UCLA SAR

Audiovisual Sustainability

Team Members

Brenda Macuil (Co-Lead). Ximena Zepeda (Co-Lead), Olivia Bonevich, Norah Dahlkamp, Elisabeth Floyd, Ava Sauer, Tiffany Vega

Stakeholder

Joe Way, Executive Director, Digital Spaces

Table of Contents

Abstract

This study evaluated the impacts of the Summer 2025 audiovisual (AV) equipment upgrades across eleven classrooms at the University of California, Los Angeles (UCLA), balancing quantitative energy performance with qualitative stakeholder experiences and expert input.

To address how upgraded campus technology can support institutional sustainability goals, an energy audit was conducted across two trial learning spaces: Kaplan A26, a smaller classroom environment, and the Physics and Astronomy Building (PAB) 2434, a large lecture hall. Quantitative assessments of power and draw before and after the overhaul revealed a significant reduction in energy consumption: Kaplan A26 achieved a 58.96% reduction in power (Watts) and an 18.03% reduction in draw (Amps), while PAB 2434 demonstrated a 64.30% reduction in power and a 55.58% reduction in draw, proving that AV upgrades effectively lower grid demand.

To gauge user outcomes, a survey capturing the perspectives of over 300 students and faculty using the upgraded rooms was conducted. The data indicated that 45.40% of students remained unaware of the upgrades; however, 49.50% of students reported a measurable reduction in technology-related classroom interruptions. Faculty feedback yielded an overall Net Promoter Score (NPS) of 42, reflecting general satisfaction with the pilot equipment.

Finally, semi-structured interviews with industry manufacturers, Sony and Crestron, contextualized our campus findings. Sony highlighted a 10-18% reduction in active power hardware via circular manufacturing, while Crestron emphasized driving behavioral changes through automated systems to reduce energy footprints.

Ultimately, the study demonstrated that sustainable AV equipment successfully improves both campus sustainability and classroom performance.

Introduction

AV equipment is electronic devices that create, process, and display, or project combined audio and visual content to enhance communication, entertainment, or education. While sustainability is not always a priority when selecting AV equipment, even small reductions in energy drawn from the grid can meaningfully contribute to sustainability at the university level. As a result, our research sought to answer the following questions: How can the impact of the sustainable AV equipment overhaul in Summer 2025 across eleven classrooms on the UCLA campus be quantified to justify similar equipment upgrades in the future? Additionally, how can faculty experiences and satisfaction with the updated equipment, combined with measured energy savings, inform the scope and implementation of future upgrades? Answering these questions will help guide our stakeholder, Joe Way, as he continues his work improving AV equipment across campus.

Our group performed faculty and student surveys to gauge the reception of the pilot equipment's functionality in a learning setting, and held two expert interviews with the equipment manufacturers to understand how sustainability is practiced in their products' design process. Additionally, we audited the energy and power consumption of legacy and pilot equipment models to quantitatively assess the energy saved by the overhaul. By modeling our project methods on past initiatives, such as the 2025 UCLA SAR AV project and similar efforts at USC, we developed effective approaches to evaluate whether the relative benefits for campus stakeholders and improvements in energy efficiency would justify the financial expenses, labor, and e-waste generated for such overhauls.

Methods

We employed several methods throughout the course of the project to fully understand the financial, environmental, and behavioral impacts of the Summer 2025 overhaul of classroom AV equipment. To better understand the differences in functionality and operation between the legacy equipment and the pilot models that replaced it, our team attended a facilities tour on campus on February 12, 2026 (see Appendix A). We toured several large lecture halls and smaller classrooms across multiple buildings on campus to observe the challenges associated with operating outdated equipment. We also observed that the pilot equipment has streamlined teaching and learning, improved accessibility for students with hearing or vision impairments, and reduced the physical space needed to house the equipment.

To provide quantitative support for anticipated improvements in energy efficiency and associated electricity cost savings, we conducted an energy audit (see Appendix B) of all technologies used in PAB 2434 and Kaplan A26 before and after the 2025 equipment overhaul. For each piece of equipment listed on the parts sheet, we obtained values for power (Watts), current draw (Amps), and voltage (DC Volts) from the instruction manuals. We used the sum of the power and draw for each room to compare energy usage. While we did not add the voltage values, those values we obtained can be used to cross-reference data using Ohm's Law: $P\ (Watts) = V\ (Volts) \times I\ (Amps)$.

To complement our quantitative analysis of energy consumption, we developed a structured stakeholder engagement methodology to capture their experiences with the updated

AV equipment. A critical first step in this process was clearly defining the objective of stakeholder engagement within the scope of our project. While our other methods focused on quantifying sustainability through reductions in energy use, we defined the purpose of stakeholder engagement as understanding, both quantitatively and qualitatively, how the pilot AV systems impact user experience. Specifically, we aimed to evaluate whether these upgrades improve accessibility and overall learning effectiveness, and to better understand the role AV technology plays in shaping classroom environments and educational outcomes. We identified two key stakeholder groups: (1) students who attend classes in classrooms equipped with AV systems and (2) professors who use this equipment for instruction.

We approached each stakeholder group using a tailored survey methodology. For students, we developed a survey using Google Forms, featuring a combination of Likert scale questions and open-ended response boxes. We then identified the professors and teaching assistants (TAs) holding lectures and discussions in each of the eleven renovated classrooms, and emailed them with an explanation of our project and a link to our survey with instructions to invite their students to participate. Students were incentivized to participate with a $10 BruinCard credit, offered to the first 50 respondents. Several of our Likert scale questions gauged students' perception of the pilot equipment versus legacy classrooms to better evaluate the learning outcomes of the overhaul. Other Likert-scale questions gauged preference for legacy or pilot equipment, while the open-ended box allowed students to raise any additional concerns they had regarding the performance and function of the equipment in their classroom. With over 300 total responses to the survey, we used the statistical analysis software, RStudio, to quantify satisfaction by classroom.

In the same email in which we asked professors and TAs to distribute the link to the student survey, we invited them to participate in our faculty survey. The faculty survey prompted respondents to gauge the frequency of technological issues or malfunctions with the pilot equipment, as well as their preference between legacy and pilot equipment, with an open-ended response box for any additional relevant information or opinions.

