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Enhancing Collaborative Video Note-Taking: A Mixed-Methods Study of Tagging and Formatting Strategies

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Abstract: This study explores strategies to improve collaborative video note-taking in online learning environments. Responding to the widespread shift toward digital education, a mixed-methods approach was employed, combining survey analysis and controlled experiments. A preliminary survey involving 85 students highlighted key issues in current collaboration tools, particularly in terms of note organization and efficiency. Two within-subjects' experiments (n = 128 each) assessed the effects of tag-enhanced notes, Markdown-formatted notes, and a combined format on information retrieval performance. The results showed a significant improvement in efficiency with the combined approach, supporting the integration of tagging and formatting features in educational note-taking systems. The findings offer practical insights for designing more interactive, adaptable, and scalable tools for online learning.

Keywords: online learning; video note-taking; collaborative learning; tagging; markdown; mixed-methods research; learning efficiency

1. Introduction

The sudden shift to online education brought by global circumstances has had a profound influence on higher education [1]. The heavy dependence on digital platforms exposed a range of challenges related to student engagement, learning efficiency, and collaboration. Among the many factors influencing success in online education, effective note-taking — especially for video content — emerged as a critical skill, as video lectures became a dominant instructional medium. However, conventional note-taking methods often fall short in digital learning environments, limiting students' ability to synthesize content and collaborate effectively.

While existing tools like Teams and Google Docs support basic note-taking, they frequently lack features tailored to video-based learning and real-time collaboration — such as time-stamped annotations and synchronized inputs [2]. Previous work has indicated that tagging systems and formatting techniques like Markdown may enhance the organization and retrieval of notes. Despite this, few studies have examined how these features might work in tandem to improve the efficiency of collaborative video note-taking in online settings [3].

This study addresses that gap by evaluating the individual and combined effects of tagging and Markdown formatting on learning performance. Through a mixed-methods design, the research provides evidence-based insights for enhancing the functionality and effectiveness of digital note-taking tools. The outcomes aim to guide the development of more engaging and learner-centered online education platforms.

2. Methodology

This research employed a mixed-methods approach to comprehensively investigate user needs and identify strategies to optimize video note-taking tools for online learning environments.

The qualitative phase included semi-structured interviews and diary-based studies, enabling a deeper exploration of user experiences during real-world tool use. Five university students participated, offering perspectives on usage motivations, behavioral patterns, emotional reactions, and overall evaluations of the tool [4]. Open-ended questioning facilitated detailed, narrative-style feedback, revealing both strengths and pain points. These findings provided a theoretical basis for design iteration. While rich in context, this phase was limited by sample size, interpretive subjectivity, and time-intensive data collection [5].

To complement these insights, the quantitative phase involved structured surveys and statistical analyses aimed at identifying usage trends and feature preferences. An initial questionnaire gathered data on user background, usage frequency, functionality expectations, and satisfaction [6]. After refining the focus based on initial results, a second survey was conducted to explore feature prioritization and emerging user needs. Recognizing that surveys may miss emotional and behavioral subtleties, later stages incorporated low-fidelity prototyping and usability evaluations to validate design effectiveness and overall acceptance [7].

By integrating both qualitative and quantitative perspectives, the study offers a well-rounded understanding of user experiences and behavior, laying a solid foundation for the continued development of more effective collaborative video note-taking tools [8].

3. Data Acquisition

3.1. First Survey

The initial survey aimed to evaluate students' awareness of common challenges in online learning and to identify their specific needs related to video note-taking features [9]. The target group consisted of enrolled students at Goldsmiths, University of London, including undergraduate, postgraduate, and international students, all of whom had prior experience with online courses [10].

To improve the reliability and representativeness of the data, the survey design carefully accounted for potential sources of error, including both sampling issues (such as limited coverage) and non-sampling factors (such as design bias, measurement inaccuracies, or disruptions caused by respondents). The questionnaire primarily featured closed-ended items, supplemented by several open-ended prompts to gather both quantitative data and qualitative insights.

With considerations of sample size and design, the survey achieved a 95% confidence level and a margin of error of ±5%. Prior to distribution, demographic screening was conducted to ensure eligibility. Clear, concise language was used throughout the questionnaire to minimize ambiguity and avoid leading questions. According to system logs, the average completion time was 84.5 seconds, indicating a high degree of user engagement and clarity in question design.

A total of 80 responses were collected, all of which were validated following data cleaning. The demographic breakdown of the participants is presented in Table 1, forming the basis for subsequent analysis and interpretation.

