



University of Wales Trinity St Davids, Swansea

**The Application and Practice of Extended Reality in Vocational
Education and Training Project Proposal**

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1. Introduction

Vocational education is the foundation for developing human resources and a critical factor in supporting the modernization of national industry, enhancing worker quality, and encouraging employment. Due to the unique character of their courses, practical training courses in vocational education are challenging to implement due to time and space constraints. As is typical of vocational training, VET in electrical entails not only high costs of experimentation and significant loss of human and material resources but also high costs of trial and error, serious safety hazards, etc., along with tedious and fragmented professional knowledge, abstract content, and difficulty in mastering, frequently requiring teachers to perform a great deal of preparatory work before class. Practical training classes are impacted by classroom cohesion. Expanded reality technologies, such as VR, AR, and MR, can integrate virtual reality with reality. This is a valuable remedy for the high cost of investigations and the unavailability of experimental instruments in the practical training classroom and can also prevent safety issues to a significant degree.

Through research on the current situation of teaching activities of teachers of electric power majors and analysis of the characteristics of the extended reality system, this project determines the applicability of the technology in the practical training classroom. By developing the XR experimental teaching system, XR technology is integrated into the practical training class, combined with gamification, which not only simulates the operational steps of the experiment but also restores the user's future work site and career promotion path, giving full play to the immersion experience. Helping practical training classes overcome time and space constraints has contributed to the theoretical and empirical research of the XR experimental teaching system, to the cultivation of electric power students' learning interest and the improvement of their experimental operation ability, and the optimisation of practical training teachers' teaching conditions and the improvement of classroom efficiency.

2. Project Background

2.1. Introduction of XR

Unity treats the "X" in "XR" as a mathematical unknown that encompasses the definitions of augmented, virtual, and mixed reality in its official training course. Qualcomm characterises "XR" as the subsequent generation of mobile computing platforms[12]. In terms of creating a sense of immersion, extended reality comprehensively surpasses AR, VR and MR, i.e. it enables users to be fully immersed in artificially created virtual environments and enables them to superimpose virtual world objects onto the real world with the help of XR, which can be said to be a further development of MR. The main purpose of XR is to broaden human experiences, especially the senses of existence and the acquisition of cognition(Lokesha, 2020).

Bryson defined VR as "computer technology that produces a three-dimensional interactive world with space"(2013) . People gradually realised VR's limitations as it developed. AR arrangement digital content on actual world. It cannot interact directly with the environment and is generated using a media that shows both the real world and digital

material (Palmas & Klinker, 2020). MR is a mix of VR and AR that allows interaction with the real world and combines virtual and real.

The Horizon Report is a global leader for advancements in education technology that informs decision-makers and encourages learners, educators, and leaders to evaluate education technology possibilities more thoroughly. It identifies six emerging technologies and practises that will impact the future of education in 2020, including XR technology. It indicates that the curriculum of higher education is actively experimenting with XR. Horizon 2022 mentions XR as an immersive learning tool for AI that helps create virtual simulation learning environments and meta-universe learning environments, allowing students to have immersive and interactive learning experiences and deepen their embodied understanding of intelligent learning environments through somatic, haptic, and skill interaction. It appears that the application of XR in education has become a significant trend in the evolution of education. XR has changed society as a new medium. XR has attractive educational potential. The virtual system's teaching methods overcome the boundaries of space and time, resulting in a new logical, inventive, interactive, non-realistic teaching instrument and platform.

2.2. Policies Related to Vocational Education in China

In September 2020, the Ministry of Education issued the Action Plan for Improving the Quality and Excellence of Vocational Education (2020-2023) to implement the National Implementation Plan for Vocational Education Reform issued by the State Council, to run a fair and quality vocational education with outstanding type characteristics, to accelerate the modernisation of vocational education, and to better support the sustainable and healthy development of China's economy and society.

In March 2020, the "Work Plan for Strengthening "0 to 1" Basic Research" gives full play to the source supply and leading role of basic research in science and technology innovation and solves the problem of the lack of "0 to 1" original achievements in basic research in China.

In October 2021, the General Office of the State Council issued the Opinions on Promoting the High-Quality Development of Modern Vocational Education, planning that by 2025, the modern vocational education system will be basically completed, and the construction of a skill-based society will be comprehensively promoted. The schooling pattern will be optimised, schooling conditions will be significantly improved, the enrollment scale of vocational, undergraduate education will not be less than 10% of the enrollment scale of higher vocational education, and the attractiveness and training quality of vocational education will be significantly improved.

In April 2022, the Standing Committee of the National People's Congress voted to adopt the New Vocational Education Law, which was enacted on 1 May of the same year. The law clarifies that vocational education is a type of education with the same importance as general education, focuses on enhancing the recognition of vocational education, deepening the integration of industry and education and school-enterprise cooperation, improving the system and measures to guarantee vocational education, and better promoting the high-quality development of vocational education.

Based on the above policies, it is easy to see that China is vigorously promoting the

reform and modernisation of vocational education, from improving the quality of vocational education to making it clear in law that vocational education is as important as general education, from strengthening basic subjects to promoting a skill-based society, the head reflects the state's determination to attach importance to vocational education.

2.3. Feasibility of XR for VET Applications

In general, the viability of adopting XR as the sole or supplemental training approach depends on a variety of issues, including training requirements, available resources, health and safety risks, privacy concerns, etc. To establish whether XR training can produce successful effects, firms and organisational groupings should conduct a comprehensive analysis incorporating the following basic(Sanika, 2020).

