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Youtube Videos as Learning Support in Computer Architecture: A Quasi-Experimental Study of Student Achievement

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ABSTRACT

This study examines the role of YouTube videos as a learning support resource for the Operating System and Networking topic in the Computer Architecture course at Polytechnic Sultan Abdul Halim Mu'adzam Shah (POLIMAS). With the growing use of digital video platforms in higher education, it is important to evaluate their contribution to student learning, particularly in technical and vocational education and training (TVET). This study evaluates whether there is a statistically significant difference in achievement between traditional classroom instruction and self-directed learning using YouTube videos. It also estimates the practical magnitude of any difference using Cohen's *d*. A non-equivalent quasi-experimental design was employed involving two cohorts of Diploma in Digital Technology students: a traditional teaching group (n = 72) and a self-directed YouTube-based learning group (n = 69). Achievement data were analysed using descriptive statistics and an independent samples t-test. The traditional teaching group recorded a slightly higher mean score than the YouTube-based group; however, the difference was not statistically significant, $t(139) = 1.53$, $p = 0.127$, with a small effect size (Cohen's $d = 0.26$). Overall, self-directed learning using YouTube videos produced performance comparable to traditional instruction, although it did not surpass it. The findings also suggest that YouTube videos are best positioned as a supplementary resource, particularly when combined with structured teaching activities such as diagram-drawing exercises and direct lecturer guidance. This study provides empirical evidence to inform the design of blended learning approaches in TVET and technology-based education contexts.

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1. Introduction

In today's digital learning environment, online platforms are increasingly used to support teaching and learning in higher education. This is especially true for technical subjects, where students often need to see how a process works. Multimedia materials especially educational videos have attracted attention because they combine visuals and audio. This can make difficult concepts easier to follow and understand. Noetel *et al.*, [1] reported that a systematic review in higher education also reported overall learning benefits from video, although the effects vary across studies. In this situation, YouTube is one of the most commonly used platforms. It supports different learning preferences and is often used by students for quick explanations, revision and independent study. Çoklar *et al.,* [2] highlighted that YouTube offers several educational advantages due to its popularity and ease of access. Greeves *et al.,* [3] likewise showed that YouTube is widely used in higher education to support different learning activities, although concerns about content quality remain. In addition, Maziriri *et al.,* [4] reported that students generally perceive YouTube as useful for learning and tutorials. The same trend can be seen earlier at school level. Bardakcı *et al.,* [5] found that students deliberately use YouTube to support their studies and improve academic performance, indicating that YouTube is widely accepted as an educational resource. What is less clear is whether this widespread use translates into measurable achievement outcomes, especially in Malaysian polytechnic settings where achievement-based evidence remains limited. This gap matters because technical subjects often rely on structured practice and close guidance to support understanding.

YouTube videos are widely available learning tools that often boost students' motivation. They can also encourage learners to take more responsibility for their own study. This is closely related to self-directed learning. Students plan their learning, monitoring their understanding and decide when they need extra support. Garrison *et al.,* [6] described self-directed learning as a combination of self-management, self-monitoring and motivation.

YouTube videos may also improve long term recall, especially when key points are presented through matching visuals and spoken explanations instead of just text. This aligns with the cognitive theory of multimedia learning. Mayer [7] explained from a multimedia learning perspective that learning improves when words and visuals are organised to supports active processing and minimise cognitive overload. Mayer [7] further noted that short, segmented videos can help break complex explanation into manageable parts, thereby reducing cognitive load. Mayer et al., [8] also explained that a well-planned combination of visual and narration can strengthen understanding and memory.

Alhrahsheh *et al.,* [9] also emphasize YouTube's role in education and find that when students see it as easy and useful, it can stimulate learning and student engagement. However, video is not equally effective in every setting. Much depends on how it is used. In technical education, abstract concepts often require guided demonstrations, repeated diagram sketching and step by step explanations to build understanding in a systematic way. Navarrete *et al.,* [11] suggested that visual kinaesthetic activities such as repeatedly drawing diagrams, can deepen students' understanding of technical processes. They also stressed the importance of strong visual supports in reinforcing students' processing of complex technical information.