Table 1. Demographics of the First Survey.

Variable	Item	Amount	Percentage(%)
Age	18-20	5	6.3%
	21-23	63	78.8%
	24-26	8	10%

	27-29	2	2.5%
	30+	2	2.5%
Gender	woman	55	68.8%
	man	24	30%
	non-binary	0	0
	prefer not to say	1	1.3%
	Other	0	0
The current level of study	Undergraduate	27	33.7%
	Master	52	65%
	Ph.D.	1	1.3%
Country of the current study	China	51	63.8%
	UK	26	32.5%
	America	1	1.3%
	Others	2	2.5%
Total time for online classes	Less than 1 month	14	17.5%
	1-3 months	33	41.3%
	3-6 months	20	25%
	More than 6 months	13	16.3%

Calculations based on N = 80.

The first five survey questions focused on demographic information. Responses to the age question (Q_1) were concentrated in the 21-23 age range, with a median age of 22. Gender distribution (Q_2) indicated a majority of female respondents. Educational background (Q_3) was predominantly at the Master's level, consistent across all descriptive measures. Question 4 captured participants' study locations, while Question 5 revealed that most respondents had experienced 1 to 3 months of online learning during the pandemic, with a median duration in that range.

For the non-demographic section, all participants (Q_6) reported using Microsoft Teams as their primary online learning platform. Self-assessed knowledge mastery (Q_7) yielded a mean score of 3.1 on the rating scale, with a median of 3. Question 8 examined students' review strategies, with detailed results presented in Table 2.

Table 2. Ways to Review Online Lessons.

Item	Amount	Percentage(%)
Repeat the recording	44	55%
View screenshots	25	31.3%
Review notes	31	38.8%
View the lesson PPT	42	52.5%
No review	17	21.3%
Others	2	2.5%

Further analysis based on the sample of 80 respondents indicates that a substantial number of participants identified “re-watching recordings” and “viewing lesson slides or PPTs” as their primary review strategies.

Question 9 focused on students' note-taking habits, with results summarized in Table 3. The majority of respondents reported regularly taking notes during online learning sessions, showing a nearly equal split between digital and traditional (handwritten) formats.

Table 3. Ways to Take Notes.

Item	Amount	Percentage(%)
Paperless Notes (e.g. OneNote, Evernote, Notability)	39	48.8%
Traditional paper notes	34	42.5%
No notes	17	21.3%

	Others	4	5%

Continuing with the analysis of the 80 responses, students were asked to identify the primary challenges they faced when reviewing recorded lectures. The most frequently reported issue was difficulty locating key points (53.8%), followed by excessive video length (46.3%), lack of subtitles (32.5%), and inconvenient note-taking (18.8%). An additional 11.3% selected "other," citing reasons such as having "no problems" or being "unable to record the screen."

Question 11 investigated participants' familiarity with video note-taking software. A significant majority (87.5%) had never used such tools, while 12.5% had prior experience. Among the 10 valid responses from users, commonly selected features included collaboration tools (4), pop-up annotations (4), and timestamp functions (5). No respondents selected the "other" option. Notably, 87.5% expressed a willingness to use this type of software in the future, while 12.5% were not interested.

3.2. Interview

Following the initial questionnaire, semi-structured interviews were conducted to gain a deeper understanding of user experiences and expectations. A total of five participants were interviewed. Their demographic information is summarized in Table 4.

Table 4. Demographics of Interview.

Number	Age	Gender	Current level	Major	App for online classes
1	23	Female	Postgraduate	User experience engineering	Teams
2	19	Male	Undergraduate	Architecture	Teams/Miro
3	23	Female	Postgraduate	User experience engineering	Teams
4	23	Female	Postgraduate	Design	Teams
5	22	Female	Postgraduate	Users experience engineering	Teams

The interview phase served to enrich and contextualize the findings from the initial survey by exploring students' challenges with online learning and note-taking, as well as their expectations for video-based learning tools. In addition to sharing general experiences, participants frequently highlighted desired features such as timestamps, pop-up annotations, and integrated chat boxes.

While video note-taking was widely regarded as a means of enhancing knowledge retention, several concerns were raised regarding usability and technical reliability. A key theme that emerged was the importance of precise time-stamping, which participants viewed as essential for aligning notes with specific instructional segments. This alignment was seen as critical to facilitating efficient, targeted review sessions.

Participants generally agreed that video note-taking tools should function as supplementary aids — organizing complex audiovisual content into structured, digestible text — rather than fully replacing traditional note-taking practices.