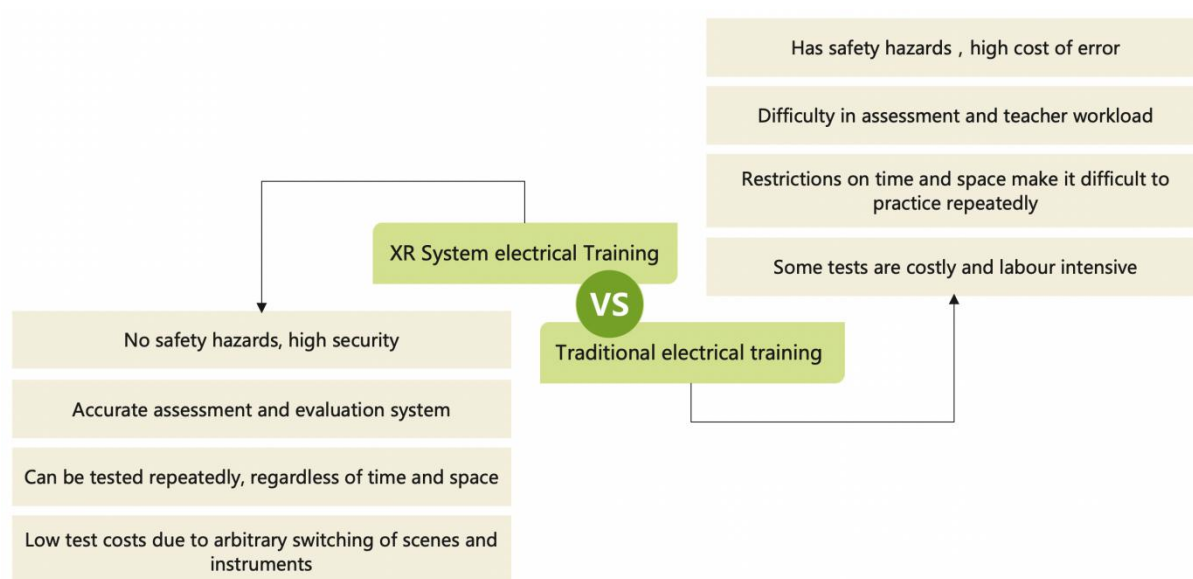


Table 1: Traditional vs. XR teaching Picture source: self made

To sum up, the above factors, taking electricity training in vocational education as an example, compared to traditional practical training, the XR system, especially the VR teaching system, can not only solve classroom problems for teachers and students to a certain extent but also alleviate the phenomenon of insufficient test instruments and inadequate number of teachers in schools.

Farra et al. developed a virtual reality simulation for disaster training, where the participants showed good progress in immediate assessment after virtual reality-based training and in the assessment after two months, which showed stability even in disaster training(2013).To support the previous point, Kaplan et al. have stated that, though extended reality-based training and traditional training produce similar results with respect to various tasks, one of the key benefifits of using extended reality-based training is that it can be implemented and is useful in environments which are very difficult and pose a threat in traditional training(2020).

Salah noted that a VLS-based VR teaching method was created to train students on the reconfigurable manufacturing system (RMS) using a case study. The majority of students were satisfied with its efficacy. Compared to conventional training techniques, VR-based

instruction was superior in terms of user comprehension, satisfaction, number of errors, and completion time (2019).

Hoover et al. used the Microsoft HoloLens HMD to teach workers about wing assembly. The author compared completion time, error count, net promoter score, and quantitative feedback utilising desktop model-based instructions (MBI), Table MBI, and Tablet AR. The HoloLens AR condition improved assembly success compared to non-AR circumstances (2018).

2.4. Research Gap

Nowadays, the vast majority of XR teaching systems are just mechanical lists of expertise, with little user-centred consideration of the interactivity and holistic nature of the system. These systems may be qualified if used as an initial practice of XR technology in teaching activities. Still, they are often not up to standard as a mature teaching medium that becomes part of teaching. Another problem lies in the weakness of systemic wholeness, primarily based on a laboratory, an experiment, or a point of knowledge, without building a complete framework for the subject or even a course, which is perfectly understandable considering the difficulty of developing XR systems. Still, if XR wants to be genuinely integrated into education, the conception of a theoretical framework for the subject or course cannot be missing. All the reviewed studies, except for a single report, concentrated on very short-term use in an experimental setting therefore future studies should focus on extended and frequent use (Alnagrat, Ismail et al. 2021) .

3. Aims and Objectives

Aim 1: Exploring the use of extended reality technology in vocational education. Ob 1: Assessing the nature and characteristics of XR and the potential application areas of XR technology. Ob 2: Analyse the current situation of XR technology application in vocational education and training. Ob 3: Analyse the current development of vocational education and training in China, taking electricity as an example

Aim 2: Design an XR electricity teaching system that is a reference for other professions. Ob 1: Study which theories can be integrated with the XR teaching system to produce better learning outcomes. Ob 2: Design a user-centred interactive flow and framework for the XR teaching system and complete the system. Ob 3: Find users to test the developed XR practical experience system, evaluate the effectiveness of use and optimise it based on their feedback.

The ultimate propose of the project is to assess and verify the effectiveness of this teaching medium in enhancing the learning and cognition of Chinese VET students and the effectiveness of teachers teacher efficacy by investigating and comprehending the application of advanced extended reality technology in vocational education and training, to explore a more optimal solution to the XR practical training teaching system model and provide a theoretical and practical basis for the XR based teaching system. As the research could not encompass the entirety of vocational education, a representative sample of teachers and students of electricity were chosen as the study's target, and an XR teaching system for this subject was developed.

4. Deliverable

The output results are divided into three main parts. The first part is a text-based analysis of the current state of XR application in vocational education and training, the current state of teaching and the needs of teachers and students in electricity. The second part is designing the interaction process and architecture of the XR teaching system based on different theories, which are dominated by the system design. The main goal of the third part is to implement the designed system. Still, due to time and team size, it cannot implement the whole system entirely, but only to ensure that the operating system is complete while demonstrating some of its functions.

Technical achievement: development of an XR teaching system, one of the critical achievements of the project is the development of a VR teaching system

Academic property rights: one utility model patent (for the XR teaching system interaction and framework and the system developed), one thesis

Economic benefits results: After the project was completed, the XR teaching system could help the school save much money on test instruments and equipment.

Social benefit outcome: The developed XR teaching system can relieve the pressure of course assessment on practical training course teachers. The gamified experience can cultivate students' interest in learning and improve their learning experience, thus promoting the development of vocational education.

