Enhancing Practical Pedagogy: A UDL Perspective on the Value of Videos for Practical Class Preparation Among Third-level Student-teachers in Science Education.

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Abstract.

In higher education science courses, practical laboratory classes pose issues of accessibility, limited student autonomy and mounting evidence that students are not engaging in independent preparation for these classes. Videos are an established tool for helping to embed Universal Design for Learning (UDL) principles into the classroom. Although videos have been used to support lab instruction, research on their effectiveness largely focuses on the effects on academic achievement and studies a pre-digital native era of learner. This study sought to explore student behaviour towards preparation for lab classes and their perceptions of the utility of technique videos to aid their preparation. This was researched by surveying third level students studying science modules as part of initial teacher education using a survey tool with substantial qualitative elements. Three themes emerged from the analysis surrounding student confidence, autonomy and, surprisingly, student emotional well-being. Findings outline a potential role for videos in supporting student engagement in the typically rigid classroom lab setting. This evidence suggests that effective usage of videos could inform pedagogy and curriculum design in subjects where UDL principles have been difficult to incorporate. This could unlock new opportunities to widen participation and inclusion across higher education.

Keywords: Higher education; Lab classes; UDL; Video.

1. Introduction.

1.1 The importance of lab classes.

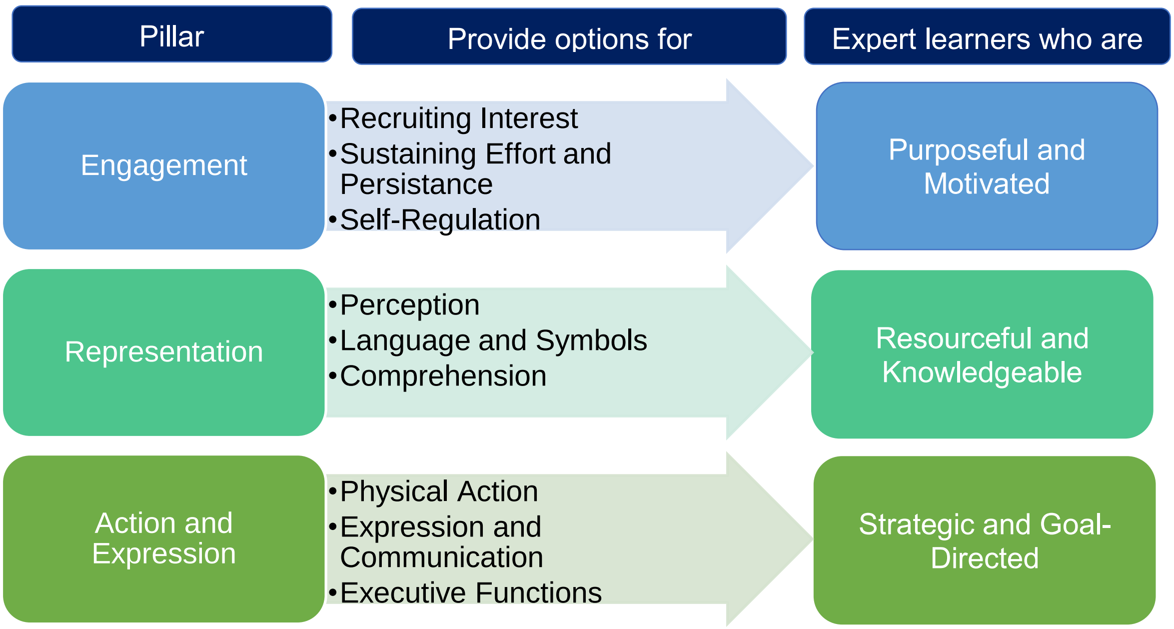
Practical or laboratory classes form a key part of science education (Hofstein and Mamlok-Naaman, 2007) with benefits for student comprehension being cited for the past 200 years (see Edgeworth and Edgeworth, 1811; Lunetta et al., 2007; Lloyd et al., 2019 for examples). Traditional instruction for practical classes in higher education typically involves some verbal instruction on the technique to be carried out and the theory behind it, as well as a written step-by-step protocols for students to follow. Despite the longstanding use of practical classes and the benefits they can offer, studies have begun to question the effectiveness of this traditional approach. For example, a study by Collis et al. (2008) surveyed 695 first year undergraduate students of a bioscience course in a UK university who reported that practical classes were less effective due to an underestimation of the "*magnitude of the transition which students are undergoing from school to university type work*" (Collis et al., 2008, p13). This suggests that students may feel ill equipped to carry out practical work due to dissonance between their capabilities and lecturer expectations. Consequently, students often report completing practical classes without understanding what they are doing or how it connects to the theory covered in lectures (Seery, 2013). Additionally, recent research has demonstrated that learning practical skills can place significant cognitive load on students' working memory, making it difficult for students to learn effectively (Aronne et al., 2019). The amount of information being processed by students is argued to occupy the whole working memory, making it difficult to understand and retain new information (Reid and Shah, 2007; Seery and Donnelly, 2012). In order to enhance the learning potential of practical classes, it is vital to critically appraise various approaches to their instruction. This research focuses on appraising the pedagogical approach of Universal Design for Learning (UDL), which aims to enhance learning outcomes for all students.