3.3. Second Survey

The second survey aimed to evaluate students' perceptions of specific video note-taking features by asking them to rate the usefulness of various functions. Targeting students at Goldsmiths with prior experience or interest in online learning tools, the survey yielded 61 valid responses. The summarized results are presented in Table 5.

Table 5. Data of Rating for Video Note-Taking Function.

Category	Mean	Median	Standard Deviation	Margin of error
Dialogue box	3.74	4	0.83	3.74 ± 0.21
Pop-ups	2.92	3	1.19	2.92 ± 0.15
Tags	3.97	4	0.90	3.97 ± 0.23
Timestamp	4.25	4	0.86	4.25 ± 0.22

In evaluating the perceived usefulness of various video note-taking features, the comment box received predominantly positive feedback. A majority of participants (85.2%) found it beneficial for annotation, while 47.5% considered it helpful for reviewing content, and 49.2% for collaborative purposes.

The pop-up window feature was also regarded as useful for annotation (72.1%); however, it was rated significantly lower for review (21.3%) and collaboration (27.9%). Many students described it as intrusive, and over half expressed a reluctance to use it in practice.

The tag feature received relatively balanced support across all categories: 60.7% considered it useful for annotation, 55.7% for review, and 39.3% for collaboration. Negative feedback was limited, suggesting overall acceptability.

The timestamp function emerged as the most favorably rated feature. It was considered highly effective for review by 85.2% of participants and for annotation by 75.4%. Although only 23% found it useful for collaboration, more than 90% supported its inclusion in video note-taking tools, with fewer than 10% raising concerns about its accuracy.

3.4. Diary Study

The diary study offered an opportunity to capture real-time reflections on live video learning, providing a more granular view of students' day-to-day challenges in online education. One student from Goldsmiths participated over five consecutive days prior to the Christmas break, submitting observations every four hours via messages and spreadsheets. The core findings — based on cleaned and consolidated data — are summarized in Table 6.

Table 6. Data of Diary Study.

Day	Start time	End time	Category of class	Issues	Solution
1	2 pm	6 pm	Lecture	I can't keep up with the teacher. Too many points.	I think I need to have a look at recorded videos or PPT.
2	10 am	2 pm	Lab	The lab is too long for me so I could always be distracted by other stuff. If there is a timestamp feature so I can review quicker, that would be much easier to understand.	Repeatedly search for the knowledge points I needed in the recording.
4	2 pm	6 pm	Lecture & Lab	There was group work and we needed to integrate our discussion.	Assign someone to record the results of the discussion.

The diary data suggest that challenges vary by course type (e.g., lecture vs. lab). In lectures, the primary issue is retaining fragmented knowledge delivered during live sessions, often compounded by fast-paced instruction. This leads students to rely on rewatching recordings for post-class review and knowledge consolidation. In lab-based courses, the focus shifts to practical tasks, with students emphasizing the need to easily locate specific instructional steps for effective replication.

4. Data Analysis

This mixed-methods study combined questionnaires and controlled experiments to explore user needs and evaluate the effectiveness of structured note formats in online learning.

4.1. Questionnaire Survey

A survey of 85 undergraduate and postgraduate students from China and the UK, all with experience in online learning and group projects, was conducted to assess user needs and preferences. The findings are summarized below:

1) Value of Video Note-Taking: Approximately 80% of participants believed that video note-taking features could improve note organization during online classes.
2) Efficiency of Current Tools: Participants reported using Teams, Google Docs, and Microsoft Office for collaboration and note-taking. About half rated these tools as moderately efficient (3 on a 5-point scale), while only 10% considered them "very efficient," indicating room for improvement in collaboration features.
3) Group Note-Taking Benefits: Over 90% of respondents agreed that group note-taking enhances efficiency, with 43% rating its benefit as 4 or higher.
4) Feature Preferences: User preferences for various proposed video note-taking features were also collected.

4.2. Experimental Studies

Two controlled experiments were designed to evaluate how different note-taking formats affect information retrieval efficiency. Both used a within-subjects design. Participants were recruited and screened using consistent criteria to reduce bias. Task completion time was the main performance indicator.

4.2.1. Experimental Overview

Initial qualitative interviews and quantitative surveys provided preliminary insights into user needs, which informed a directional product design. To confirm the influence of note-taking and collaboration efficiency on online learning, a more in-depth experimental study was conducted.

The experiment involved three within-subject conditions: tag-enhanced notes, Markdown-formatted notes, and a combination of the two. Additionally, a control condition with plain notes was included.