5. Research Design

5.1. Experiments, Observations, Interviews to be Conducted

Henan, a province in central China, has an average level of economic growth and education. Understanding the current condition of the development of vocational education in China, in general, is facilitated by selecting Henan institutions as the survey's focus. Three to five institutions in Henan Province were chosen to investigate the current situation of their practical training in electricity, primarily through interviews and observations.

Interview

The students interviewed should have taken or be taking practical training classes and the teachers interviewed should have taught or be teaching practical training classes. Both parties can be in a teacher-student relationship, three students interviewed from each institution, two males and one female, as there are more males than females in the field of electricity.

Teacher outline: (two interviews per institution, 6-10 people)

1. basic information about the interviewee (teaching experience, title, course, type of school)
2. Classroom arrangements and assessment methods for practical training courses? (teaching format, grouping situation, resource conditions, students' practice hours, assessment methods)
3. How do the students perform in class? (examples, attention, learning effect)
4. Does the current format of teaching meet the aims of the subject and produce good

people? What changes would you like the school and teachers themselves to make?

5. Does the school have an XR teaching system? Do you use it in the classroom? How effective is it? / Explain XR technology to the teacher (show supporting video), ask the teacher what he/she understands about XR and discuss the changes the technology might bring to the subject

Student outline: (interview three people per institution, 9-15 people)

1. Basic information about the interviewees, why did they choose this subject?

(gender, year of study,)

2. What do you understand about the subject now? (Is it difficult? Do you have any interest in it? Do you want to work in this field after graduation?)

3. Is the practical training course interesting? How is the learning effect?

4. What are the learning time and learning tools in life? What are the interests and efficiency?

5. What do you like to do after school? Have you ever played or heard of VR games? How do you feel about it?

Observation

During the interview process, a trusting relationship is established with the teacher, which facilitates access to the observation site (practical training classroom). The main objectives of the observation are the realistic training environment, the experimental equipment, the students and teachers, teaching methods, etc. This information can verify and complement the data collected during the interviews. The non-participant observation was preferred, using the '6 W's' method to outline the words.

-Who? Who are they? Role-position relationships

-What is happening? What is happening? Performance discourse behaviour? (expected, unintended)

-When? When did the act and event occur? (point in time)

-Where? Where did it happen? What are the characteristics of this place? (moving location)

-How? How does the behaviour occur? How do they relate to each other?

-Why? What prompted the event? The way of looking at it?

Contrast Experiment

The primary purpose of the contrast experiment was to test the effectiveness of the XR teaching system after it had been produced for users. Twenty-four students, divided into three groups of eight each, were selected for the trial, which ultimately tested the students' assessment scores and learning satisfaction. The first group of students did not use the XR Teaching System and received traditional lectures; the second group used only the XR Teaching System and did not receive face-to-face lessons. The third group received both standard lecture formats and used the XR Teaching System for practice. The following issues need to be considered when selecting subjects for the experiments: whether or not XR equipment has been used may affect the results, the student's own ability to master the subject matter may affect the results, and interest in the novelty brought about by the new technology may affect the results, the teacher's assessment criteria during the assessment process may affect the results, etc.

5.2. Data to be Collected

Data collection and analysis take place simultaneously. Qualitative research in the pre-project phase is a cyclical process, spiralling from research design to data collection to data analysis to writing in a continuous loop.

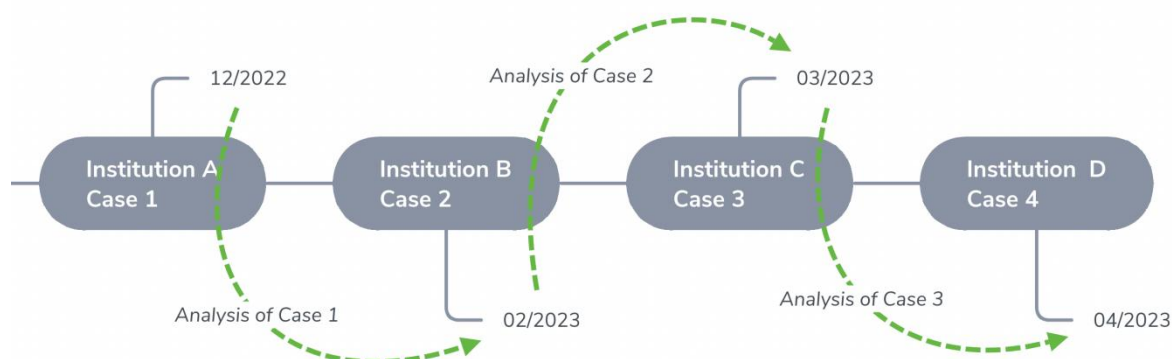


Table 2: Data collection and analysis process Picture source: self made

The type and amount of information expected to be collected to study the current state of the practical training classroom in electricity in vocational education and the classroom needs of electricity teachers and students are as follows.

Table 5: Type and volume of data collection projections Picture source: self made

Type of data	Amount
1.Observation	
Classroom transcripts (audio-visual materials)	6-8
Classroom notes (textual material)	6-8
2.Interviews	
Semi-structured interviews (1-to-1)	15-25
Focus groups (4-6)	2
3.Substance	
Teacher Lesson Plans	3-5
Teachers' work summary	3-5
Student lab reports	20
Photos	30

5.3. Methods to Analyze Results

Data analysis is primarily the collection of data through interviews and observations and the transfer of data to text to form notes, a personal summary and description of the text by the researcher, which in turn generates reflections and analysis of the data and ultimately a theory. This process is more suited to categorization analysis, in which Grounded theory excels, coding the data and extracting different themes from the data to produce core classes that explain the factors that influence the effectiveness of teaching and learning in practical courses. The process of data collection and analysis is a simultaneous.