1.2 Video tools within the UDL framework.

While UDL is often presented as a kind of checklist for '*inclusive*' teaching practise, it could be more aptly described as a toolkit for educators to help facilitate each learner's access, involvement and growth in their education (Meo, 2008; King Sears, 2009). The tools centre around a UDL framework comprised of three pillars (further detailed in Figure 1):

- Pillar 1 ('*Engagement*') addresses how to engage students by providing multiple means for recruiting interest, sustaining effort and persistence and self-regulation (CAST, 2018).
- Pillar 2 ('*Representation*') addresses how topics/concepts are presented by providing multiple means of perception essentially allowing for customisation of the display of information, providing options for language and symbols and options for comprehension by identifying background knowledge or guiding information processing for example (CAST, 2018).
- Pillar 3 ('*Action & Expression*') addresses how students can act on or express what they are learning and show what they have learned (Reynor, 2021). This involves providing options for physical action, expression and communication and executive functions (CAST, 2018).

Figure 1: UDL guidelines (adapted from CAST, 2018).



Video as an educational tool perhaps aligns most obviously with the UDL principle of Representation (CAST, 2018) as effective video resources have been shown to provide options for the three distinct areas of Perception, Language and Symbols, and

Comprehension:

1. Well-developed video resources support Perception by providing alternatives to auditory and visual information through effective visuals with closed captions and a transcript with spoken descriptions, respectively (Nave, 2021). Digital tools such as videos also allow for integration of assistive technologies such as closed captioning which can help improve accessibility for students with and without learning difficulties (Rao et al., 2021).
2. Video resources provide options Language and Symbols with the capacity to illustrate new vocabulary, terminology and symbology through multiple media. This has been demonstrated through the extensive use of video in English as a foreign language (EFL) teaching. Videos can therefore facilitate the introduction of unfamiliar vocabulary and pronunciation (Rahayu, 2020).
3. Finally, video resources can support Comprehension by activating background knowledge, particularly when used as a pre-teaching tool. This use of video can allow for students to take mental pauses when being exposed to new information. This can help with information processing while presenting the information in an accessible and customisable way for students (Nave, 2020).

As a lecturer in the science discipline in a third level educational setting, it is readily apparent to the author that many practical classes lack UDL facilitation. This may be in part due to the rigid requirements of these classes where there is often a set protocol to follow with safety considerations and limited time. It can therefore be challenging to provide options, flexibility and freedom for students to choose modes of Engagement, Representation, and Action and Expression within these constraints. To address classroom limitations, educators often provide variety through options for the mode of assessment at the conclusion of the learning journey (Reynor, 2021). However, it could be argued that a UDL approach would be better implemented during the learning process by improving preparedness for practical classes using video as a pre-lab resource. In this way, it seeks to support student learning from the very beginning of their learning journey.

1.3 Videos as a pre-lab preparation tool.

There is belief among academics that students are less and less prepared for practical classes, resulting in poorer student capabilities in the laboratory (Rodgers et al., 2019). This has been confirmed empirically in a 9-year study by Whittle et al. (2010) that demonstrated a discernible decline in reported laboratory practice and confidence. Addressing student preparedness for practical classes is therefore an important step in maximising the learning potential of these classes. There have been many interventions which seek to improve student preparedness for practical classes, for example, through the use of pre-lab video demonstrations.

The use of videos to teach practical skills is not a new idea. In 1974, Kempa and Palmer demonstrated that videos were superior to written instruction when teaching practical skills in the science lab. This is thought to be a result of being able to see a demonstration rather than reading a description. More recent evidence has demonstrated that students who received video instruction completed practical science experiments faster than those with written instruction (Burewicz and Miranowicz, 2006). Video demonstrations have also been shown to improve students’ procedural and conceptual knowledge (Nadelson et al., 2014) and student tool/equipment manipulation (Kempa and Palmer, 1974; Burewicz and Miranowicz, 2006). However, much of this data was collected in a time when videos were not as accessible. Students entering higher education today have grown up in a digital age and are accustomed to viewing videos frequently in everyday life (Prensky, 2001). Aronne et al. (2019) argues that video instruction may have improved student performance in the past due to novelty, but improvement may not continue to be seen. Notably, students who engaged in remote online teaching during the COVID-19 pandemic reported digital fatigue as a result of too much digital content (Flynn and MacNeill, 2021). Therefore, it is important that when videos are used, they are tailored to student needs and are used in appropriate contexts.