The Operating System and Networking topic in a Computer Architecture course involves technical content that requires visual reasoning, an understanding of internal computer processes and familiarity with network structures. Yehezkel *et al.,* [12] explained that learning Computer Architecture benefits greatly from visualization, particularly when students need to form accurate representations of how internal processes work. For many first semester students, these concepts are new and can feel quite abstract. As a result, they often rely on step-by-step guidance through lectures, instructor drawn diagrams and structured in class exercises to develop a basic understanding. In a related study, Yehezkel *et al.,* [13] showed that novice learners frequently struggle to build correct mental models; therefore, guided explanations and structured practice are commonly needed at the early stage. This leads to a practical question for teaching. Can self-directed video-based learning without repeated diagram work and immediate clarification from the lecturer produce a level of comprehension comparable to conventional instruction? Although YouTube use in Malaysian polytechnic education is increasing, empirical evidence on its effectiveness as a learning support in this setting remains limited. International studies generally suggest that videos can help students engage with abstract content, but the impact is not uniform. Noetel *et al*., [1] and Zhang *et al*., [14] found that evidence from higher education is generally positive, but outcomes depend on how videos are used and the learning tasks that accompany them. Greeves *et al.,* [3] reported that YouTube is widely used in higher education to support different learning activities, although practices and outcomes differ depending on context. Much depends on the learning environment, how the videos are integrated into teaching and students' prior knowledge and learning habits. Mayer [10] highlighted that instructional videos can support learning when their design aligns with how learners process information. Brame *et al*., [15] also noted that effectiveness depends on how videos are integrated into teaching, rather than the video itself. Similarly, Navarrete *et al.,* [11] emphasized that the impact of video-based learning are shaped by the learning context, implementation strategy and learner characteristics. For this reason, there is a clear need to evaluate YouTube-based learning under authentic classroom conditions, especially when it is intended to replace or even to complement traditional teaching methods.

At Polytechnic Sultan Abdul Halim Mu'adzam Shah (POLIMAS), YouTube videos have been introduced in the Computer Architecture course as supporting learning materials. They are embedded in a dedicated digital eBook, so students can access them easily before class and during revision. However, the actual contribution of these videos to student achievement is still unclear when students rely on them in a self-directed way. This is especially important when compared with traditional teaching, which typically includes repeated diagram sketching, live explanations and structured practice in class. For that reason, this study was carried out to examine the role of YouTube videos as a learning support resource for the Operating System and Networking topic. In particular, the study compares student achievement under two approaches; traditional classroom instruction and self-directed video-based learning. It also considers how YouTube videos might work best when combined with conventional teaching methods in the future. By addressing this gap, the study clarifies whether self-directed learning through YouTube can reach a similar level of effectiveness as traditional face-to-face classroom instruction for a technical subject and whether a blended approach can further strengthen learning outcomes. Importantly, the study reports both statistical significance and practical magnitude (effect size) to support teaching decisions in a real polytechnic setting.

1.1 Research Objectives

This study was conducted to achieve the following objectives:

i. To evaluate whether there is a statistically significant difference in student achievement between traditional classroom instruction and self-directed learning using YouTube videos for the Operating System and Networking topic.
ii. To determine the practical magnitude of the achievement difference between traditional classroom instruction and self-directed learning with YouTube videos by estimating the effect size (Cohen's *d*).
iii. To discuss the potential of using YouTube videos as a supportive resource that can be combined with diagram drawing exercises to strengthen student learning in the future.

1.2 Research Questions

Based on the outlined objectives, this study addresses the following research questions:

i. Is there a statistically significant difference in student achievement between traditional classroom instruction and self-directed learning using YouTube videos for the Operating System and Networking topic?
ii. What is the effect size (Cohen's d) of the achievement difference between the traditional approach and the self-directed learning YouTube video approach?
iii. What are the teaching implications of integrating YouTube videos and diagram drawing exercises as a teaching strategy to support student achievement?