Lastly, our team conducted semi-structured interviews with representatives of Crestron and Sony, two of the most prominent manufacturers of UCLA's classroom AV equipment, to obtain deeper insights into system functionality, maintenance challenges, and decision-making constraints. Our questions prompted these AV Experts on what they felt sustainability means in the AV industry, how sustainability is practiced in their corporate settings, and how environmental considerations are incorporated into AV Equipment design. These interviews did not stick to a set agenda of specific questions, but were instead structured as a fluid conversation, allowing our team to capture the most important considerations for AV industry professionals without being limited by our narrow pre-existing knowledge of the inner workings of these manufacturers.

Together, these methods have enabled us to integrate stakeholder insights with our energy audit findings, ensuring that both sustainability metrics and human-centered outcomes inform our recommendations for future AV equipment investments.

Results

Our energy audit demonstrated significant energy savings. In Kaplan A26, we observed a 58.96% reduction in power and a 18.03% reduction in draw (see Appendix B, B.1). Similar results were found in PAB 2434, with a 64.30% reduction in power and a 55.58% reduction in draw (see Appendix B, B.2). These results represent a significant improvement in energy consumption, as the pilot equipment allows classroom technology to use less energy power from the grid. The audit also revealed that these AV upgrades are highly efficient in larger learning spaces with greater potential for energy consumption. These results provide insight into the use of power on UCLA's campus and the reduction in power consumption achieved by implementing more sustainable AV equipment in classrooms. We identified significant reductions in energy consumption and strongly encourage the future expansion of sustainable AV equipment upgrades to additional locations across campus.

Student surveys were analyzed using R, creating charts that broke down survey responses (see Appendix C). It was shown that 45.40% of students were not aware of renovated equipment, with almost 41% being aware (see Appendix C, C.2). As both are very close in value, we observe how the students are split in their knowledge of the pilot AV equipment, which can open the door to an educational AV sustainability pilot program. We also observed how 49.50% of the students saw fewer interruptions with tech issues in the renovated classrooms than in others (see Appendix C, C.4). This crucial data shows that the pilot equipment has improved the classroom environment. Almost 38% of students had no preference between the legacy and pilot equipment, while 41.6% preferred or strongly preferred the pilot equipment (see Appendix C, C.3). With the higher number of passive responses, it shows how students might not notice the AV equipment itself and instead understand how AV affects their learning, e.g., interruptions, teacher experience. This is demonstrated by almost ½ of students responding that tech issues negatively impact their class less often in upgraded rooms.

Taking the average responses of each classroom for each question allowed us to calculate the satisfaction of the students surveyed in these classrooms. Six classrooms averaged approximately 4 out of 5 on the rating scale, indicating a preference for the pilot equipment, while the remaining classrooms averaged approximately 3 out of 5, indicating a neutral perception of the pilot equipment (see Appendix C, C.7). Overall, our student survey results show a strong leaning towards the pilot AV equipment in the pilot classrooms, compared to others.

The Net Promoter Score (NPS) is a metric used to measure user satisfaction and the likelihood that a person will recommend a product or service to others. Scores of 9–10 are typically categorized as “promoters,” or highly loyal users; however, these responses often reflect a more enthusiastic subset of users rather than the broader population experience. For the faculty NPS (see Appendix D, D.2), survey responses were categorized using a Likert scale and grouped into three categories: promoters (faculty who preferred the pilot AV equipment), detractors (those who preferred the legacy equipment), and passives (those with no strong preference for either). The results included 7 promoters, 2 detractors, and 3 passives, yielding an NPS of 42. This score indicates overall faculty satisfaction with the renovated classroom environments since the average score of seven should be interpreted as an optimal outcome, indicating generally balanced and favorable perceptions of the AV upgrades.

Building on our internal analysis of user satisfaction and system performance, we also sought to contextualize our findings within broader industry practices and sustainability developments in AV technology. This external perspective helps validate our results and provides insight into how institutional needs align with manufacturer capabilities and emerging trends.

In the following section, we summarize insights from representatives at Sony and Crestron, focusing on two main areas: (1) improvements taking place in the sustainability landscape of AV manufacturing, and (2) what these manufacturers have observed institutions can do to improve sustainability within their AV systems.

Sony Interview Insights

For Sony, sustainable AV at the manufacturing level centers around their "Road to Zero" initiative, which focuses on shifting toward circular economies and reducing power consumption across the entire supply chain. They address materials by repurposing recycled CDs into product components, reducing ink use, and implementing minimalist, eco-friendly packaging that simultaneously cuts transportation emissions. In terms of hardware performance, Sony successfully rearchitected recent products to slash active power consumption by 10–18% while integrating features such as built-in local AI-tracking cameras that eliminate the carbon footprint of cloud computing and reduce the need for peripheral equipment.

On the institutional implementation side, the interview highlighted that a major pitfall for universities is letting short-term budget constraints lead to "good enough" solutions that fail long-term sustainability goals. To combat this, institutions like UCLA are encouraged to look beyond immediate upfront impacts and consider the entire lifecycle of equipment use. Institutions should integrate sustainability into their 3-to-5-year Master Resource Plans by evaluating the total cost of ownership alongside student and faculty demand for eco-friendly tech. Specifically, procurement teams should ensure that adopting lower-power devices does not compromise classroom functionality, verifying that equipment like energy-efficient projectors or displays still meets the necessary brightness and operational requirements of the learning spaces.

Crestron Interview Insights

Crestron's approach highlights how hardware design can directly drive institutional behavioral change. From a manufacturing standpoint, their priorities revolve around raw material sourcing, lowering plastic content in favor of recyclable metals, designing hardware that can be easily repaired, and reducing packaging waste by allowing buyers to customize exactly what accessories ship with a product.

However, Crestron stresses that true sustainability is realized through product functionality and smart automation. For institutional implementation at campus scales, they advocate for shifting the "new norm" of classroom behavior through automated convenience: utilizing tools like touch panels, motion detectors, and programmed logic, such as an automatic 6:00 PM system shutdown that can be overridden locally by sensors if a room remains occupied. Because institutions often buy through third-party networks, a key takeaway for a university is to actively collaborate with its contracted dealers and consultants to customize programming post-purchase. This will allow seamless integration of cloud-based systems, which significantly reduces the physical hardware footprint required on-site.