5.4 timetable

Table 5: timetable Picture source: self made

Project timetable																			
	9 2022	10 2022	11 2022	12 2022	1 2023	2 2023	3 2023	4 2023	5 2023	6 2023	7 2023	8 2023	9 2023	10 2023	11 2023	12 2023	1 2024	2 2024	3 2024
Assessing the nature and characteristics of XR and the potential applications of XR technology																			
Analysing the current state of XR technology in vocational education and training																			
Analysis of the current development of vocational education and training in China, with the example of the electric power profession																			
Examine which theories can be integrated with XR teaching systems to produce better learning outcomes																			
Designing user-centred interaction processes and frameworks for the XR teaching system and completing the system																			
Find users to use the XR teaching system, test its effectiveness and optimise it based on user feedback																			

The project's expected duration is one and a half years, which can be divided into 18 months to develop the plan. From the timetable, the yellow part is the time available for writing in the program (the writing time may be shorter), and the blue part is the time for collecting data analysing the data and producing the system. It is worth noting that the design and production cycle of the XR teaching system for this project is up to 10 months, where a more detailed time plan is needed, especially for the development of systems that require multiple people to work together, where an unreasonable schedule can cause a lot of stress and burden to the whole team.

6. Expected Project Risks and Response Strategies

The risk of project loss due to a possible failure of R&D equipment and instruments, the development of XR systems requires the use of computers with high computing power and VR or MR glasses (not required for AR projects), operating handles, and positioners, etc. The failure and damage of XR supporting equipment may disrupt the project schedule, but the damage to project engineering files in the computer may cause a significant blow to the project; therefore, development projects will be stored on two computers, a hard drive and a cloud drive to ensure the project runs, while reducing the number of times XR equipment is taken out of the project and reducing the probability of accidents.

Risk of data leakage: The pre-project research data contains school and personal information; therefore, all places where names appear in the article will be anonymous. To prevent data leakage such as video and audio recordings, the computer where the data is

stored will be password set, and the computer will not be loaned out during the project research.

Risks to the health of XR users, in the case of VR glasses, for example, users will experience vertigo and nausea with prolonged use, so during the comparison experiment, each person will wear them for no more than 40 minutes at a time, during which time users will also be asked how they feel about using them and stop immediately if discomfort occurs.

There is a risk of contracting Covid-19. The researcher needs to come into contact with many people during interviews, observations and comparative experiments, and for safety reasons, will wear a mask in the classroom, contact the interviewee before the interview to confirm their health status, and adjust the interview time if necessary, and wear a mask during the observation process.

7. Conclusion

Before this project, I had already had extensive experience working on XR projects, having completed two XR-related collaborative projects, one at the undergraduate level and one at the master's story, the first of which was a collaboration between myself and another student and the company's programming staff. I was the designer and organiser of both projects, so the process was advantageous. Although there were shortcomings in both the review and reflection projects, I was able to improve my skills in various areas, such as learning to use group work and 3D modelling and animation in the first project and being able to use design thinking to design the XR experimental system and develop a simple system program in the second project. I am now able to participate in all phases of the project entirely.

The project is similar to the Master's degree design completed by the three parties. I was responsible for collecting and analysing receipts in the early stages of the project to ensure that the project was feasible and to define the problems that the XR teaching system could solve and needed to solve. In the later stages of the project, the company's programmer and I were responsible for developing the XR system while constantly communicating with the teachers of the vocational institutions to ensure the accuracy of the presentation of professional knowledge and practice in the XR system.

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APPLICATION FOR ETHICAL APPROVAL

In order for research to result in benefit and minimise risk of harm, it must be conducted ethically. A researcher may not be covered by the University's insurance if ethical approval has not been obtained prior to commencement.

The University follows the OECD Frascati manual definition of **research activity**: "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications". As such this covers activities undertaken by members of staff, postgraduate research students, and both taught postgraduate and undergraduate students working on dissertations/projects.

The individual undertaking the research activity is known as the "principal researcher".

Ethical approval is not required for routine audits, performance reviews, quality assurance studies, testing within normal educational requirements, and literary or artistic criticism.

Please read the notes for guidance before completing ALL sections of the form.

This form must be completed and approved prior to undertaking any research activity. Please see Checklist for details of process for different categories of application.

SECTION A: About You (Principal Researcher)

1	Full Name:	Xiangyu Dong			
2	Tick all boxes that apply:	Member of staff:	☐	Honorary research fellow:	☐
	Undergraduate Student	☐	Taught Postgraduate Student	☐	Postgraduate Research Student
					☒
3	Institute/Academic Discipline/Centre:	UWTSD			
4	Campus:	SWANSEA			
5	E-mail address:	2104582@student.uwtsd.ac.uk			
6	Contact Telephone Number:	07422534961			
For students:					
7	Student Number:	2104582			
8	Programme of Study:	full time PROFDOC Art & Design programme			
9	Director of Studies/Supervisor:	Rob			

SECTION B: Approval for Research Activity

1	Has the research activity received approval in principle? (please check the Guidance Notes as to the appropriate approval process for different levels of research by different categories of individual)	YES	☐	NO	☐
					Date
2	If Yes, please indicate source of approval (and date where known): Approval in principle must be obtained from the relevant source prior to seeking ethical approval	Research Degrees Committee	☐		
		Institute Research Committee	☐		
		Other (write in)	☐		

SECTION C: Internal and External Ethical Guidance Materials

	Please list the core ethical guidance documents that have been referred to during the completion of this form (including any discipline-specific codes of research ethics, location-specific codes of research ethics, and also any specific ethical guidance relating to the proposed methodology). Please tick to confirm that your research proposal adheres to these codes and guidelines. You may add rows to this table if needed.
1	UWTSD Research Ethics & Integrity Code of Practice ☒
2	UWTSD Research Data Management Policy ☒
3	<i>[List any other relevant documents here]</i> ☐

SECTION D: External Collaborative Research Activity

If there are external collaborators then you should gain consent from the contact persons to share their personal data with the university. If there are no external collaborators then leave this section blank and continue to section E.

