ETHICAL CONSIDERATIONS FOR CONDUCTING RESEARCH WITH VIRTUAL REALITY IN EDUCATION: ESTABLISHING REQUIREMENTS FOR CONSENT FORMS

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Abstract

The widespread adoption of Immersive Virtual Reality (VR) is an undeniable statement. Currently, major tech companies like Meta, HP, Microsoft, and Apple are engaged in fierce competition to capture a significant share of the market by developing high-quality, affordable VR devices.

One area where VR holds great potential is education. Numerous projects, studies, and papers have explored the applications and benefits of utilizing VR in teaching. Some even predict that VR will become a defining technology in future education.

One of these projects is e-DIPLOMA: Electronic, Didactic and Innovative Platform based On Multimedia Assets; a Horizon Europe multidisciplinary project coordinated by the Universitat Jaume I of Castellón. This project aims to develop an innovative e-learning platform that integrates different innovative technologies, such as VR, Augmented Reality (AR) and Artificial Intelligence (AI), taking into account a deep pedagogical approach and full compliance with ethical standards.

However, the use of VR in the classroom, particularly with minors and vulnerable people, raises many ethical concerns. To draw accurate conclusions, it is essential to conduct further research and field studies that provide valuable insights.

Field studies often involve directly testing and piloting VR products with students, which necessitates careful consideration of various implications. Obtaining consent forms from students or their parents/legal guardians, depending on the students' age or decision-making capacity, is one crucial implication. Consent forms must be fully informative and unambiguous, detailing the possible consequences, both physical and psychological.

The objective of this paper is to establish specific requirements for consent forms when conducting research involving VR devices, particularly in educational settings. Exposure time to VR content, simple protocols for dizziness or any other health problem, data capture by sensors included in VR devices or Accessibility, inclusivity and exclusion are some of the key aspects that a proper consent form should include. By addressing these requisites, we aim to ensure ethical and responsible use of VR technology in education, particularly to the e-DIPLOMA project.

To accomplish this objective, we conducted desk research on popular VR devices and a literature review using databases such as SCOPUS, Web of Science, Google Scholar, and PubMed, spanning the past 10 years and over 25 relevant works were selected, including research papers, conference presentations, didactic books, and publications from the general press.

Keywords: Virtual Reality, Ethics, Consent Forms, e-DIPLOMA, Education.

1 INTRODUCTION

Virtual Reality experiences can provoke undesirable effects in the users, both at physical and psychological level. Virtual Reality sickness or cybersickness [1] is the term used to refer to adverse symptoms that users can experiment with the usage of VR, especially in a total immersion. Regarding psychological health, VR can become addictive, can provoke isolation, or can be used for manipulation [2].Moreover, VR has many Ethical considerations to be analysed due to its invasive characteristics [3].

Due to these problematic aspects, and to be ethically compliant, researchers should obtain an informed consent forms from the users when they take part on research activities involving VR. This form must be customized to different matters, such as the audience, the technology used, or the aim pursued [4].

Our primary objective in this paper is to structure an accurately detailed informed consent form, tailored specifically for research involving the utilization of VR within educational contexts. To achieve this goal, we have undertaken desk research focused on widely used VR devices, alongside a wide review of scientific literature pertaining to potential side effects and ethical considerations inherent to the realm of educational technology.

This work is structured into four sections: Introduction - states the aim of the paper and provides a brief explanation of VR concepts as well as contextualizes the work; Informed Consent Form for Educational Research with VR, which defines what an informed consent form is and give details about the methodology used to establish the specific requirements when VR is employed in educational research; Results- this section is divided in two parts: the side effects of VR devices and the structure, and requirements for the informed consent form; Conclusions and Future Work summarizes the necessary characteristics an informed consent form should include and proposes future work to enhance the ethical procedures when VR is applied as a digital tool in educational research, emphasizing the upcoming tasks in e-DIPLOMA project.

1.1   VR concepts

VR is not a new technology. In fact, it was in the middle of the 80's when the term "virtual reality" was coined [5]. However, in recent times it is becoming more and more popular due to the improvement in content, the increase in the realism of the generated worlds, the rapid evolution of Artificial Intelligence and the interest that large technology companies are showing in it. Apple, Meta, Microsoft, Sony or HP are just some of them. In addition, the affordable prices that VR devices have right now have provoked that this technology is available for a great part of the society [6].

It is important to differentiate the term VR from Augmented Reality (AR), Mixed Reality (MR) and Extended Reality (XR). AR joints real world with virtual objects; MR combines VR and AR; and finally, XR is an umbrella term that refers to VR, AR and MR. [7]

There are different types of VR, and the use of dedicated devices such as Head Mounted Displays (HMDs) is not always necessary. The non-immersive VR is that one that offers to the viewer a computer-generated environment but that doesn't need extra devices than the computer to visualize the scenarios, this VR allows user interactions using input devices, for instance a joystick, a mouse, or a keyboard.