Challenges

Our first challenge in the research project was to become familiar with the technical terminology of AV equipment. As in any field, certain uses of terminology may not be intuitive, and there was a significant learning curve in understanding some of the terms used in the academic material gathered for our literature review. Similarly, we encountered a lack of relevant sources for our literature review because the work on providing sustainable AV equipment in institutional spaces is relatively new. To address this challenge, we contacted our stakeholder, Joe Way, who provided a facilities tour to familiarize us with the AV systems at UCLA. He also helped explain key AV terminology during our meetings. Regarding the literature review, he advised us to review the AV SAR group’s prior literature review to identify relevant sources and to incorporate insights from his previous work at USC, which had a scope similar to our current project. By using these SAR resources, we were able to advance our research, establish a baseline for subsequent steps, and become more familiar with the AV equipment network at UCLA.

Launching our surveys presented another challenge. We needed to consider which student groups the surveys should reach, as responses would come from different classrooms across campus, some equipped with legacy AV systems and others with upgraded equipment. We also had to determine what data to collect, deciding which questions would best capture differences in satisfaction with the renovated classrooms while avoiding bias in wording. While the response rate for the student survey was excellent, the response rate for the faculty survey was low at only eleven responses. Scheduling expert interviews was also difficult, as our communications with representatives at PlaceOS and Panasonic ultimately fell through, and we were ultimately unable to secure an opportunity to speak with them by the end of the project.

Another challenge we faced was analyzing a vast amount of data for our student survey. Our student survey yielded 332 responses, which made it difficult for us to obtain a proper NPS for the student population we surveyed. We used RStudio to construct graphs representing our vast data set. We also had to clean up some of the data to ensure we did not include duplicate responses and also to weed out any responses that did not pertain to the classrooms we were sampling. We tried to represent the remaining data to the best of our ability with help from close faculty and our stakeholders as well.

Discussion

Our analysis indicated that modern AV technology can significantly reduce energy consumption, demonstrating a potential for AV upgrades to support UCLA's sustainability goals. Additionally, the upgrades were found to enhance classroom performance and reliability, even when users were not explicitly aware that changes had been made. These findings suggest that future evaluations should incorporate a structured return-on-investment (ROI) framework to better quantify long-term cost savings and efficiency gains, thereby strengthening the justification for continued infrastructure upgrades. Thus, UCLA Digital Spaces must implement targeted outreach and collaboration campaigns with professors, TAs, and students. Actively communicating the value and functionality of these investments will bridge the awareness gap and foster a stronger preference for these modernized environments, relative to how it currently stands, with the majority disagreeing or strongly disagreeing that they prefer these renovated spaces relative to the legacy equipment used.

Faculty responses provided additional insight into the perceived effectiveness of the upgrades. General performance ratings ranged from neutral to positive, and the systems received a majority of promoters, indicating generally favorable perceptions. Though at the same time, some faculty members expressed strong concerns when the equipment did not function as expected. For example, one professor, Dr. Alison Lipman, confided, “I would like to add that I have just requested that my dept. permanently changed my classroom to an older system because I actually cannot teach my class at all with the new system. It is a horrible system… It has actually ruined my course.” Her responses demonstrate that not only is environmental impact important, but reliability and operations are critical factors in the success of future AV modernization efforts, since we don’t want to create a disrupted teaching and learning environment. As a result, our expert interviews highlighted operational training as a key strategy for improving both user experience and sustainability outcomes. When faculty and staff are more comfortable using AV systems, equipment is less likely to be left running unnecessarily or used inefficiently, reducing energy usage. Additionally, our experts recommend that the integration of smart technologies, such as occupancy sensors and automated power management systems, could further reduce energy consumption by ensuring equipment operates only when classrooms are in use. Together, these findings suggest that combining energy-efficient technology with effective training, communication, and smart energy-management tools can maximize both the sustainability and functionality of future AV upgrades at UCLA.

One limitation of this study was the availability of data for legacy equipment. While detailed information was available for the recently installed pilot system, records for some of the replaced equipment were incomplete. As a result, comparisons between legacy and pilot systems may not fully capture the total magnitude of energy savings. Future studies could benefit from more comprehensive baseline data to strengthen the accuracy of energy efficiency assessments.

Overall, this project demonstrates that AV upgrades can play an important role in advancing sustainability efforts on campus. Moving forward, UCLA could further enhance these benefits by improving communication with stakeholders, providing additional user training, incorporating smart energy-management technologies, and developing sustainability benchmarks for future AV upgrades, such as Energy Star, which is a government-backed symbol for energy efficiency. Conducting return-on-investment analyses could also help quantify the long-term financial and environmental benefits of continued investments in energy-efficient classroom technology.

Conclusion

Our investigation into the audiovisual (AV) upgrades in Kaplan A26 and PAB 2434 demonstrates that modernizing classroom technology is a highly viable pathway toward achieving UCLA's broader sustainability goals. By analyzing energy metrics, user perceptions, and expert insights, this project highlights both the tangible successes of recent renovations and the critical areas where future implementations can be optimized. Thus, sustainability in educational technology cannot be achieved in a vacuum. By merging energy-efficient upgrades with proactive stakeholder communication, robust user training, and intelligent automation, UCLA can maximize both the environmental benefits and the functional reliability of its AV equipment systems, setting the standard for a sustainable university-level campus.

Appendix A: Facilities Tour Photos

Photo 1: Several lecture screens in Boelter 2760

Photo 2: Easy connection to zoom in Kaplan

Photo 3: Old technology box in Kaplan A48

Photo 4: New technology box in Franz Hall

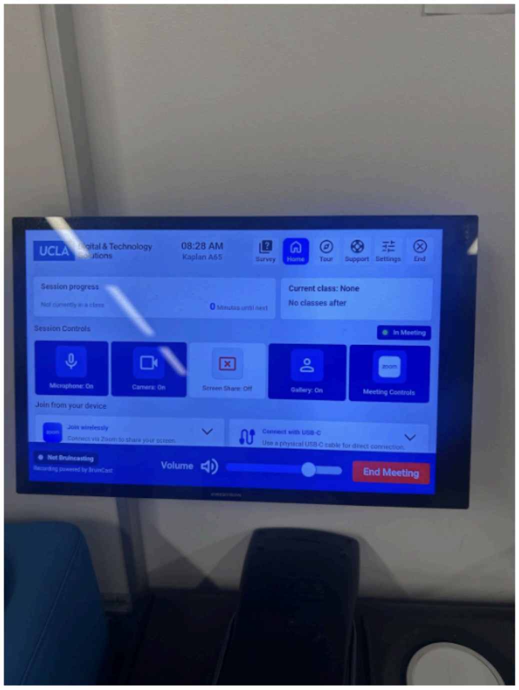


Photo 5: Easy-to-use touchscreen monitor

Photo 6: Assisted hearing device for students with hearing aids in Kaplan

Appendix B: Energy Audit Spreadsheet

A.1: Energy audit data for the pilot AV equipment in Physics and Astronomy Building 2434