In total, 128 online learners with prior experience in online courses were randomly assigned into four groups of 32 participants each. Each participant completed a single task on a laptop or desktop, with task completion time recorded automatically.

4.2.2. Experiment 1: Tag-Enhanced Notes

Design: 128 participants divided into four groups (32 each) took part in a within-subject experiment with three conditions. The control group reviewed plain notes, while the experimental group accessed notes enhanced with visual tags beside key headings.

Hypotheses:

H_0: No difference in efficiency between tagged and untagged notes.

H_1: Tagged notes improve efficiency.

Results: Descriptive statistics showed low kurtosis (0.226) and skewness (0.064), with Q-Q plots confirming approximate normality, supporting the use of t-tests.

The control group averaged 67.25 seconds (SD = 12.48) per task; the experimental group averaged 58.75 seconds (SD = 10.31).

An independent t-test yielded $t(62) = 3.04$, $p < 0.001$ (one-tailed), indicating a significant efficiency improvement with tag-enhanced notes (Figure 1).

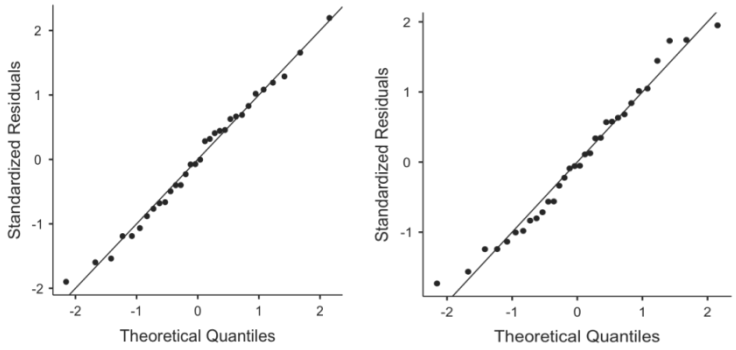

Figure 1. Q-Q Plots for Control and Experimental Groups.

4.2.3. Experiment 2: Markdown-Formatted Notes

Design: Participants completed a standardized task. The control group received unformatted notes, while the experimental group received Markdown-formatted notes.

Hypotheses:

H_0: No efficiency difference between formatted and unformatted notes.

H_1: Formatted notes improve efficiency.

Normality Assessment: Skewness was low (0.0900 < 0.5). Q-Q plots indicated approximate normality, supporting the use of parametric tests.

Results:

Control: 69.84s (SD = 11.92); Experimental: 52.16s (SD = 9.42).

Independent t-test: $t(62) = 6.78$, $p = 7.57 \times 10^{-7}$. Significant efficiency improvement observed.

4.2.4. Experiment 3: Combined Format

Design: Participants completed the same standardized task. The control group received unprocessed notes, while the experimental group received Combined Format notes (combining tags and Markdown formatting).

Hypotheses:

H_0: No efficiency difference between combined and unprocessed notes.

H_1: Combined format improves efficiency.

Results:

Control: 71.06s (SD = 12.29); Experimental: 45.44s (SD = 8.37).

Skewness = 0.414.

Independent t-test: $t(62) = 12.37$, $p = 1.17 \times 10^{-14}$. Synergistic efficiency gains observed.

4.3. Comparative Analysis

The combined format reduced task completion time by 36% compared to control, outperforming the standalone tag format (23% improvement) and Markdown format (13% improvement). All results were statistically significant ($p < 0.01$).

5. Conclusion

This study demonstrates that structured note formats significantly enhance information retrieval efficiency in online learning environments. Key findings include:

1) Tag-Enhanced Notes: Reduced task time by 13% ($p < 0.01$), supporting the role of visual cues in accelerating navigation.
2) Markdown Formatting: Achieved 25% faster completion ($p < 0.01$), supporting the hypothesis that text hierarchy improves scannability.
3) Synergistic Effects: The combined format yielded the greatest improvement (36%, $p < 0.001$), suggesting that multimodal structuring maximizes cognitive offloading.

4) Practical Implications: Results advocate integrating visual tags and semantic formatting in educational tools, prioritizing automated timestamp tagging and lightweight markup export features.
5) Limitations: Participant demographics were relatively homogeneous (university students), and lab-controlled tasks may limit generalizability.
6) Future Directions: Investigate long-term retention effects, explore AI-generated versus manual tags, and extend formatting paradigms (e.g., interactive outlines, nested hierarchies).

This research provides empirical validation for structured note design principles and offers actionable insights for EdTech innovation.

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