There is a dearth of research on the use of videos specifically as a UDL-tool in a science context. Existing research on UDL-designed science instruction has focused more generally on UDL-based learning environments in pre-third level settings (see Kohnke et al., 2022) with students with learning difficulties or disabilities. For example, Marino et al. (2014) demonstrated that providing middle school science students with multiple means of representation and expression through video games and supplemental texts improved levels of student engagement. However, student performance in response to this UDL instruction was not significantly different than when taught using traditional instruction. By contrast, Marino (2009) demonstrated that students with learning difficulties benefited from UDL-based learning environments. In this study, middle school science students of varying reading abilities were provided with UDL-informed tools such as videos on the topic of space. Results showed that students with poorer reading abilities used and benefited from the UDL-tools the most despite no statistically significant differences in test scores. Similar results were observed by King-Sears et al. (2015) which examined the effectiveness of UDL-informed teaching in a high school chemistry class. Students were provided with self-management strategies, multimedia lessons with narrations and animations, and workbooks on this multimedia content for example. While no significant difference was found in test scores between the UDL-informed lessons and traditional lessons, there was suggestion of a relationship between post-treatment test scores and students with disabilities.

This study seeks to collect student perspectives on their preparedness for practical classes and identify whether providing optionality for preparation through the provision of pre-lab videos of technique demonstration could improve student experiences in the practical classroom setting.

2. Methodology.

The research used a post-positivist approach to address the two central research questions of this study. The first question asks what are student perspectives on the importance of preparing for practical classes? The second research question asks what is the shared student perspective of the utility of videos as a pre-lab tool?

2.1 Research design.

An online anonymous survey of students in second, third and fourth year of initial teacher education training who were studying science modules was used to collect both quantitative and qualitative data. The qualitative elements of the survey were designed in light of best practice in development of qualitative surveys and allowed for collection of rich data where participants could imbue their own terminology, language and vocabulary to provide unique insight into the student experience (Braun and Clarke, 2020). This approach was chosen as it was deemed to be more respectful of participant time than interviews/focus groups given the exploratory nature of the study while facilitating rich data collection.

2.2 Materials.

The survey was designed to explore student practices and attitudes to lab class preparation and educational lab videos. Following feedback from a small pilot group of 2 lecturers of subjects with practical elements and experience in quantitative research, the final survey tool consisted of 10 questions in a mixture of open and closed formats (Appendix I). Extensive choice was included for closed questions to mitigate potential omissions of relevant information not captured through the responses (Krosnik & Presser, 2010, p. 267). Questions were grouped into three sections; demographics, preparation for practical classes and attitudes towards video use for practical class preparation. Per best practice, demographics were addressed first including participant year of study, approximate grade in science modules, and confidence in various lab techniques to prime participants for the subsequent questions.

Following demographics, questions were posed surrounding practical class preparation based on commonly observed student practices by the researcher with a mixture of frequency scale, utility scale and open-ended questions. Finally, participant perspectives on use of videos as educational tools in labs was investigated using a mixture of open and closed questions. The questionnaire was administered using Microsoft Forms.

2.3 Sampling.

The study used non-probability purposive sampling. The accessible population for this study were exclusively female students in initial teacher education. Although this impacts on the generalisability of the data in terms of gender representation which will be discussed further in '*Discussion*', it provided two key benefits. Firstly, female engagement in science is typically lesser than males so beneficial interventions will be most important for this demographic (Brown et al., 2017). Secondly, as trainee teachers, it is envisaged that this group will provide adept appraisal of new educational supports. For this reason, the sample inclusion criteria was that participants had some experience of school placement as trainee teachers and hence excluded first year students. The resulting sample only includes students from second, third and fourth year. Following ethical approval, relevant student groups were contacted through email via class mailing lists. 112 students were contacted with a response rate of 42% (47 participants).