Room	Main Category	Sub Category	Sub Category	QTY	Make	Item	Power (Watts)	Draw (Amps)	Voltage (V)
PAB 2434	Credenza Equipment	AV Equipment	ALS	1	ListenTech	LT-82	45	1.5	100-240
PAB 2434	Credenza Equipment	AV Equipment	PDU	1	Crestron	PC-200	0	15	120
PAB 2434	Credenza Equipment	AV Equipment	Processor	1	Crestron	RMC-4	6.5	0.135	48
PAB 2434	Credenza Equipment	AV Equipment	UC	1	Crestron	Collab Eng / UC-C100-PRO-Z-WM	30	0.3	100-240
PAB 2434	Credenza Equipment	AV Equipment	NVX	2	Crestron	NVX-384	20	0.5	24-48
PAB 2434	Credenza Equipment	AV Equipment	NVX	1	Crestron	NVX-384	20	0.5	24-48
PAB 2434	Credenza Equipment	AV Equipment	Camera Encoder	1	Epiphan	Nexus	84	7	100-240
PAB 2434	Credenza Equipment	AV Equipment	Audio	1	Audinate	AVIO USB-A	1.5	0.5	5
PAB 2434	Production Wall plate	AV Equipment	Audio Wall plate	1	symetrix	xIO XLR 2x2	15.4	0.35	48
PAB 2434	Production Wall plate	AV Equipment	NVX Wall plate	1	Crestron	DM-NVX-E20-2G-B-T	9.2	0.75	240
PAB 2434	Production Wall plate	Other	HMDI pass-through	1	Crestron	MP-WP152-B	0	0	0
PAB 2434	Production Wall plate	AV Equipment	NVX	1	Crestron	NVX-384	20	0.5	48
PAB 2434	Interface Devices	AV Equipment	ALS	2	ListenTech	LA-140	15	0.6	30
PAB 2434	Interface Devices	AV Equipment	Occupancy Sensor	1	Crestron	cen-odt-C-poe	4	0.083	50
PAB	Interface	AV Equipment	Scheduler	2	Crestro	TSS-1070-B-S-LB	15	0.313	50

2434	Devices				n				
PAB 2434	Interface Devices	AV Equipment	Touch Screen Wall-mounted	1	Crestron	10" Panel	15	0.31	48
PAB 2434	Camera	AV Equipment	PTZ Camera	2	Sony	SRGA40W/N	80	4.1	19.5
PAB 2434	Security Camera	AV Equipment	Axis Communications	1	AXIS	M4318-PLR	6.4	0.13	48
PAB 2434	Audio Equipment	AV Equipment	Speaker Ceiling	3	SoundTube	IPD4-CM62-BGM-II-WH	40	0.70-0.91	44-57
PAB 2434	Audio Equipment	AV Equipment	Speaker Ceiling	6	SoundTube	CM62-BGM-II-WH	32	0.32	100
PAB 2434	Audio Equipment	AV Equipment	Ceiling Microphone	1	Sennheiser	TCC2 SL 2	8.8	0.18	48
PAB 2434	Video - Display	AV Equipment	Display	2	Sony	FW75BZ40L	299	1.25	110-240
						Total	1294.3	24.249	

A.2: Energy audit data for the legacy AV equipment in Physics and Astronomy Building 2434

Qty	Make	Model	Power (Watts)	Draw (Amps)	Voltage (V)
1	Raxxess	24 space AV rack			
1	Panasonic	PT-VMZ50	370	1.7	240
1	Logitech	Rally Cam	24	2	12
1	Extron	USB Extender T	2.5	1	12
1	Extron	USB Extender R	6	0.5	12
1	Extron	RGB-168xi	15	0.2	240
1	Extron	MLC 226 IP	5	0.42	12
1	Extron	MLS 506	60	5	12
1	Furman	M-8x2	1800	15	120
1	Crestron	HD-TX-301	30	1.25	24
1	Crestron	HD-RX-4K-210	9	1.25	24

1	Crestron	DA2-4KZ	4.3	0.75	24
2	Kramer	FC-46H2 HDMI audio de-embedder	1.85	0.37	5
1	Apple	Mac Mini (2018)	150	1.25	12
1	Bogen	GS150D Gold Seal Series Amplifier	150	3	120
1	Shure	QXLD receiver	4.8	0.4	12
2	RDL	ST-MX2 mixer	1.44	0.06	24
2	JBL	Control 25T	30	0.424	0.3
6	Extron	SI 26CT speakers for PA	60	0.86	70
1	Barix	Instreamer IP audio encoder	5	1	5
2	Netgear	GS105	2.7	1	12
1	Sound Associates	SA-1422	30	1	30
1	Sound Associates	SA-1710	120	5	33
1	Sound Associates	SA-1211	48	2	24
2	Stewart	electric screen (size 120x90)	180	1.5	120
		Total	3625.58	54.588	

A.3: Energy audit data for the pilot AV equipment in Kaplan A26

Room	**Main Category**	**Sub Category**	**Sub Category**	**QTY**	**Make**	**Item**	**Power (Watts)**	**Draw (Amps)**	**Voltage (V)**
Kaplan A26	Credenza Equipment	AV Equipment	ALS	1	ListenTech	LT-82	45	1.5	100-240
Kaplan A26	Credenza Equipment	AV Equipment	PDU	1	Crestron	PC-200	0	15	120
Kaplan A26	Credenza Equipment	AV Equipment	Processor	1	Crestron	RMC-4	6.5	0.135	48
Kaplan A26	Credenza Equipment	AV Equipment	UC	1	Crestron	Collab Eng / UC-C100-PRO-Z-WM	30	0.3	100-240
Kaplan A26	Credenza Equipment	AV Equipment	NVX	2	Crestron	NVX-384	20	0.5	24-48
Kaplan	Credenza	AV	NVX	1	Crestron	NVX-384	20	0.5	24-48