1.3 Research Hypotheses

The hypotheses were formulated in both null (H_0) and alternative (H_1) forms as follows:

i. Hypothesis 1:

- H_{01}: There is no significant difference in student achievement between traditional classroom instruction and self-directed learning using YouTube videos for the Operating System and Networking topic.
- H_{11}: There is a significant difference in student achievement between traditional classroom instruction and self-directed learning using YouTube videos for the Operating System and Networking topic.

ii. Hypothesis 2:

- H_{02}: The difference in student achievement between traditional classroom instruction and self-directed learning with YouTube videos is small in practical terms (Cohen's $d < 0.50$)
- H_{12}: The difference in student achievement between traditional classroom instruction and self-directed learning with YouTube videos is at least moderate in practical terms (Cohen's $d \geq 0.50$)

2. Methodology

This section describes the research design, population and participant selection, outcome measure, study procedure and data analysis methods used to address the research objectives.

2.1 Research Design

The study used a quasi-experimental, non-equivalent control group design with two separate student cohorts. Random assignment was not possible. Students were already placed into classes according to their intake semester. Creswell *et al*., [16] noted that this type of design is commonly used in real classroom settings when researchers need to compare learning approaches without reshuffling students. In this study, one cohort was taught through traditional classroom instruction, while the other cohort learned in a self-directed learning using YouTube video. This intact group comparison allowed the two approaches to be evaluated based on students' performance outcomes.

2.2 Population and Sample

The population for this study included all Diploma in Digital Technology students at POLIMAS who were enrolled in the Computer Architecture course. The sample was taken from two cohorts of first semester students who attended intact class groups. Importantly, these selected classes were taught by the same lecturer. This helped to keep the syllabus coverage, teaching approach and assessment methods consistent across groups. Two class groups from each cohort were included in the study. Other classes were excluded because they were handled by different lecturers, which could introduce unnecessary variation. For the final analysis, only students who sat for the Operating System and Networking topic test and had complete score records were included. The study sample consisted of two cohorts, as described below.

• Cohort 1 – Traditional Teaching Group (older cohort): First semester students from the December 2024 session who were taught through conventional face-to-face methods, with no video usage (n = 72).

• Cohort 2 – Video Learning Group (newer cohort): First semester students from the June 2025 session who learned in a self-directed manner using YouTube videos as the main learning material (n = 69).

As noted earlier, each cohort included two class groups taught by the same lecturer. Other classes in both cohorts were excluded because they were handled by different lecturers. This approach helped keep the comparison fair. Both groups followed the same course content and learning outcomes, with the main difference being whether YouTube videos were used as the primary learning resource.

2.3 Outcome Measure

The primary outcome measure for this study was students' score on an Operating System and Networking topic test, administered after each cohort completed the relevant instruction. The test measured understanding of core operating system concepts and basic computer networking. It included a combination of multiple-choice items and short structured response questions. The questions focused on key areas such as process management, memory allocation and network topology. The two cohorts did not sit for exactly the same test paper. However, both versions were developed from the same learning outcomes and were aligned in terms of topic coverage and level of difficulty to support a fair comparison. Both test versions were also academically vetted to confirm that they assessed comparable content domains at a similar cognitive level. The test was administered immediately after instruction, so it captured short term achievement.

Internal consistency reliability, for example, KR-20 or Cronbach's alpha, was not computed because the dataset available for reporting contained overall test scores rather than item-level responses. Instead, measurement quality was supported through alignment with the same learning outcomes and academic vetting. Tavakol *et al.*,[17] suggested that reporting an internal consistency estimate for the objective items and rater agreement for the structured responses would strengthen the reliability evidence in future work.