2.4 Procedure.

Upon receiving ethical approval from Atlantic Technological University ethics committee, invitations to participants were distributed via group mailing lists. The survey collected responses from 24th November – 20th December 2023. Only participants who consented to the survey by affirming all informed consent statements were allowed to access the survey. For quantitative data, analysis followed a deductive approach. SPSS version 28 was used to carry out descriptive statistical analysis. Microsoft Excel was used for figure construction. For qualitative data, analysis took an inductive approach. Per Braun and Clarke (2020), qualitative data was treated as a cohesive dataset and thematic analysis was carried out across the dataset rather than separating responses to individual questions. Data was coded whereby each piece of information is prescribed a code and codes were then grouped together into common themes (Braun & Clarke, 2006) (see Appendix II). It was ensured that themes were "*coherent, consistent, and distinctive*" (Braun & Clarke, 2006, p96). For presentation of findings, direct quotes are attributed to participants using an ID number, for example Participant 1 is denoted as P1.

3. Analysis of findings.

The participant profile will first be presented followed by the themes which emerged from analysis of participant responses to the questions surrounding their behaviors and attitudes towards preparation for practical classes and their perceptions of the utility of lab technique videos as a pre-lab tool.

3.1 Participant profile.

Participants were distributed between second, third and fourth year of their degree programmes (36%, 23% and 40% respectively, Table 1) with a spread across grade bands for their previous year in science modules (Table 1). Notably, there was just one participant in the 'Passing' grade band of 40-49%. 87% of participants reported using videos at least 1-2 times per month for their studies.

Table 1. Participant demographics.

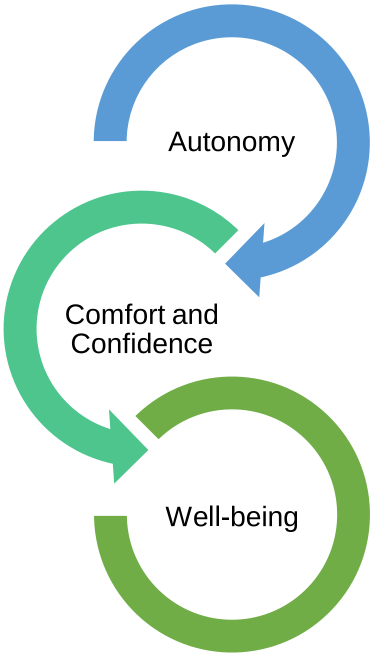
		n	%
Year of study	Second	17	36%
	Third	11	23%
	Fourth	19	40%
Average grade for previous year	>70%	13	28%
	60-69%	20	43%
	50-59%	13	28%
	40-49%	1	2%
	<40%	0	0%

Throughout the survey, participant descriptions of the benefits of video demonstrations reflected a maturity similar to how they would typically be described in the literature. For example, participants recognised technique videos as a useful tool for facilitation of different learning preferences with phrases included such as "*kinaesthetic*" (P7), "*UDL*" (P6, P39) and "*differentiation*" (P12) used to describe perceived benefits. This was perhaps best summarised in this student's response:

> '*They can serve as a powerful visual aid to help students understand complex procedures and techniques. By incorporating video demonstrations, I can provide a clear and engaging learning experience for my students. Videos can also be used to reinforce key concepts, review lab safety protocols, and showcase real-world applications of the experiments. Additionally, video demonstrations can be a valuable resource for students who may have missed a lab session or need extra support in understanding the material. Overall, video demonstrations can enhance the effectiveness of my teaching and promote a deeper understanding of lab skills among my students'* (P43).

Beyond participants' awareness of videos as a UDL tool which has been identified previously (Nave, 2021), there were three emergent themes identified: 1) autonomy, 2) comfort and confidence and 3) emotional well-being (Figure 2).