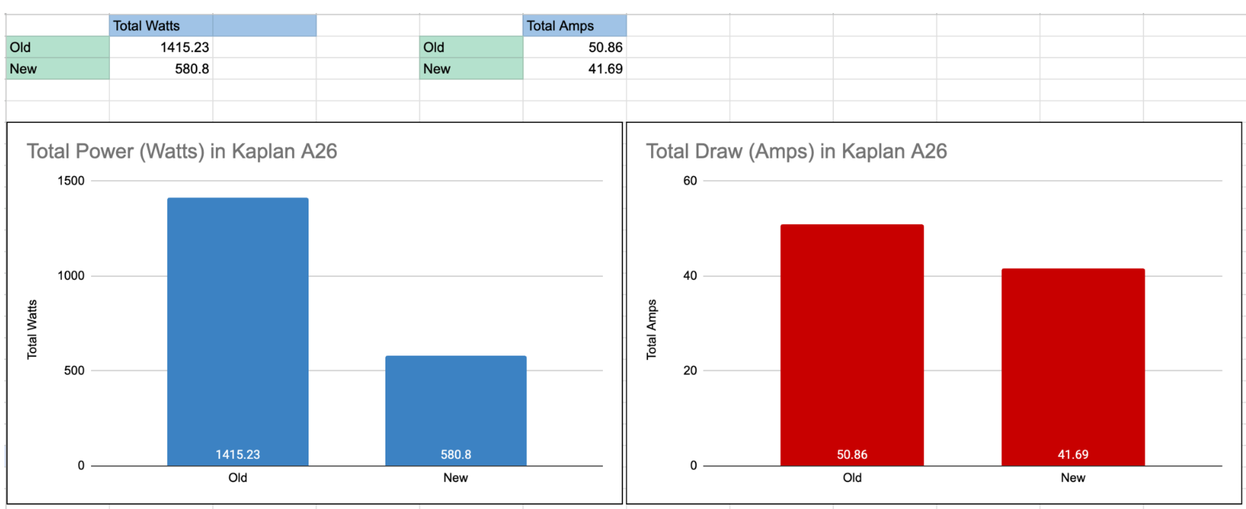
A26	Equipment	Equipment							
Kaplan A26	Credenza Equipment	AV Equipment	Camera Encoder	1	Epiphan	Nexus	84	7	100-240
Kaplan A26	Credenza Equipment	AV Equipment	Audio	1	Audinate	AVIO USB-A	1.5	0.5	5
Kaplan A26	Production Wallplate	AV Equipment	Audio Wallplate	1	symetrix	xIO XLR 2x2	15.4	0.35	48
Kaplan A26	Production Wallplate	AV Equipment	NVX Wall plate	1	Crestron	DM-NVX-E20-2G-B-T	9.2	0.75	240
Kaplan A26	Production Wallplate	Other	HDMI pass-through	1	Crestron	MP-WP152-B	0	0	0
Kaplan A26	Production Wallplate	AV Equipment	NVX	1	Crestron	NVX-384	25	1.5	240
Kaplan A26	Interface Devices	AV Equipment	ALS	1	ListenTech	LA-140	15	0.6	30
Kaplan A26	Interface Devices	AV Equipment	Occupancy Sensor	1	Crestron	cen-odt-C-poe	4	0.085	48
Kaplan A26	Interface Devices	AV Equipment	Scheduler	1	Crestron	TSS-1070-B-S-LB	15	0.31	50
PAB 2434	Interface Devices	AV Equipment	Touch Screen Wall-mounted	1	Crestron	10" Panel	15	0.31	48
PAB 2434	Camera	AV Equipment	PTZ Camera	2	Sony	SRGA40W/N	80	4.1	19.5
PAB 2434	Security Camera	AV Equipment	Axis Communications	1	AXIS	M4318-PLR	6.4	0.13	48
Kaplan A26	Audio Equipment	AV Equipment	Speaker Wall	2	SoundTube	IPD-SM500i-II-WH	40	1.67	24
Kaplan A26	Audio Equipment	AV Equipment	Ceiling Microphone	1	Sennheiser	TCC2 SL 2	8.8	0.18	48
Kaplan A26	Video - Display	AV Equipment	Display	1	Sony	FW75BZ40L	299	1.25	110-240
						Total	580.8	41.69	

A.4: Energy audit data for the legacy AV equipment in Kaplan A26

Room	Main Category	Category	Sub Category	Qty	Make	Model	Power (Watts)	Draw (Amps)	Voltage (V)
Crestron Small Room	Video - Projector	AV Equipment	Projector	1	Panasonic	PT-RW330U projector	460	2	100-240
Crestron Small Room	Camera	AV Equipment	PTZ Camera	1	Aver	PTZ 330W	19	1.58	12
Crestron Small Room	Camera	AV Equipment	USB Extender	1	Extron	USB Extender T	6	0.5	12
Crestron Small Room	Camera	AV Equipment	USB Extender	1	Extron	USB Extender R	18	1.5	12
Crestron Small Room	AV Rack Equipment	AV Equipment	PDU	1	Middle Atlantic	PDLT power distribution	300	25	12
Crestron Small Room	AV Rack Equipment	AV Equipment	Connection Panel	1	Extron	AAP 301	0	0	0
Crestron Small Room	AV Rack Equipment	AV Equipment	AV Processor	1	Crestron	DMPS3-300	30	4	100-240
Crestron Small Room	Interface Devices	AV Equipment	Touch Screen Wall-mounted	1	Crestron	TSW-560	30	0.63	48
Crestron Small Room	Audio Equipment	AV Equipment	Amplifier	1	Crestron	AM-200	8	0.75	24
Crestron Small Room	Video - Projector	AV Equipment	Projector accessory	1	Crestron	RMC-100-C	5.8	0.75	24
Crestron Small Room	AV Rack Equipment	AV Equipment	Computer	1	Apple	Mac Mini (2018)	150	1.25	12
Crestron Small Room	AV Rack Equipment	AV Equipment	Computer Display	1	ELO	2402L monitor	14.33	1.4	12
Crestron Small Room	AV Rack Equipment	AV Equipment	ALS	1	Sound Associates	SA-1710	120	4	30
Crestron Small Room	AV Rack Equipment	AV Equipment	ALS	1	Sound Associates	SA-1211	25	0.2	180
Crestron Small Room	AV Rack Equipment	AV Equipment	ALS	1	Sound Associates	SA-1422	25	0.15	180