2.4 Procedure

The study was implemented in two instructional phases, one for each cohort, as outlined below:

i. Phase 1: Traditional Classroom Instruction (Cohort 1) – Students attended face-to-face lectures using printed notes and PowerPoint slides. The lecturer explained the content in real time and repeatedly drew diagrams on the board to clarify key ideas. Students also completed guided diagram drawing exercises during class to reinforce their understanding. No videos or other multimedia materials were used in this phase.
ii. Phase 2: Self Directed Video Based Learning (Cohort 2) – Students received curated YouTube video links embedded in a digital learning eBook. Each video was short (about 2–5 minutes)

and covered the same topics taught in Phase 1, such as process management, memory allocation and network topology. Students were asked to watch the videos before class as part of a flipped learning approach and to revisit them during revision before the test. During face-to-face sessions, traditional lecturing was kept to a minimum. Instead, class time was mainly used for follow up discussion and for addressing students' questions and difficulties, since most content learning took place through the videos.

After each cohort completed its instructional period, all students sat for the Operating System and Networking topic test. Cohort 1 and Cohort 2 answered different sets of questions. However, both tests measured the same intended learning outcomes and were administered under similar conditions.

2.5 Data Analysis

Data were analysed using IBM SPSS Statistics 23.0 and Microsoft Excel. The analysis was carried out in two main steps.

i. Descriptive statistics: We first summarized each group's performance by calculating the mean (M), standard deviation (SD) and sample size (N). This provided an overall picture of score patterns under each teaching approach.
ii. Inferential statistics: Next, we ran a two-tailed independent samples t-test to examine whether the difference in mean scores between the traditional teaching group and the video learning group was statistically significant. Levene's test was used to check the equal-variance assumption. Levene's test showed no significant difference in variances ($p = 0.693 > 0.05$), so the t-test results from the equal variances assumed row were reported. We also calculated Cohen's d to estimate the magnitude of the difference in means. Based on Cohen [18], effect sizes were interpreted using Cohen's benchmarks (small ≈ 0.2, medium ≈ 0.5, large ≈ 0.8). For hypothesis testing, the significance level was set at $p < 0.05$.

The sample size was determined by the available intact classes, not by a preset target. With n = 72 and n = 69, the comparison is more sensitive to moderate differences than to very small ones. Cohen [17] explained that reporting the effect size alongside the p-value to supports interpretation in practical terms.

2.6 Ethical Considerations

Approval to conduct the study was obtained from the POLIMAS management before any data were collected. Student information was treated as confidential and used only for academic purposes. No names or identifying details were recorded in the report. Throughout the study, the procedures followed the institution's research ethics guidelines, with a clear focus on protecting participants and keeping performance data private.

3. Results

The descriptive results show that Cohort 1 (traditional teaching group) recorded a slightly higher average score than Cohort 2 (video learning group). Table 1 summarizes the figures. The traditional teaching group obtained M = 84.94 (SD = 10.91, n = 72), while the video learning group recorded M = 82.10 (SD = 11.09, n = 69).

Table 1
Descriptive Statistics for Both Groups

Group	N	Mean (M)	Standard Deviation (SD)
Traditional Teaching	72	84.94	10.91
Video Learning	69	82.10	11.09

To determine whether the difference in mean scores was statistically meaningful, an independent samples t-test was conducted. As shown in Table 2, the result was not significant, t (139) = 1.53, p = 0.127, indicating no statistically significant difference in achievement between the two groups. In other words, the traditional teaching group's slightly higher mean was not strong enough to be distinguished at the 0.05 level. The 95% confidence interval for the mean difference also crossed zero, which supports the same conclusion. We also calculated an effect size to gauge how large the difference was in practical terms. Cohen's d was 0.26, which is considered a small effect based on standard benchmarks. This means the performance gap between the traditional teaching approach and the video-based approach was modest and likely limited in practical impact. Therefore, H_{01} was not rejected and H_{11} was not supported. The small effect size also indicates a small practical difference between the two approaches; hence, H_{02} was supported, while H_{12} was not supported.