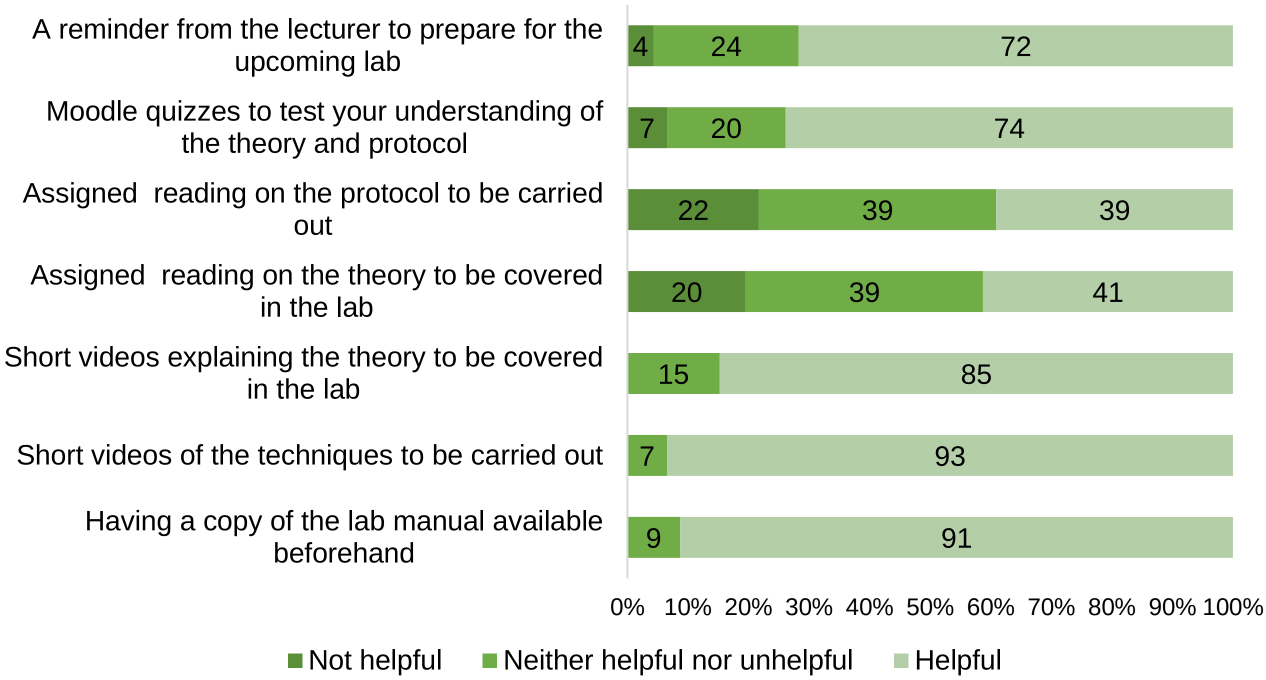
Figure 2. Emergent themes from student perspectives on practical class readiness and the role of videos.



3.2 Theme 1: Videos provide autonomy.

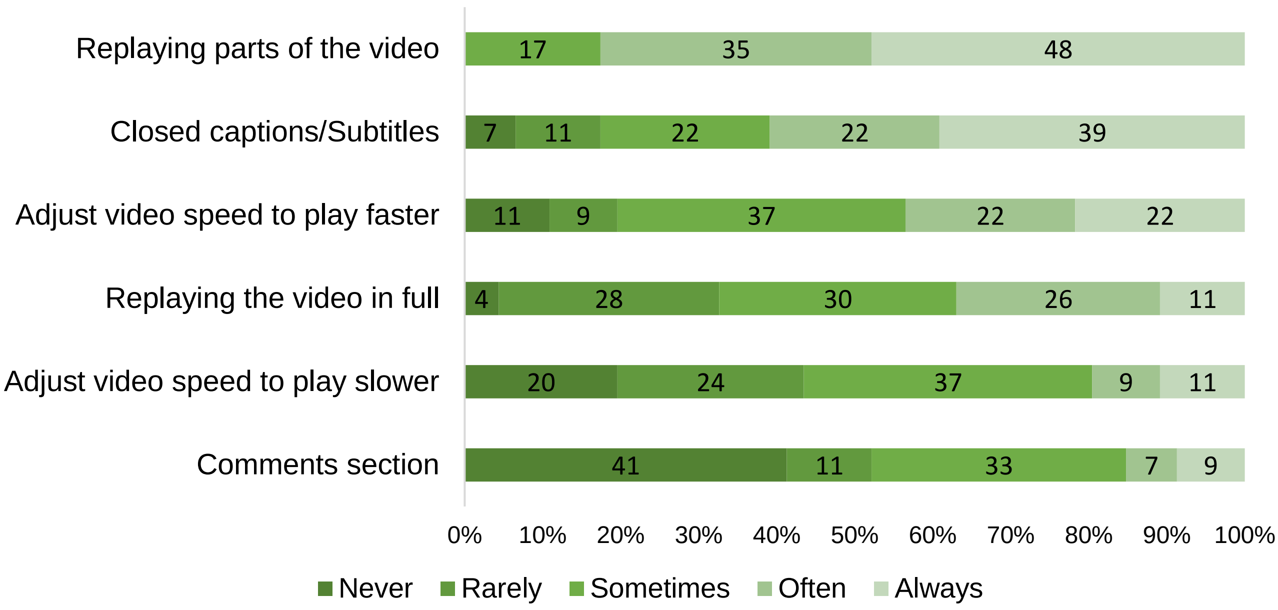
To explore the type of resources participants find helpful for practical class preparation, participants were asked to categorise different types of resources as either helpful, neutral (neither helpful nor unhelpful) and not helpful (Figure 3). 93% of participants deemed videos as a helpful resource and this was the resource most frequently identified as helpful. This is perhaps unsurprising as students noted how they liked to have visual demonstrations of practical skills. This is consistent with research showing how videos are a preferred autonomous study activity for students (Rahayu, 2020). Videos therefore may help address Pillar 1 of UDL principles i.e. Engagement. When asked directly if they thought video demonstrations of lab techniques would be useful to aid in preparation for practical classes, just one of the 39 students who responded did not think videos would be useful and suggested that no students would watch them. The need for relevant and focused content is underlined by another student noting "*as long as they are short and not too time consuming*" (P38). Reasons for the positive attitude demonstrated towards videos as a pre-lab tool may be further explained by the second emergent theme; videos provide autonomy. In this analysis, the concept of autonomy with video resources is detailed across the following areas: use of captions, bespoke pace of instruction and reuse of video.