1	Institution					
2	Contact person name					
3	Contact person e-mail address					
4	Is your research externally funded?	YES	☐	NO	☐	
5	Are you in receipt of a KESS scholarship?	YES	☐	NO	☐	
6	Are you specifically employed to undertake this research in either a paid or voluntary capacity?	Voluntary	YES	☐	NO	☐
7		Employed	YES	☐	NO	☐
8	Is the research being undertaken within an existing UWTSD Athrofa Professional Learning Partnership (APLP)?	If YES then the permission question below does not need to be answered.	YES	☐	NO	☐
9	Has permission to undertake the research has been provided by the partner organisation?	(If YES attach copy) If NO the application cannot continue	YES	☐	NO	☐

Where research activity is carried out in collaboration with an external organisation

10	Does this organisation have its own ethics approval system?	YES	☐	NO	☐
	If Yes, please attach a copy of any final approval (or interim approval) from the organisation (this may be a copy of an email if appropriate).				

SECTION E: Details of Research Activity

1	Indicative title:	The application of extended reality in vocational education and training and taking the electrical professional as an example		
2	Proposed start date:	01/2022	Proposed end date:	03/2024
	Introduction to the Research (maximum 300 words per section) Ensure that you write for a <u>Non-Specialist Audience</u> when outlining your response to the points below: <i>Purpose of Research Activity</i> <i>Proposed Research Question</i> <i>Aims of Research Activity</i> <i>Objectives of Research Activity</i> Demonstrate, briefly, how Existing Research has informed the proposed activity and explain <i>What the research activity will add to the body of knowledge</i> <i>How it addresses an area of importance.</i>			
3	Purpose of Research Activity The propose of the project is to assess and verify the effectiveness of this teaching medium in enhancing the learning and cognition of Chinese VET students and the effectiveness of teachers teacher efficacy by investigating and comprehending the application of advanced extended reality technology in vocational education and training, to explore a more optimal solution to the XR practical training teaching system model and provide a theoretical and practical basis for the XR based teaching system. As the research could not encompass the entirety of vocational education, a representative sample of teachers and students of electricity were chosen as the study's target, and an XR teaching system for this subject was developed. (this box should expand as you type)			
4	Research Question 1. Which current vocational education and training professions and courses in China are suitable for supporting training through XR technology? 2. What is the current situation of VET in China that is suitable for supporting training via XR, as well as the deficiencies of such teaching status quo? 3. Identity gaps in area of XR and VET, research on which theories can be integrated with an extended reality training systems to produce superior learning outcomes and why. (this box should expand as you type)			
5	Aims of Research Activity Aim 1: Exploring the use of extended reality technology in vocational education. Aim 2: Design an XR electricity teaching system that is a reference for other professions. (this box should expand as you type)			
6	Objectives of Research Activity Aim 1: Exploring the use of extended reality technology in vocational education. Ob 1: Assessing the			

	nature and characteristics of XR and the potential application areas of XR technology. Ob 2: Analyse the current situation of XR technology application in vocational education and training. Ob 3: Analyse the current development of vocational education and training in China, taking electricity as an example Aim 2: Design an XR electricity teaching system that is a reference for other professions. Ob 1: Study which theories can be integrated with the XR teaching system to produce better learning outcomes. Ob 2: Design a user-centred interactive flow and framework for the XR teaching system and complete the system. Ob 3: Find users to test the developed XR practical experience system, evaluate the effectiveness of use and optimise it based on their feedback. (this box should expand as you type)
	Proposed methods (maximum 600 words) Provide a brief summary of all the methods that may be used in the research activity, making it clear what specific techniques may be used. If methods other than those listed in this section are deemed appropriate later, additional ethical approval for those methods will be needed. You do not need to justify the methods here, but should instead describe how you intend to collect the data necessary for you to complete your project.
7	Using a mixed methods approach, collecting both qualitative and quantitative data. Interview The students interviewed should have taken or be taking practical training classes and the teachers interviewed should have taught or be teaching practical training classes. Both parties can be in a teacher-student relationship, three students interviewed from each institution, two males and one female, as there are more males than females in the field of electricity. Observation During the interview process, a trusting relationship is established with the teacher, which facilitates access to the observation site (practical training classroom). The main objectives of the observation are the realistic training environment, the experimental equipment, the students and teachers, teaching methods, etc. This information can verify and complement the data collected during the interviews. The non-participant observation was preferred, using the '6 W's' method to outline the words. Contrast Experiment The primary purpose of the contrast experiment was to test the effectiveness of the XR teaching system after it had been produced for users. Twenty-four students, divided into three groups of eight each, were selected for the trial, which ultimately tested the students' assessment scores and learning satisfaction. The first group of students did not use the XR Teaching System and received traditional lectures; the second group used only the XR Teaching System and did not receive face-to-face lessons. The third group received both standard lecture formats and used the XR Teaching System for practice. (this box should expand as you type)
	Location of research activity Identify all locations where research activity will take place.
8	Zhengzhou, Henan Province, China (this box should expand as you type)
	Research activity outside of the UK If research activity will take place overseas, you are responsible for ensuring that local ethical considerations are complied with and that the relevant permissions are sought. Specify any local guidelines (e.g. from local professional associations/learned societies/universities) that exist and whether these involve any ethical stipulations beyond those usual in the UK (provide details of any licenses or permissions required). Also specify whether there are any specific ethical issues raised by the local context in which the research activity is taking place, for example, particular cultural and/or legal sensitivities or vulnerabilities of participants. If you live in the country where you will do the research then please state this.