Table 2
Independent Samples t-Test Results

Statistic	Value
T	1.53
Df	139
p (two-tailed)	0.127
Cohen's *d*	0.26 (small)

Overall, Cohort 1 (traditional teaching group) recorded a slightly higher mean score than Cohort 2 (video learning group). The mean for Cohort 1 was M = 84.94 (SD = 10.91), compared with M = 82.10 (SD = 11.09) for Cohort 2. However, the difference was not statistically significant (p = 0.127). In practical terms, both groups performed at a similar level given the sample size and score variation. The effect size was also small (Cohen's d = 0.26), which supports the same conclusion.

Taken together, the results indicate that self-directed learning through YouTube videos produced achievement that was broadly comparable to traditional classroom instruction in this setting. The traditional group did score slightly higher on average. However, the difference was not significant and the effect size was small, suggesting that YouTube-based learning was almost as effective as the conventional approach for the Operating System and Networking topic.

4. Discussion

The findings show that student achievement did not differ significantly between the traditional teaching approach and the self-directed YouTube video learning approach for the Operating System and Networking topic. The traditional group recorded a slightly higher mean score (M = 84.94) than the video group (M = 82.10). However, the difference was not statistically significant, t (139) = 1.53, p = 0.127 and the effect size was small (d = 0.26). In practical terms, students who learned independently through YouTube performed almost as well as those who learned through conventional face-to-face instruction. This pattern is consistent with multimedia learning theory, where short videos can support understanding by pairing narration with visuals and allowing replay when needed. Mayer [7] and Mayer [10] explained that these features enhance learning by supporting cognitive process. At the same time, Garrison *et al.,* [6] noted that self-directed learning can be demanding for novice learners, especially when they have to regulate their own pace and check misconceptions without immediate scaffolding.

These results have a few practical implications for teaching. First, the video learning group performed similarly to the traditional teaching group. This suggests that learning independently through YouTube did not put students at a disadvantage. Their results were almost the same as the students who learned through traditional classroom instruction. This indicates that YouTube videos can work as a useful learning support for first semester students. In particular, they can help students follow the basic concepts of operating systems and networking. This point is consistent with past research. Alhrahsheh *et al.*, [9] note that videos can support self-directed learning, particularly when students perceive them as easy to use and helpful. Evidence from student-based studies supports this. Maziriri *et al.,* [4] reported that students generally view YouTube as useful for learning and tutorials. Jackman *et al.,* [19] also argued that YouTube can bring pedagogical benefits when it is used deliberately as part of classroom instruction. Similar findings have been reported elsewhere. Kabooha *et al.,* [20] found positive student responses to YouTube-based learning activities and Clifton *et al.,* [21] linked YouTube use with improved learning and engagement. However, YouTube works best when it is used with care. In other words, content needs to be curated and aligned with the intended learning outcomes. Brame *et al.*, [15] made the same point by stressing that video effectiveness depends on design and integration, not on the platform alone.

However, the video learning cohort scored slightly lower than the traditional teaching cohort and this may be linked to how the learning was delivered. In the traditional teaching group, students had direct guidance from the lecturer. They also received in-class demonstrations and repeated diagram drawing practice. These hands-on activities are important in technical subjects because they help students visualise the process and organise the steps clearly. Among the activities, diagram drawing is the one that often makes the difference. When students repeatedly sketch system diagrams, they learn through more than one channel, not just by reading or listening. Navarrete *et al.,* [11] also noted that strong visual supports and interactive elements can improve how students process technical information. In our study, the video group did not have the same structured diagram practice during class. Most learning happened through individual video viewing, which may not give the same reinforcement or allow misconceptions to be corrected immediately, as can happen during guided classroom exercises.