Crestron Small Room	Audio Equipment	AV Equipment	Speaker Wall	2	KSI	6061CSM drop ceiling mount speaker	64	0.9	70.7
Crestron Small Room	AV Rack Equipment	AV Equipment	Network Switch	1	Cisco	SF300-24	16.4	0.15	110
Crestron Small Room	Audio Equipment	AV Equipment	Ceiling Microphone	1	Sennheiser	TCC2 ceiling mic	8.8	0.2	44
Crestron Small Room	Video - Projector	AV Equipment	Projection Screen	1	DaLite	36446 Model C Manual Projection Screen (69 x 110")	0	0	0
Crestron Small Room	Audio Equipment	AV Equipment	Dante for Zoom	1	Dante	AVIO 2CH USB-A	1.5	0.5	5
Crestron Small Room	AV Rack Equipment	AV Equipment	Lecture Capture	1	Extron	SMP-351	30	3	12
Crestron Small Room	Camera	AV Equipment	Lecture Capture	1	Panasonic	HE42	14.4	0.5	12
Crestron Small Room	Camera	AV Equipment	Lecture Captue	1	Panasonic	AW-UE4	5	1	5
						TOTAL	1415.23	50.86	

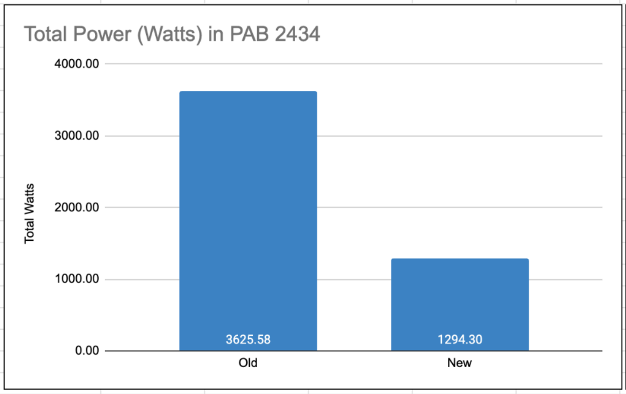
B.1: Bar graphs comparing the total Power (Watts) and Draw (Amps) between the legacy and pilot AV equipment in Kaplan A26

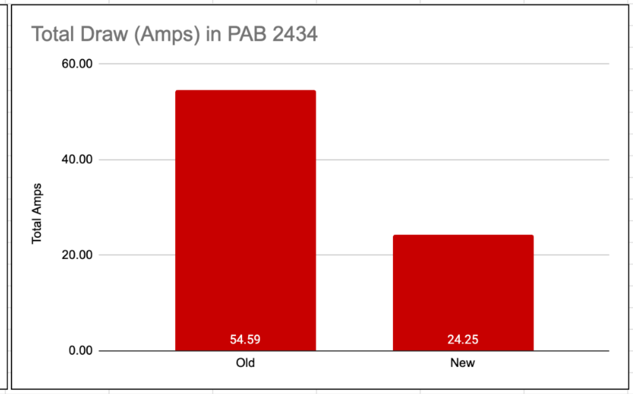


B.2: Bar graphs comparing the total Power (Watts) and Draw (Amps) between the legacy and pilot AV equipment in PAB 2434

	Total Watts
Old	3625.58
New	1294.30

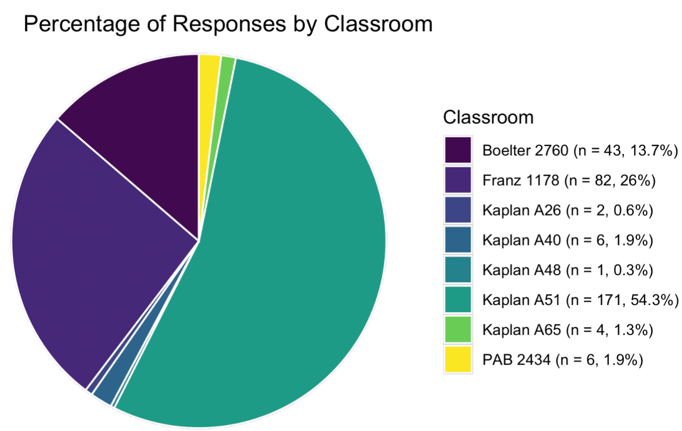
	Total Amps
Old	54.59
New	24.25



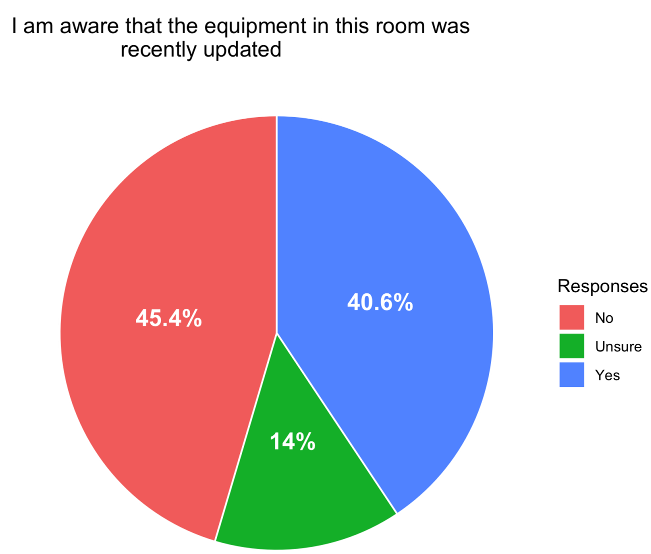


Appendix C: Student Survey Data

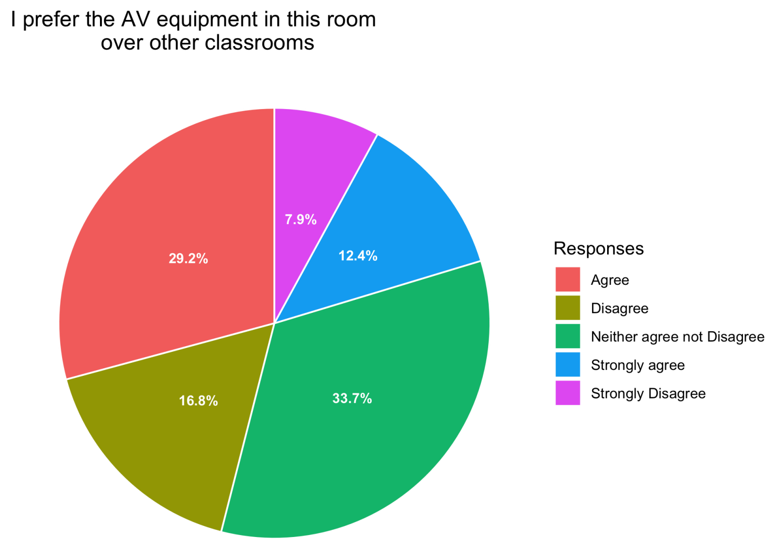
C.1: Figure 1. The number of responses from each classroom