Figure 3. Percentage frequency for helpfulness of various supports for lab preparation (n = 46).



When watching videos, 93% of participants used captions at least some of the time, with just 7% of participants never using closed captions and 39% always using closed captions (Figure 4). Evidence from EFL teaching demonstrates that videos facilitate the introduction of unfamiliar vocabulary and pronunciation, mitigating a commonly perceived obstacle for students in the field of science (Young, 2005). The use of closed captions particularly for science lab videos may help promote familiarity with the terminology. Similarly, captions could help alleviate additional barriers in other learning resources, with a participant noting that lab manuals can "*almost feel[s] like another language*" (P18). This self-reported evidence on how students use video resources is aligned to Pillar 2 of UDL principles i.e. Representation, specifically Perception, which allows customisation of the display of information, alternatives to auditory information through closed captions and alternatives to written protocols (CAST, 2018; Nave, 2021).

Figure 4. Percentage frequency for use of video features on a Likert scale (n = 46).



Students also note how autonomous videos can support their pace of instruction:

> '*Sometimes lab time goes by very fast and so it would be nice to have the basis in advance*' (P25),
>
> '*Sometimes the investigation carried out in the lab can be rushed naturally because of time restraints'* (P7)

Figure 4 demonstrates that students also regulate the pace of the videos with participants speeding up or slowing down playback. The participants' positive attitude towards the freedom to self-pace their study with videos is a well-established benefit of videos and has been noted previously as a way to create a more inclusive classroom (Trang, 2022). Given the vast and comprehensive catalogues of videos on free platforms such as YouTube, they provide a feasible approach for educators to enhance accessibility through the use of closed captioning for example, and autonomy for students, underscored by the readily achievable integration of UDL principles within higher education.

Many of the video features identified within the theme of autonomy center around the principle of Representation, specifically the facet of Perception. However, it is evident that the establishment of autonomy in terms of not just how the videos are viewed i.e. with/without caption, speed etc. but also when they are used suggests alignment to the UDL principle of Engagement. For example, all participants reported that they replay parts of videos. Additionally, participants noted that they perceive videos would be a useful tool for revision with one student noting that it "*would be good to know before the lab and also have the videos to refer back to after the lab*" (P35). Participants also noted the benefit videos could provide for their dual identities as student-teachers noting how they can function as "*reminders of how labs should be carried out*" (P13).

Therefore, video resources have the capacity to support individual choice and autonomy as they can be accessed before lab classes, watched and rewatched or used as revision. This may help support development of independent learners empowering them to control how resources are used (Nave, 2021).

3.3 Theme 2: Building comfort, expressing confidence.

Feelings of comfort and confidence are evident when participants were explaining why they did or did not prepare for practical classes and why they thought access to technique videos could be useful. Firstly, confidence influences students' choice to prepare for their practical classes. This finding is consistent among students regardless of whether they felt they took time to prepare for their practical classes. Participants who reported not taking time to prepare for practical classes often cited that preparation was needless. This seemed to come from perceptions that it is well explained in the lab, or that not preparing for labs has "*not been an issue so far*" (P24) or as one participant noted "*I feel as though I learn from doing and being in the lab*" (P46). For these participants, this reflects an expression of confidence in either their proven abilities or prospective capacity. For other participants who reported that they did take adequate time to prepare for practical classes, they were looking to build this confidence;

> '*By preparing before labs, even minimally, I find myself more confident*' (P36).

Building confidence was further cemented as a role for technique videos. Note that confidence in this context was also expressed as comfort with reference to their role as a student-teacher:

> '*By watching videos the night before a lesson, it makes me feel a lot more comfortable teaching the lesson when unsure of the skills. Some skills e.g. microscopy - we have not used in college since 1/2nd year*' (P28).

