3	2	3	2	3	3	2
LIX	2	2	1	2	2	2	3	2
LX	3	1	2	2	3	3	3	3
LXI	3	1	1	1	2	3	1	2
LXII	3	3	1	2	3	3	3	3
LXIII	1	3	1	2	1	3	3	2
LXIV	1	3	1	2	2	3	3	2
LXV	3	3	1	3	3	3	1	2
LXVI	3	3	1	3	3	3	3	3
LXVII	3	3	3	3	3	3	3	3
LXVIII	3	3	1	3	3	3	3	3
LXIX	3	3	1	3	2	3	3	3
LXX	3	3	2	3	3	3	3	2
LXXI	3	3	3	3	3	3	3	3
LXXII	3	3	3	3	3	3	3	3
LXXIII	1	3	1	3	3	3	1	1
LXXIV	3	3	1	3	3	3	2	2
LXXV	3	3	3	2	2	3	3	3
LXXVI	3	3	3	3	3	3	3	3
LXXVII	3	3	3	3	3	3	3	2
LXXVIII	3	3	1	1	3	3	3	1
LXXIX	2	3	3	3	2	3	3	3
LXXX	3	3	1	3	3	3	3	3
LXXXI	3	3	3	2	3	3	3	3
LXXXII	3	3	3	3	3	3	3	3
LXXXIII	1	2	1	2	1	2	2	2
LXXXIV	3	3	3	3	3	3	3	3
LXXXV	3	3	1	3	3	3	3	3
LXXXVI	3	3	3	3	1	3	3	3
LXXXVII	3	3	1	3	3	3	3	3
LXXXVIII	3	3	2	3	3	3	3	3
LXXXIX	3	3	3	3	3	3	3	3
XC	3	1	2	3	3	3	3	1
XCI	3	3	2	3	3	3	3	3
XCII	3	3	1	3	3	3	3	3
XCIII	3	3	3	3	3	3	3	2

Sr. No.	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
XCIV	3	3	2	3	2	3	3	3
XCV	3	3	1	2	2	3	3	3
XCVI	3	3	1	1	2	2	1	1
XCVII	1	3	1	2	2	3	2	2
XCVIII	3	3	2	3	3	3	3	3
XCIX	1	3	3	3	3	3	3	3
C	3	3	2	3	3	3	3	3
CI	3	3	2	3	3	3	3	3
CII	3	3	2	3	3	3	3	3
CIII	3	3	1	3	3	3	1	3
CIV	3	3	1	3	3	3	3	3
CV	3	3	3	2	3	3	3	2
CVI	3	3	3	3	3	3	3	3
CVII	3	3	2	3	3	3	3	3
CVIII	3	3	3	3	3	3	3	3
CIX	3	3	2	2	3	3	3	3

Question number one was used to record only the Yes/No type of response. So, it was not possible to assign a Likert scale for this question and, thus, it was not included in the further analysis. Standard deviation was calculated using VAR.S (Variance) test using Microsoft Excel. Following results were obtained from the statistical analysis done using Microsoft Excel.

The variance of scores on each question $= 0.5440$

The variance of total score $= 21091.1333$

The sum of the variance of items $= 3.5854$

$k = $ no. of items in the test $= 109$

Cronbach's Alpha Coefficient $\alpha = \frac{109}{109-1}\left(1 - \frac{0.5440}{21091.1333}\right)$

Cronbach's Alpha Coefficient $\alpha = 1.00$

As per Keith S. Taber (2017) positive 1.00 value of Cronbach's validates the reliability of survey questionnaire as well as positive experiences and perceptions of students about VBA.

1) Quantitative Analysis

Quantitative data obtained from the objective test on fundamentals of lathe machine analyzed to gather insights into students knowledge retention about fundamentals of lathe machine operations. To determine the reliability of the objective test and to assess the direction of the relationship between a total

score and question wise score of the students statistical analysis was performed using Biserial point correlation.