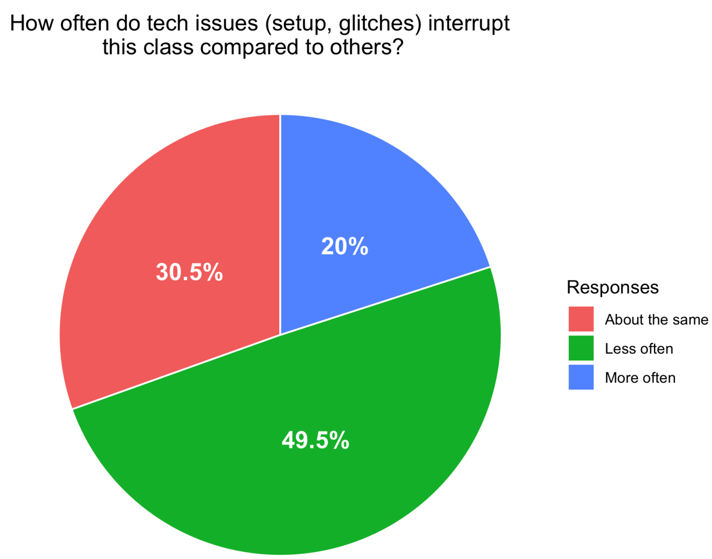
C.2: Figure 2. Understanding whether students were aware of AV upgrades



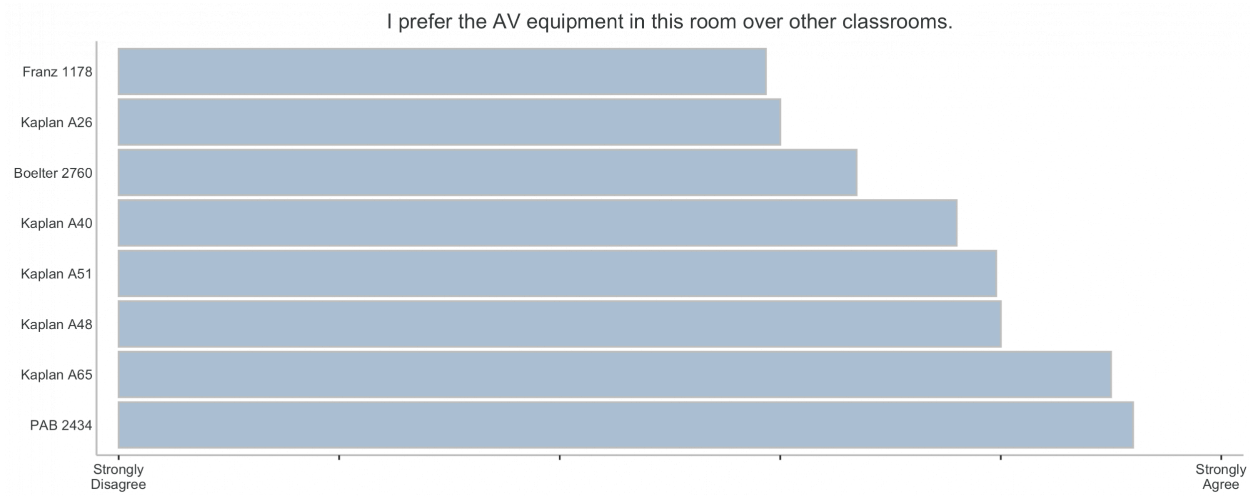
C.3: Figure 3. Analyzing whether students preferred the AV equipment in their classrooms



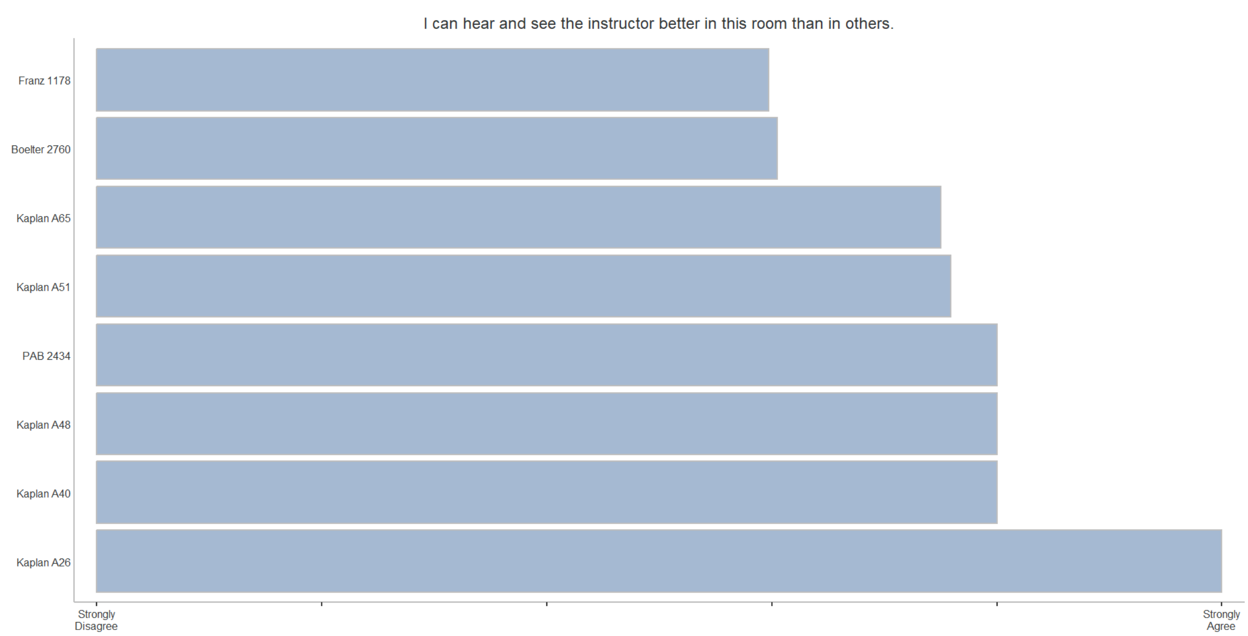
C.4: Figure 4. Understanding how often technology issues occur in class time