The sense of confidence participants noted with either their own self-directed preparation or that which they expect to receive from engaging with pre-lab videos has been well demonstrated previously by Maldarelli et al. (2009) and Smith-Keiling et al. (2019). These studies note that pre-lab preparation activities improved student recall, mastery and confidence. Maldarelli et al. (2009) used recorded lab demonstrations and even through this simple resource, improvements in student command of their skills and self-confidence was seen. This helps to illustrate that the incorporation of UDL tools into practical classes does not need to be complex to impact upon student confidence. The confidence observed here could be interpreted as the expected outcome of facilitating Pillar 1 Engagement of the UDL principles that learners are Purposeful and Motivated (CAST, 2018).

3.4 Theme 3: Student emotional wellbeing.

A consistent and emergent theme from the participant perspectives towards practical class preparation and technique videos was that of anxiety. Anxiety, stress, and frustration were repeatedly mentioned as reasons why participants took steps to prepare for practical classes. Some participants cited the reduction of anxiety as the sole reason for preparing for practical classes:

> '*…being prepared reduces stress*' (P43),
>
> '*So I am confident in what I'm doing and not anxious*' (P16),
>
> '*In case of anything not going to plan/going drastically wrong*' (P28).

Participants who felt that videos could be a useful pre-lab resource were asked their reasoning for this. While some point to the need for visual explanations and demonstrations to help with understanding, some participants associate this with being less likely to make mistakes, helping to avoid frustration, anxiety, and embarrassment:

> '*It is challenging to do something for the first time in front of both a lecturer and your peers, in fear of doing something incorrectly*' (P36),
>
> '*Would be more confident completing during the lab and wouldn't be as stressed out hoping I'm doing thing right*' (P16),
>
> '*You wouldn't be worried in the lab that you're doing it wrong*' (P22),
>
> '*It would result in less confusion in the lab which can be frustrating*' (P44).

This sense of frustration is detailed by one participant when explaining why they thought technique videos could be a useful teaching tool. For this participant, the frustration of not knowing how to use a piece of equipment has stuck with them:

> '*Yes definitely, for example, I had to plan a lesson demonstrating how to prepare [specific] apparatus and I had never done it before. It was difficult to find a video just demonstrating how to put equipment together rather than how to do the actual [technique]*' (P11).

The worries and frustrations echoed by this participant are diametrically opposed to the aspiration of UDL to produce expert learners who are purposeful and motivated, resourceful and knowledgeable, strategic and goal directed (CAST, 2018). This is echoed by participants whose description of technique videos is akin to having a mentor to support them during teaching placement:

> '*I feel really concerned about preparing and making up solutions that students will be using in investigations. By having videos available that I can reference on preparing and storing the chemicals … I would feel entirely more comfortable both as a student teacher and once qualified*' (P36),
>
> '*We feel quite isolated when I'm [on] placement so to know there are videos available to help us do labs on placement would be so reassuring*' (P9).

A recent report by Union of Students of Ireland and the National Forum for the Enhancement of Teaching and Learning views embedding wellbeing almost as a discipline/subject in the curriculum of higher education (Byrne & Surdey, 2021). Given the sentiments of anxiety and stress expressed by participants regarding their mandatory course elements of practical classes, perhaps there should be a two-pronged approach to this, 1) embedding wellbeing in the curriculum where possible but also 2) ensuring provision of and access to resources which help to support student confidence and help with the development of habitus within their chosen field of study.

4. Discussion.

This research sought to explore student perspectives on preparation for practical classes and perspectives regarding the utility of videos as a pre-lab tool. The study focused on a purposive sample of higher education students in initial teacher education, who would have the ability to provide measured perspective on the benefits of video resources from their '*dual identity*' as student and teacher. The study found that participants engaged in preparation for practical classes to build their confidence and posited that video demonstrations of techniques could be a helpful tool. Students were accustomed to personalising their experiences with videos, making use of various video tools such as closed captions and speeding up playback. These findings align with previously reported benefits of videos as a tool for learning practical skills in science (Burewicz & Miranowicz, 2006; Maldarelli et al., 2009; Smith-Keiling et al., 2019). An emergent and prominent finding was the prevalence of feelings of emotional distress. The perspectives of participants' feelings of stress when completing practical work are striking. There are many targeted initiatives to help foster student well-being in higher education such as the '*Being Well, Living Well*' initiative at Atlantic Technological University Sligo which aims to help maintain student emotional and mental well-being (ATU Sligo, 2024) and programmes to embed wellbeing into curricula (Byrne & Surdey, 2021). However, given that participants suggested that feelings of stress could be mitigated through the provision of appropriate resources such as video, the finding propounds the role that effective, student-centered teaching can play on student mental wellbeing and highlights the importance of customisable pedagogical approaches such as UDL to complement specific well-being interventions.