Table 3 :
Marks Scored by Respondents in Objective Test Out of 10

Sr. No.	Score	Sr. No.	Score	Sr. No.	Score
I	3	41	5	81	2
II	5	42	5	82	7
III	5	43	4	83	8
IV	2	44	3	84	4
V	4	45	3	85	5
VI	5	46	5	86	3
VII	5	47	4	87	4
VIII	6	48	5	88	4
IX	6	49	4	89	6
X	6	50	5	90	5
XI	4	51	5	91	5
XII	7	52	6	92	6
XIII	6	53	5	93	5
XIV	5	54	3	94	8
XV	5	55	2	95	4
XVI	3	56	7	96	6
XVII	7	57	4	97	7
XVIII	1	58	5	98	4
XIX	5	59	6	99	5
XX	6	60	3	100	6
XXI	9	61	2	101	6
XXII	8	62	4	102	7
XXIII	6	63	4	103	5
XXIV	5	64	3	104	5
XXV	9	65	3	105	7
XXVI	6	66	5	106	4
XXVII	8	67	3	107	2
XXVIII	3	68	7	108	4
XXIX	6	69	8	109	6
XXX	8	70	3		
XXXI	8	71	3		
XXXII	4	72	2		
XXXIII	4	73	4		
XXXIV	5	74	4		
XXXV	5	75	4		
XXXVI	5	76	7		
XXXVII	5	77	4		
XXXVIII	7	78	4		
XXXIX	5	79	3		
XL	4	80	6		

Microsoft Excel functions AVERAGE, STDEV.S (Standard Deviation), CORREL (Pearson Correlation Coefficient) were used for the statistical analysis.

Average marks scored by all the respondents = 4.935

Mean Score = 5

To determine reliability of the test Pearson Correlation coefficient r analysis was done through Microsoft Excel using CORREL function. The r-value average was considered to interpret the result.

Table 4 :
Questionwise Pearson Correlation Coefficient (r)

	Pearson Correlation Coefficient r
Question 1	0.347688568
Question 2	0.412843684
Question 3	0.249997668
Question 4	0.01625934
Question 5	0.496906402
Question 6	0.406218199
Question 7	0.398117787
Question 8	0.330545631
Question 9	0.493834676
Question 10	0.527619466
Average Pearson Correlation Coefficient r	0.368003142

Positive Pearson correlation coefficient r 0.36 indicated a moderate positive relationship between the reliability of the test questions and the respondents' total scores.
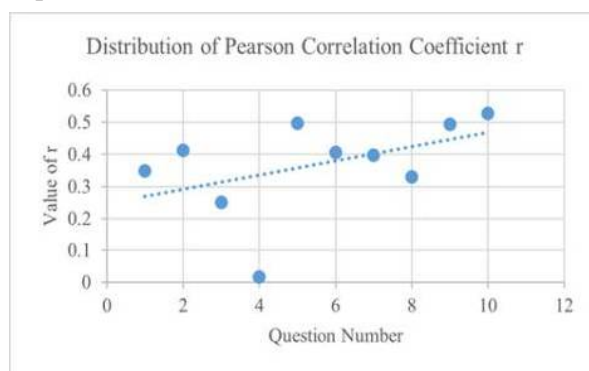
Fig.2 : Non-linear distribution of Pearson Correlation Coefficient r

Question wise distribution of Pearson correlation coefficient r indicates non monotonic relationship between the internal consistency of the test questions and marks scored by the respondents.

To assess relationship between individual question wise scores and overall test performance statistical analysis was carried out by Biserial Point Correlation using Microsoft Excel tools.

Analysis using Biserial point correlation was carried out to consider the effect of question-wise binary variables (1,0) and student-wise variations in the total score.

Biserial Point Correlation

$$\gamma_{rp} = \frac{1}{\sqrt{n}} * \frac{m1-mo}{SD} \qquad \text{Equation (2)}$$

Where

γ_{rp} = Biserial point correlation

n = Number of participants

m1 = Mean total score of the participants who answered the questions correctly

mo = Mean total score of the participants who answered the questions in correctly

SD = Standard deviation of total scores

Responses to each question were converted to binary variables as per correct/incorrect answer.

Table 5 :
Binary Variable Responses

Response	Correct	Incorrect
Binary Variable	1	0

The following results were obtained by statistical analysis of the test scores carried out using Microsoft Excel.