9	Zhengzhou, Henan Province, China 5 vocational education institutions in Zhengzhou as the venue for the activity Ethical stipulations in two countries are similar. China is more likely to be successful in finding student participants when permission is granted by the teacher and school management. <i>(this box should expand as you type)</i>
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10	Use of documentation not in the public domain: Are any documents <u>NOT</u> publicly available?	NO	☒
		YES	☐
11	If Yes, please provide details here of how you will gain access to specific documentation that is not in the public domain and that this is in accordance with the current data protection law of the country in question and that of England and Wales. <i>(this box should expand as you type)</i>		

	Does your research relate to one or more of the seven aims of the Well-being of Future Generations (Wales) Act 2015?	YES	NO
12	A prosperous Wales	☐	☒
13	A resilient Wales	☐	☒
14	A healthier Wales	☐	☒
15	A more equal Wales	☐	☒
16	A Wales of cohesive communities	☐	☒
17	A Wales of vibrant culture and thriving Welsh language	☐	☒
18	A globally responsible Wales	☐	☒
19	If YES to any of the above, please give details:		
	<i>(this box should expand as you type)</i>		

SECTION F: Scope of Research Activity

	Will the research activity include:	YES	NO
1	Use of a questionnaire or similar research instrument?	☒	☐
2	Use of interviews?	☒	☐
3	Use of focus groups?	☒	☐
4	Use of participant diaries?	☐	☒
5	Use of video or audio recording?	☒	☐
6	Use of computer-generated log files?	☒	☐
7	Participant observation with their knowledge?	☒	☐

8	Participant observation without their knowledge?	☐	☒
9	Access to personal or confidential information without the participants' specific consent?	☐	☒
10	Administration of any questions, test stimuli, presentation that may be experienced as physically, mentally or emotionally harmful / offensive?	☐	☒
11	Performance of any acts which may cause embarrassment or affect self-esteem?	☐	☒
12	Investigation of participants involved in illegal activities?	☐	☒
13	Use of procedures that involve deception?	☐	☒
14	Administration of any substance, agent or placebo?	☐	☒
15	Working with live vertebrate animals?	☐	☒
16	Procedures that may have a negative impact on the environment?	☐	☒
17	Other primary data collection methods. Please indicate the type of data collection method(s) below.		
	Details of any other primary data collection method:	☐	☐
	(this box should expand as you type)		

If NO to every question, then the research activity is (ethically) low risk and **may** be exempt from **some** of the following sections (please refer to Guidance Notes).

If YES to any question, then no research activity should be undertaken until full ethical approval has been obtained.

SECTION G: Intended Participants

If there are no participants then do not complete this section, but go directly to section H.

	Who are the intended participants:	YES	NO
1	Students or staff at the University?	☒	☐
2	Adults (over the age of 18 and competent to give consent)?	☒	☐
3	Vulnerable adults?	☐	☒
4	Children and Young People under the age of 18? (Consent from Parent, Carer or Guardian will be required)	☐	☒
5	Prisoners?	☐	☒
6	Young offenders?	☐	☒
7	Those who could be considered to have a particularly dependent relationship with the investigator or a gatekeeper?	☐	☒
8	People engaged in illegal activities?	☐	☒
9	Others. Please indicate the participants below, and specifically any group who may be unable to give consent.		
	Details of any other participant groups:	☐	☐
	(this box should expand as you type)		

	Participant numbers and source Provide an estimate of the expected number of participants. How will you identify participants and how will they be recruited?	
10	How many participants are expected?	Contrast experiment: 20 students Interview: 12 students + 6 teachers Focus group: 4 students + 4 teachers Observation: 12 students Questionnaire: 500 students <i>(this box should expand as you type)</i>
11	Who will the participants be?	Undergraduate students and teachers of electrical professional (Vocational education and training in higher education) <i>(this box should expand as you type)</i>
12	How will you identify the participants?	Students should from higher education, currently on a training course or have already been on a training course. Teachers and students are from the same institutions and teacher is teaching training class. <i>(this box should expand as you type)</i>

	Information for participants:	YES	NO	N/A
13	Will you describe the main research procedures to participants in advance, so that they are informed about what to expect?	☒	☐	☐
14	Will you tell participants that their participation is voluntary?	☒	☐	☐
15	Will you obtain written consent for participation?	☒	☐	☐
16	Will you explain to participants that refusal to participate in the research will not affect their treatment or education (if relevant)?	☒	☐	☐
17	If the research is observational, will you ask participants for their consent to being observed?	☒	☐	☐
18	Will you tell participants that they may withdraw from the research at any time and for any reason?	☒	☐	☐
19	With questionnaires, will you give participants the option of omitting questions they do not want to answer?	☒	☐	☐
20	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	☒	☐	☐
21	Will you debrief participants at the end of their participation, in a way appropriate to the type of research undertaken?	☒	☐	☐
22	If NO to any of above questions, please give an explanation			
	<i>(this box should expand as you type)</i>			

	Information for participants:	YES	NO	N/A
24	Will participants be paid?	☐	☒	☐
25	Is specialist electrical or other equipment to be used with participants?	☒	☐	☐
26	Are there any financial or other interests to the investigator or University arising from this study?	☐	☒	☐
27	Will the research activity involve deliberately misleading participants in any way, or the partial or full concealment of the specific study aims?	☐	☒	☐
28	If YES to any question, please provide full details			

As this study is related to extended reality technology, XR devices such as VR glasses and handling grips will be used by the participants in the testing process

(this box should expand as you type)

SECTION H: Anticipated Risks

Outline any anticipated risks that may adversely affect any of the participants, the researchers and/or the University, and the steps that will be taken to address them. If you have completed a full risk assessment (for example as required by a laboratory, or external research collaborator) you may append that to this form.						
1	Full risk assessment completed and appended?	<table border="1"> <tr> <td>Yes</td> <td>☐</td> </tr> <tr> <td>No</td> <td>☒</td> </tr> </table>	Yes	☐	No	☒
Yes	☐					
No	☒					
2	Risks to participants For example: sector-specific health & safety, emotional distress, financial disclosure, physical harm, transfer of personal data, sensitive organisational information					
	Risk to participants: 1. Physical harm when overuse of XR equipment 2. Transfer of personal data 3. Emotional distress, may be forced to participate <i>(this box should expand as you type)</i>	How you will mitigate the risk to participants: 1. The researcher will observe the participants who are using the device and stop immediately if there is a problem 2. Researchers add passwords to devices where personal data is stored, anonymize participants 3. Confirm that participants are participating voluntarily and sign an informal consent form prior to the interview <i>(this box should expand as you type)</i>				
3	If research activity may include sensitive, embarrassing or upsetting topics (e.g. sexual activity, drug use) or issues likely to disclose information requiring further action (e.g. criminal activity), give details of the procedures to deal with these issues, including any support/advice (e.g. helpline numbers) to be offered to participants. Note that where applicable, consent procedures should make it clear that if something potentially or actually illegal is discovered in the course of a project, it may need to be disclosed to the proper authorities					
	N/A <i>(this box should expand as you type)</i>					
4	Risks to the investigator For example: personal health & safety, physical harm, emotional distress, risk of accusation of harm/impropriety, conflict of interest					
	Risk to the investigator: 1. Risk of infection of Covid-19 due to the number of people to be contacted in the course of interviewing and observing. 2. Received allegations due to loss of confidentiality of data <i>(this box should expand as you type)</i>	How you will mitigate the risk to the investigator: 1. Determining whether participants have Covid-19 before interviewing, if yes, change interview time 2. Add a password to my computer, do not lend out the computer during the research period, and only save the data to a separate hard drive as a backup, do not upload it to the cloud <i>(this box should expand as you type)</i>				
5	University/institutional risks For example: adverse publicity, financial loss, data protection					
	Risk to the University: 1. Adverse publicity	How you will mitigate the risk to the University: 1. Anonymous to the school, add a password to my computer, do not lend out the computer				