To contextualise the findings however, it is important to acknowledge the limitations of the study. The exploratory nature of the study necessitated a convenience sampling strategy which resulted in a sample population of all females who were studying to qualify as post-primary school science teachers. This under-represents male students and students studying science in other capacities. This is of particular importance as data from the Higher Education Authority (HEA) (2022) shows that male new entrants to Natural Sciences, Mathematics and Statistics degrees across all National Framework Qualification levels have lower completion rates than females (75% vs 81% respectively). Similarly, males show higher rates of non-progression (15%) than females (13%) in these disciplines (HEA, 2022). Therefore, studying the effectiveness of provision of video resources for the practical elements of these disciplines, particularly for males who may be struggling academically, is an interesting area of future study. However, this study of an all-female sample provides valuable insight into an underrepresented group, as females are reported to be less engaged in science and are the focus of many national government interventions to improve same (Department of Education, 2022). Secondly, the accessible population were all in initial teacher education programmes which require high academic achievement for entry from post-primary education (CAO, 2023), which may omit the perspectives of students who would benefit most from more inclusive classroom practices. However, the findings that high-achieving students express feelings of anxiety and stress about practical classes suggests a potentially even greater benefit of video resources for students with an acute need for more accessible resources that can support their learning outside of class time. By targeting a more representative distribution of academic ability, it may provide a better estimate of the full benefit of such interventions.

The limitations of this research provide an exciting new avenue for further research. Future research should explore a more nationally representative sample of the student population studying science with improved gender balance. Additionally, it may be beneficial to explore if implementation of video resources across a range of science subjects and educational levels would see similar benefits to student engagement and understanding. This proposed future research agenda is necessary in light of the current study which suggests that UDL principles as a pedagogical approach may help foster student wellbeing and could help cultivate student success on a national level if correctly adopted and implemented at scale.

5. Conclusions.

This study uses the lens of UDL to provide a novel and timely examination of student perspective into the utility of videos in the practical science classroom. When using videos for their studies, students engage in autonomous learning and bespoke personalisation of their experiences by speeding up videos, replaying them and using closed captions. Beyond the academic benefits, development of confidence was reported as a primary reason for engaging in practical class preparation and participants felt that technique videos could provide a mechanism for fostering self-assurance. Finally in their self-reported statements, students articulated their proactive engagement in practical class preparation as a deliberate effort to mitigate feelings of anxiety and frustration and speak to the role for technique videos as resources to help support this. This final finding speaks to a role for UDL in a holistic approach to student emotional well-being. Given the exploratory nature of this study, future research should seek to empirically investigate the subject with a broader sample of the student population with a view to quantifying how the role of UDL-centric practical science class instruction and resourcing could influence students' academic and emotional well-being.

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7. Appendices.

7.1 Appendix I: Overview of survey tool

Topic	Subject	Options
Demographics	1. Year	2nd/3rd/4th year
	2. Average overall grade in science modules last year	H3/Pass/H2.2/H2.1H1.1
	3. Confidence in carrying out lab activities independently	5-point Likert scale
Practical class preparation	4. Activities carried out to prepare for practical classes	Frequency scale
	5. Perception of if adequate steps are taken to prepare for practical classes	Yes/No
	6. Reasoning for question 5	Open
	7. Helpfulness of resources for practical class preparation	3-point Likert scale
Videos for practical class preparation	8. Frequency of use of video features	5-point Likert scale
	9. Perspectives as a student on utility of pre-lab videos	Open
	10. Perspectives as a teacher on utility of pre-lab videos	Open

7.2 Appendix II. Sample Coding

As a student, do you think video demonstrations of lab techniques for independent pre-lab viewing would in development of your lab skills? Please explain your answer.

Response	Code
Yes, as if you're unsure how to carry it out on placement you could use the video to refresh yourself	Revision
Yes it would. Would be more confident completing during the lab and wouldn't be as stressed out hoping I'm doing thing right	Confident Avoid mistakes. Stress
Yes as you would know how to do it before going in then in the lab it would be testing your skills	Understanding
Yes I think it would give us a good foundation before building on prior knowledge	Understanding
Yes, more confident in lab	Confidence
Yes as you wouldn't be worried in the lab that you're doing it wrong	Avoid mistakes. Stress
It can often be hard to see what the lecturer is doing when they are explaining the protocol due to large volumes of learners	Visual
Yes, sometimes the investigation carried out in the lab can be rushed naturally because of time restraints. Other students can sometimes rush ahead putting pressure on one to speed up, which can result in the procedure being carried out incorrectly. It also can prevent confusion of investigation method.	Pace