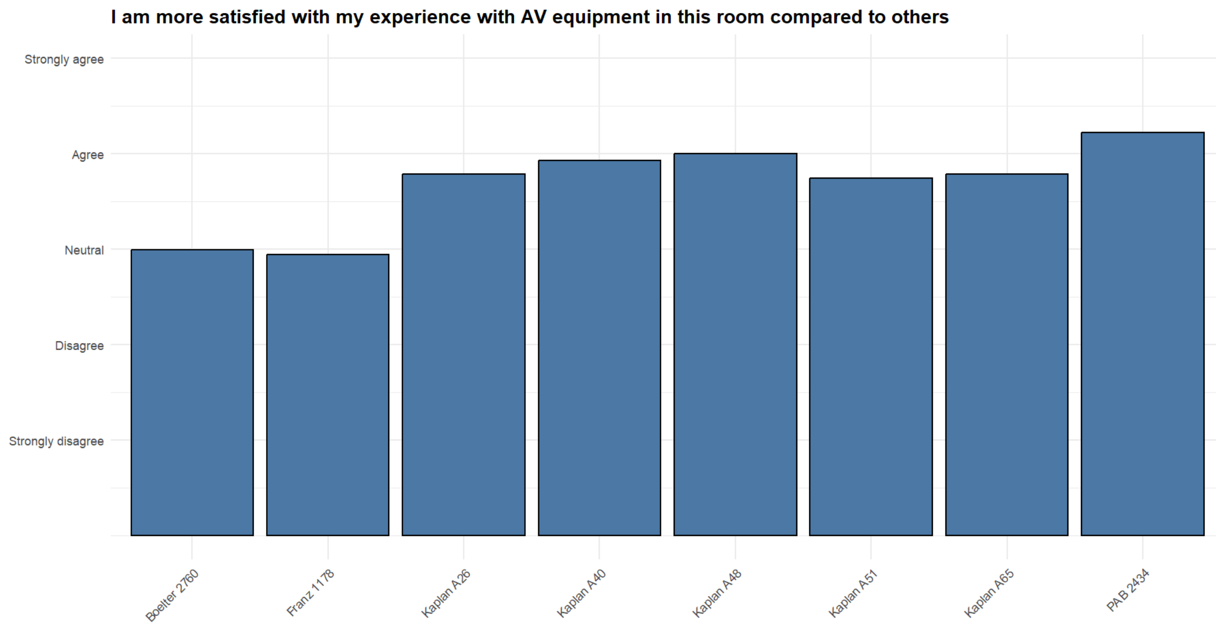
C.5: Figure 5. Analyzing whether students preferred the AV equipment in the renovated classrooms



C.6: Figure 6. Gauging whether students had better learning experiences in renovated classrooms



C.7: Figure 7. Quantifying overall satisfaction using several survey questions



Appendix D: Faculty Survey Data

D.1: Figure 1. Faculty Survey Questions

1. Name
    a. Get certain identifying information — ask them for that and say you won't publish it
        i. Can quote them for quotations used in reports

    b. Distinguish between TAs and professors, ask what role is within the university

2. How often do you use the projectors, speakers, microphones, and displays for your lectures?

3. On a scale of 1-10, how often do you use the projectors, speakers, microphones, and displays for your lectures?

4. On a scale of 1-10, how often have you encountered problems with the AV equipment, such as connecting to the projector, in the classrooms or lecture halls you have taught in?

5.How long does it typically take to connect your computer/device to the projector?

6. Do you turn off the AV equipment when your lecture ends?

7. Do you prefer the AV equipment in this classroom more compared to the equipment in other classrooms?

8. Any other information that you think would be important for our study?

D.2: Figure 1. Net Promoter Score from Faculty Survey

	A	B	C	D	E	F	G
1	Score	Category		Detractors	Passives	Promoters	
2	8	Passive		2	3	7	
3	2	Detractor					
4	0	Detractor					
5	10	Promoters					
6	9	Promoters					
7	9	Promoters			Score:	7/12 x100 = 58.33%	
8	9	Promoters				2/12 x 100 = 16.67	
9	7	Passive				58.33 - 16.67 = 41.66	
10	9	Promoter			Final Score:	~ 42	
11	7	Passive					
12	9	Promoter					
13	9	Promoter					

Appendix E: Student Survey Questions

1. (awareness/perception) My professors are proficient at operating the audiovisual (AV) equipment in this room.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree
2. (awareness/perception) My professors in older classrooms are proficient at operating the AV equipment.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree
3. (awareness/perception) I am aware that the equipment in this room was recently updated and changed.
    a. Yes
    b. No
    c. Unsure
4. (accessibility/learning) I prefer the equipment in this room over other classrooms.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree
5. (accessibility/learning) How often do AV equipment malfunctions (including setup difficulties) delay the start or interrupt the flow of your class?
    A. Never
    B. Rarely
    C. Sometimes
    D. Frequently
    E. Always
6. (accessibility/learning) The updated equipment in this room has improved my ability to learn during lecture time.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree
7. (accessibility/learning) I can hear the professor or instructor well from all areas of the room.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

8. (accessibility/learning) Recorded lectures are of higher quality in this room compared to those recorded in other classrooms.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree
    f. N/A

9. (accessibility/learning) Are there any issues you face with AV equipment in your classrooms that hinder or alter your ability to learn during class time? (i.e., hard to hear/see the professor or the material displayed)
    a. Open ended question box
10. (sustainability) Sustainability is important to me.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree
11. (sustainability) I am aware of the environmental impact of AV devices such as projectors and digital screens (energy consumption, e-waste, etc.)
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

Works Cited

Alevizos, T. (2023, April 16). University of Southern California ITS Learning Environments Department gets SAVe Certified. Sustainability in AV. https://saveav.org/university-of-southern-california-its-learning-environments-department-gets-save-certified/

Institute of the Environment and Sustainability at UCLA. (2025). AV equipment sustainability: Final draft [PDF]. UCLA. https://www.ioes.ucla.edu/wp-content/uploads/2025/10/AV-Equipment-Sustainability-Final-Draft-1.pdf

Sustainability in AV. (2025). SAVe 2025. https://saveav.org/save-2025/