Table 6 :
Statistical Analysis Result

Parameter	Value
m1 Total score of the participants who answered correctly	8.53
m0 Total score of the participants who answered incorrectly	1.47
Standard Deviation of the total score	1.65
Total number of respondents	109

Biserial Point Correlation

$$\gamma_{rp} = \frac{1}{\sqrt{n}} * \frac{m1-mo}{SD}$$

$$\gamma_{rp} = \frac{1}{\sqrt{109}} * \frac{8.53-1.47}{1.65}$$

$\gamma_{rp} = 0.0957 * 4.278$

Biserial Point Correlation $\gamma_{rp} = 0.40$

Biserial Point Correlation γrp = 0.40 indicates a moderate positive correlation between the success of a question and the number of questions correctly answered by the respondents. This indicates that test questions designed to determine respondents knowledge retention were statistically significant. The mean of marks scored by all the respondents was 5 as per statistical quantitative data analysis, this results in interpreting positive impact of video-based assignment on respondents knowledge retention.

5. Results And Discussion

1) Results of Qualitative Analysis

According to the qualitative analysis, 81% of students found VBA to be more engaging than conventional written assignments. Furthermore, 78% of the respondents believed that VBA promoted a greater comprehension of the subject matter. The qualitative data indicated that VBA provided clearer feedback, according to 64% of the respondents. Additionally, the majority of students (88%) felt that VBA encouraged creativity and innovative thinking more effectively compared to traditional assignments. Nevertheless, 40% of those who responded indicated that they needed more time to complete the VBA. 64% of the respondents believe that VBA is more accessible for different learning styles and abilities. The reliability analysis conducted using Cronbach's Alpha Coefficient showed a correlation value of 1.00 that was positive. This indicates positive experiences and perceptions amongst students about VBA.

2) Results of Quantitative Analysis

The quantitative analysis, focusing on students' performance in the objective test on lathe machine operations, provided further insights into knowledge retention. The average score of 4.935 out of 10 indicated a moderate level of proficiency among the

respondents. However, the mean score of 5 suggests that, on average, students demonstrated a satisfactory understanding of the subject matter. The correlation between the question-wise scores of the students and total scores was determined using the Pearson correlation coefficient. 0.36 value of Pearson correlation coefficient r indicated moderate correlation.

Additionally, to interpret the success of a question and the number of questions correctly answered by the students, correlation value r was calculated using Biserial Point Correlation. Correlation analysis conducted using Biserial Point Correlation showed a positive correlation value of 0.40. This indicates moderately positive correlation between internal consistency of the test questions and marks scored by the students. Moderate value of r proved the necessity of redesigning objective test questions.

3) Discussion

The combined findings from qualitative and quantitative analyses suggest it is essential to incorporate VBA into educational practices to enhance engagement and comprehension. The positive correlation between VBA and knowledge retention demonstrates the value of these assignments in promoting long-term learning outcomes. Despite the beneficial effect of VBA on student knowledge retention and engagement, instructors should take into account the time needed for the completion of VBA. The moderate values of Pearson correlation coefficient and Biserial point correlation r indicate the need for effective design of test questionnaire.

Conclusion

The findings of this study highlight the advantages of incorporating video-based assignments into the educational curriculum. The results indicate that VBA not only enhances student engagement, understanding, and creativity but also promotes long-term knowledge retention. Therefore, it is recommended to integrate VBA alongside conventional written assignments to provide students with varied and compelling learning experiences. Acknowledging the limitations of this study, particularly the lack of comprehensive exploration of respondents' socio-economic, demographic, and personal characteristics, is essential. These characteristics could be illuminated by future research to ensure reliable results. Video-based assignments

could be challenging for the students who lack technical skills or English as their primary language. Statistical data analysis was done based on conventional Cronbach's alpha coefficient, Pearson correlation coefficient and Biserial Point Correlation using basic functionalities of Microsoft Excel. SPSS (Statistical Package for the Social Sciences) and SAS (Statistical Analysis System) can be employed to analyze qualitative and quantitative data comprehensively. Educators need to consider the time investment required for VBA compared to traditional assignments and strive for a balanced approach in instructional design.

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