	2. Data protection <i>(this box should expand as you type)</i>	during the research period, and only save the data to a separate hard drive as a backup, do not upload it to the cloud <i>(this box should expand as you type)</i>
6	Environmental risks For example: accidental spillage of pollutants, damage to local ecosystems	
	Risk to the environment: N/A <i>(this box should expand as you type)</i>	How you will mitigate the risk to environment: <i>(this box should expand as you type)</i>

Disclosure and Barring Service				
	If the research activity involves children or vulnerable adults, a Disclosure and Barring Service (DBS) certificate must be obtained before any contact with such participants.	YES	NO	N/A
7	Does your research require you to hold a current DBS Certificate?	☐	☒	☐
8	If YES, please give the certificate number. If the certificate number is not available please write "Pending"; in this case any ethical approval will be subject to providing the appropriate certificate number.			

SECTION I: Feedback, Consent and Confidentiality

1	Feedback What de-briefing and feedback will be provided to participants, how will this be done and when?
	After collecting the data from the participants, Saved the information in the form of videos, photos, audio recordings and texts, after which the researcher will organise and analyse the data and send the organised and analysed data to the participants for personal confirmation (except for the results of the questionnaire) to ensure that the researcher's views and descriptions of the participants are actual, error-free, objective, neutral, free from exaggeration, bias, etc.; to obtain the participants' confirmation of the analysed data and correction of any disagreements, and secondary proof of the revised data. First feedback upon completing the data analysis and second feedback upon completion of the entire project. Describe to participants how to protect the data against the risk of data leakage. <i>(this box should expand as you type)</i>
2	Informed consent Describe the arrangements to inform potential participants, before providing consent, of what is involved in participating. Describe the arrangements for participants to provide full consent before data collection begins. If gaining consent in this way is inappropriate, explain how consent will be obtained and recorded in accordance with prevailing data protection legislation.
	Ensure that informed consent is obtained from each participant verbally or in writing (written preferred). Make sure they understand your study and the purpose of the research (print a copy of the study description to help participants understand). If you want to record, whether it is audio, video, or other data, you must get permission from the participant before you start. Using a nickname provided by the participant to anonymise them, explaining to the participant how the data collected will be protected from disclosure and gaining the participant's trust will all help to gain permission for the participant to record and video. <i>(this box should expand as you type)</i>
3	Confidentiality / Anonymity Set out how anonymity of participants and confidentiality will be ensured in any outputs. If anonymity is not being offered, explain why this is the case.

All names of the institution and the teachers and students within the institution are kept anonymous, and the name of the institution is replaced by a descriptive text, e.g. a national priority institution located in the capital city of the central region of China + a letter, a teacher may be referred to as the institution letter + T (abb. for teacher) + a nickname, a student may be referred to as the institution letter + S (abb. for student) + a nickname.

(this box should expand as you type)

SECTION J: Data Protection and Storage

	Does the research activity involve personal data (as defined by the General Data Protection Regulation 2016 “GDPR” and the Data Protection Act 2018 “DPA”)?	YES	NO																								
1	“Personal data” means any information relating to an identified or identifiable natural person (‘data subject’). An identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person. Any video or audio recordings of participants is considered to be personal data.	☒	☐																								
	If YES, provide a description of the data and explain why this data needs to be collected:																										
2	<table border="1"> <thead> <tr> <th>Type of data</th> <th>Amount</th> </tr> </thead> <tbody> <tr> <td>1.Observation</td> <td></td> </tr> <tr> <td>Classroom transcripts (audio-visual materials)</td> <td>6-8</td> </tr> <tr> <td>Classroom notes (textual material)</td> <td>6-8</td> </tr> <tr> <td>2.Interviews</td> <td></td> </tr> <tr> <td>Semi-structured interviews (1-to-1)</td> <td>15-25</td> </tr> <tr> <td>Focus groups (4-6)</td> <td>2</td> </tr> <tr> <td>3.Substance</td> <td></td> </tr> <tr> <td>Teacher Lesson Plans</td> <td>3-5</td> </tr> <tr> <td>Teachers' work summary</td> <td>3-5</td> </tr> <tr> <td>Student lab reports</td> <td>20</td> </tr> <tr> <td>Photos</td> <td>30</td> </tr> </tbody> </table> Audio or video recording of the data collected ensures that data is not lost and is stored as efficiently as possible; ensures the authenticity and accuracy of the survey; saves the investigator time in the interview and the use of note taking can affect the quality of the conversation; prevents omissions and misremembering and ensures the accuracy of the origin of quotes. (this box should expand as you type)			Type of data	Amount	1.Observation		Classroom transcripts (audio-visual materials)	6-8	Classroom notes (textual material)	6-8	2.Interviews		Semi-structured interviews (1-to-1)	15-25	Focus groups (4-6)	2	3.Substance		Teacher Lesson Plans	3-5	Teachers' work summary	3-5	Student lab reports	20	Photos	30
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	Does it involve special category data (as defined by the GDPR)?	YES	NO																								
3	“Special category data” means sensitive personal data consisting of information as to the data subjects’ – (a) racial or ethnic origin, (b) political opinions, (c) religious beliefs or other beliefs of a similar nature, (d) membership of a trade union (within the meaning of the Trade Union and Labour Relations (Consolidation) Act 1992), (e) physical or mental health or condition, (f) sexual life, (g) genetics, (h) biometric data (as used for ID purposes),	☐	☒																								
	If YES, provide a description of the special category data and explain why this data needs to be collected:																										
4																											