Additionally, the non-significant result suggests that video based self-learning on its own may not fully replace the lecturer's role in a technical course that often needs step by step explanation. Videos can deliver content but they cannot respond immediately when students get stuck. Some students may also struggle to stay motivated or to practice problem solving consistently without prompts and follow up. For this reason, videos tend to work best when they are used together with other teaching strategies, rather than on their own. Previous studies support this view. YouTube videos can increase engagement and may even improve performance when they are integrated in a structured way. However, they are usually used as supplements rather than complete replacements for teacher led instruction. For example, Jill *et al.,* [22] found that instructor-created YouTube videos, when used alongside regular teaching can improve student engagement, motivation and performance. In other words, the videos were part of the course design, not the only teaching method. In our study, the results show that the videos conveyed the material reasonably well. The small gap compared to traditional classroom instruction may be because students did not get immediate guidance and feedback from a live lecturer.

Overall, the findings do not show a clear achievement advantage for either approach. Students in both groups performed at a broadly similar level. This suggests that YouTube-based learning can function well as a supporting resource, particularly when the videos are short, well-curated and aligned with the topic. At the same time, the traditional teaching group maintained a small mean lead. In a technical subject, this is not surprising. Face-to-face teaching typically includes guided practice, repeated diagram work and immediate feedback when students make mistakes or misunderstand a concept. These features provide structured reinforcement that students may not get from video viewing alone. Taken together, the results point to a blended approach. Video for preparation and revision while class time for guided practise; as the most realistic way forward. To make this easier to implement, a simple teaching framework is outlined in Table 3.

4.1 Implementation of the Proposed Blended Micro Video Diagram Framework

The routine in Table 3 follows the flipped classroom idea. Students meet core content before class, then use class time for practise, discussion and feedback. van Alten *et al*., [23] found that meta-analytic evidence suggests that flipped designs can produce small gains in learning outcomes when the in-class component is used well. The in-class steps are also designed to move students beyond passive viewing, in line with the Interactive Constructive Active Passive (ICAP) framework. Chi *et al*., [24] explained that this framework supports deeper learning through more active forms of engagement. This framework can be adopted with minimal changes to existing teaching routines. It keeps the videos short and purposeful, while face-to-face time for the parts students usually find hardest, such as diagram, practise and feedback.

Table 3
Proposed Blended Micro video–Diagram Framework for Teaching Operating System and Networking

Stage	Student Task	Lecturer Task	Purpose/Theory Link
1. Before class (micro video)	Watch the assigned video and note 2–3 key points. Add one question if anything is unclear.	Share a short viewing guide about what to focus on. Post one quick check-in question.	Mayer *et al*., [8] noted that short, segmented explanations help manage cognitive load.
2. Start of class (quick check)	Answer a short retrieval question (1-3 items) based on the video.	Address common errors straight away. Keep the recap brief.	Roediger *et al*., [25] showed that retrieval practise strengthens learning and helps surface misconceptions early.
3. In class (diagram and practise)	Do diagram drills and guided problems step by step. Check answers with a partner.	Model the diagram on the board, then coach practice and give quick feedback.	Chi *et al*., [24] emphasises that active and interactive engagement improves learning; diagram work supports technical understanding during practise. Navarrete *et al*., [11] also highlighted the value of strong visual supports for processing technical information.
4. After class (revision)	Rewatch key sections if needed and	Provide a short practice list and	Cepeda *et al*., [26] found that spaced review supports longer

	complete a short practice set.	reminders on what to revise.	term learning and performance stability.

In summary, this study did not show a clear winner between the two approaches. Both approaches were effective in this setting. The results instead suggest that YouTube videos can serve as an effective learning support, especially when they are used alongside conventional teaching methods. The small difference in scores also helps explain what each approach contributes. Videos offer flexibility, clear visual demonstrations and the chance to replay content at the student's own pace. However, face-to-face teaching provides immediate clarification, guided practice and feedback that can be adjusted based on students' needs. Gopalan *et al.*, [27] noted that findings from quasi-experimental comparisons should be interpreted with caution, especially when groups come from different intakes and the test forms are not identical.

5. Limitations

This study compared two different intakes using a non-equivalent, cohort-based quasi-experimental design. It fits a real classroom setting but it comes with trade-offs. Gopalan *et al.*, [27] noted that when students are not randomly assigned, cohort effects and other unmeasured differences cannot be fully ruled out. For example, the two groups may differ in entry-level ability, study habits, access to devices or Internet or prior exposure to related topics.

Instructor variability was reduced by including only classes taught by the same lecturer. Even so, teaching can shift across semesters. The lecturer's pacing, emphasis or familiarity with the topic may have improved over time and this could influence performance. Instrumentation is another consideration. Handley et al., [28] highlighted that even when tests are aligned to the same learning outcomes, non-identical items can still affect scores because small differences in wording or difficulty matter.

There are also internal validity threats that cannot be fully removed in a cohort design. Selection is the main concern because the two intakes may differ in baseline ability or learning habits in ways we did not measure. History and maturation effects are also possible, since the cohorts were taught in different semesters. Gopalan *et al.*, [27] and Handley *et al.*, [28] described these are common issues in quasi-experimental classroom studies so the findings should be interpreted with appropriate caution.

Another limitation is the time horizon. The topic test was administered right after the instruction period. It therefore captures short term achievement rather than longer term retention.

We also did not include a delayed post-test or transfer task. These outcomes matter in technical subjects and they may respond differently to how students' study. Dunlosky *et al.*, [29], Cepeda *et al.*, [26] and Roediger *et al.*, [25] showed that retention often benefits from spaced practise and retrieval activities. Barnett *et al.*, [30] also argued that transfer should be assessed using tasks that go beyond the exact examples taught.

Future work can strengthen the comparison in a few practical ways. A short pre-test or the use of baseline indicators such as prior Grade Point Average (GPA), would help check group equivalence before the intervention. Austin [31] also suggested that matching or propensity score methods can also be used to reduce confounding from observed differences between cohorts. Finally, tracking video engagement such as completion rates and practice time would provide a clearer picture of how students actually used the videos. A delayed post-test, for example after three to four weeks would provide a direct check on retention. Adding a small set of transfer questions such as troubleshooting cases or unfamiliar network layouts would show whether students can apply what they learned to new situations. Where possible, sustained performance can also be tracked through later assessments such as the final exam or the next related topic.

6. Conclusion

This study examined whether YouTube videos can function as an effective learning support resource for a technical topic, Operating System and Networking within a Computer Architecture course. The results showed no statistically significant difference in achievement between the cohort taught through traditional methods and the cohort that learned in a self-directed manner using YouTube videos. The traditional teaching group did record a slightly higher mean score but the gap was small and not statistically significant, with a small effect size (d = 0.26).

The results suggest that self-directed learning through YouTube videos can lead to achievement that is close to what students gain through traditional lecturer classroom instruction, even for technical content. In practical terms, using YouTube as a delivery medium did not reduce students' learning outcomes. This finding supports YouTube based learning as a viable approach in this setting, rather than a weaker option. It is most likely to work when students receive clear guidance on how to use the videos and when the selected content aligns with the intended learning outcomes.

At the same time, the study suggests that YouTube videos on their own are unlikely to outperform traditional teaching. Videos can explain content but they do not provide the full support that students usually receive in a structured face-to-face class. For example, a video cannot respond when a student asks a follow-up question or adjusts the explanation based on what the class is struggling with. It also cannot replace guided problems solving and hands on practice done together in class. For this reason, videos are best used as part of a blended approach. The more promising option is to combine YouTube resources with in-person teaching. Videos can be used for preparation and revision. While class time can focus on practice, discussion and immediate feedback.

In summary, this study shows that using YouTube videos did not reduce student learning outcomes compared with traditional teaching. This supports their role as a useful supplementary learning resource. At the same time, the findings suggest that the strongest outcomes in technical and vocational education are more likely when video resources are integrated with conventional instruction. When YouTube videos are used to complement rather than replace live teaching, educators can combine the strengths of both approaches. This can provide students with a more complete learning experience.

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