	(this box should expand as you type)
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	Will data from the research activity (collected data, drafts of the thesis, or materials for publication) be stored in any of the following ways?	YES	NO
5	Manual files (i.e. in paper form)?	☒	☐
6	University computers?	☐	☒
7	Private company computers?	☐	☒
8	Home or other personal computers?	☒	☐
9	Laptop computers/ CDs/ Portable disk-drives/ memory sticks?	☒	☐
10	“Cloud” storage or websites?	☐	☒
11	Other – specify:	☐	☒
12	For all stored data, explain the measures in place to ensure the security of the data collected, data confidentiality, including details of backup procedures, password protection, encryption, anonymisation and pseudonymisation:		
	Back up a copy of the data on the hard drive to prevent loss of data due to damage to the computer, no hard drive will be taken away, the computer will be password protected and will not be loaned out during the research period, all names will be pseudonyms, which can be provided by the participants. (this box should expand as you type)		

Data Protection			
		YES	NO
	Will the research activity involve any of the following activities:		
13	Electronic transfer of data in any form?	☒	☐
14	Sharing of data with others at the University outside of the immediate research team?	☐	☒
15	Sharing of data with other organisations?	☐	☒
16	Export of data outside the UK or importing of data from outside the UK?	☒	☐
17	Use of personal addresses, postcodes, faxes, emails or telephone numbers?	☒	☐
18	Publication of data that might allow identification of individuals?	☐	☒
19	Use of data management system?	☐	☒
20	Data archiving?	☒	☐
21	If YES to any question, please provide full details, explaining how this will be conducted in accordance with the GDPR and Data Protection Act (2018) (and any international equivalents, where appropriate):		
	To prevent data from being lost, the data collected will need to be backed up on a removable hard drive in addition to a private computer, hence the need to transfer the data; as the data is collected in China and the graduation defence is based in the UK, data from outside the UK will need to be entered; to facilitate communication between the researcher and the participants, telephone numbers will need to be kept for easy contact in case of emergency (this box should expand as you type)		
22	List all who will have access to the data generated by the research activity:		

	Researcher, Supervisors, Participants, Project collaborators <i>(this box should expand as you type)</i>		
23	List who will have control of, and act as custodian(s) for, data generated by the research activity:		
	Researcher, Participants <i>(this box should expand as you type)</i>		
24	Give details of data storage arrangements, including security measures in place to protect the data, where data will be stored, how long for, and in what form. Will data be archived – if so how and if not why not.		
	The researcher stores the data in two places, a private computer not loaned out during the study and a hard drive, both with passwords. The removable hard drive is used to prevent data loss and is generally not loaned out for external use and is stored in a private space; uploading to the cloud is not considered for the time being to ensure that the data is not breached. The data will be archived for two years after the completion of the study, after which the researcher will erase the stored data. <i>(this box should expand as you type)</i>		
25	Please indicate if your data will be stored in the UWTSD Research Data Repository (see https://researchdata.uwtsd.ac.uk/). If so please explain. <i>(Most relevant to academic staff)</i>		
	No <i>(this box should expand as you type)</i>		
26	Confirm that you have read the UWTSD guidance on data management (see https://www.uwtsd.ac.uk/library/research-data-management/)	YES	☒
27	Confirm that you are aware that you need to keep all data until after your research has completed or the end of your funding	YES	☒

SECTION K: Declaration

	The information which I have provided is correct and complete to the best of my knowledge. I have attempted to identify any risks and issues related to the research activity and acknowledge my obligations and the rights of the participants. In submitting this application I hereby confirm that I undertake to ensure that the above named research activity will meet the University's Research Ethics and Integrity Code of Practice which is published on the website: https://www.uwtsd.ac.uk/research/research-ethics/		
1	Signature of applicant:	Xiangyu Dong 董向宇	Date: 19/08/2022

For STUDENT Submissions:

2	Director of Studies/Supervisor:		Date:
3	Signature:		

For STAFF Submissions:

4	Academic Director/ Assistant Dean:		Date:
5	Signature:		

Checklist: Please complete the checklist below to ensure that you have completed the form according to the guidelines and attached any required documentation:

☐	I have read the guidance notes supplied before completing the form.
☐	I have completed ALL RELEVANT sections of the form in full.
☐	I confirm that the research activity has received approval in principle
☐	I have attached a copy of final/interim approval from external organisation (where appropriate)
☐	I have attached a full risk assessment (where appropriate) ONLY TICK IF YOU HAVE ATTACHED A FULL RISK ASSESSMENT
☐	I understand that it is my responsibility to ensure that the above named research activity will meet the University's Research Ethics and Integrity Code of Practice.
☐	I understand that before commencing data collection all documents aimed at respondents (including information sheets, consent forms, questionnaires, interview schedules etc.) must be confirmed by the DoS/Supervisor, module tutor or Academic Director.

RESEARCH STUDENTS AND STAFF ONLY

All communications relating to this application during its processing must be in writing and emailed to pgresearch@uwtsd.ac.uk, with the title 'Ethical Approval' followed by your name.

You will be informed of the outcome of your claim by email; therefore it is important that you check your University and personal email accounts regularly.

STUDENTS ON UNDERGRADUATE OR TAUGHT MASTERS PROGRAMMES should submit this form (and receive the outcome) via systems explained to you by the supervisor/module leader.

This form is available electronically from the Academic Office web pages:

<https://www.uwtsd.ac.uk/academic-office/appendices-and-forms/>