Fully immersive VR provides the highest level of isolation using HMDs. These devices virtually detach the user from the real world by embedding them in a synthetic world entirely generated by the computer. Usually, these devices are glasses or helmets that avoid the visualization of the real world. In addition, the user can interact with the environment and the characters and can even modify them to their liking using different kinds of peripherals such as joysticks, microphones, gloves, sensors, or hand controllers.

1.2   Contextualization

The user isolation provided by immersive VR is being used in many different ways: psychology [8], medicine [9], engineering [10], tourism [11], etc. The education field is being very proactive in the use of VR because it allows teachers to allocate pupils in different scenarios and places, to manipulate complicate objects or engines and to show minuscule structures as molecules, and so on [12]. Hence, an important number of research has been carried out on different subjects: Maths [13], Chemistry [14], Astronomy [15] or History [16].

The e-DIPLOMA project (Project Number: 101061424 [17]) aims to establish an innovative e-learning platform that enhances and consolidates distance education as a valuable and effective alternative to conventional learning methods because most of the studies demonstrated that at this moment the educational systems were not ready for this digital transaction [18].

Therefore, to achieve this goal, the electronic platform will incorporate cutting-edge technologies such as VR. However, it is essential to acknowledge and address the social and ethical implications that may appear due to the implementation of these advanced technologies in education.

In e-DIPLOMA project VR is used as a medium to facilitate the "learning by doing" methodology. This learning methodology has been described by David Kolb in the Experiential Learning Theory [19]: "Learning by doing is the process whereby people make sense of their experiences, especially those experiences in which they actively engage in making things and exploring the world." According to [20]: "It ought not to be necessary to say that experience does not occur in a vacuum. There are some sources

outside an individual which give rise to experience". VR allows that this experience occurs in a virtual world, that can be properly designed and controlled to enhance the learning.

In order to analyse the effectiveness of this technology three innovative prototypes of learning modules are being developed and will be piloted in different countries of the consortium with different type of users, including minors. That is why an accurate informed consent form has to be tailored to follow the high standard ethical protocols that the European Commission has demanded to the project.

2 INFORMED CONSENT FORM FOR EDUCATIONAL RESEARCH WITH VR

Most of the information and existing scientific articles that discuss the formulation of this document is from the medical field due to the importance of this topic in this sphere. The paper [21] comprises the legal, ethical and administrative approach of this document in clinical trials; [22] explains the importance of the readability of consent forms to be fully useful; [23] compiles several papers, works and studies with the aim of improving patient comprehension in informed consent for medical and surgical procedures. In any case, the standards are, in most cases, equally valid for educational purposes.

2.1 Definition

According to the World Health Organization (WHO) an Informed Consent Form is a form in which the participants in research must admit that they know that are taking part in a research project, that they know all the details of the investigation and that they are free to participate. Regarding the structure of the form, "the consent form has two parts: (a) an information sheet describing the research and the nature of the participant's involvement in it, and (b) a certificate of consent attesting to the participant's consent". WHO also offers different templates that depend on the type of research to be conducted [24].

As regular conditions, consent forms must be written in the potential participants' mother tongue and in a clear way totally understandable for them, avoiding specific medical, technical or technological terminology. Also, the information part must be written in third person whilst the certificate part should be written in first person.

WHO considers that "when children or people considered to be unable or not competent to sign for themselves, a consent from a parent or guardian is required. However, children or others considered to be unable to sign for themselves, should be given the opportunity, where at all appropriate, to have their permission or concerns recorded as well" [25]. This is very relevant in education depending on the educational stage in which the research is conducted.

2.2 Methodology

This work does not aim to provide a systematic review but, to properly establish how to structure and redact the sections of a consent form for VR research in education, a comprehensive search of some of the main VR devices and a detailed analysis of various research papers on VR side effects and ethical concerns were undertaken. The objective of this search is to identify reliable and relevant guides, research papers and works that provide an accurate foundation of the aim of this paper that has a multidisciplinary approach due to the mixture of educational issues, ethical considerations, and a high innovative technology such as VR.

To study the side effects that VR experiences can provoke, an analysis of the Safety and Health Warning Guides of the most important Head Mounted Displays (HMDs) have been performed. This type of guide is a comprehensive document that provides essential information and instructions to ensure the safe and proper use of the equipment. It is a critical document for informing users about potential risks, hazards, and necessary precautions to prevent accidents, injuries, or health-related issues. For this paper, the following HMD Safety and Health Warning Guides have been examined:

- OCULUS Meta Quest Pro, Meta Quest 2 [26]
- HTC VIVE [27]
- HP Reverb G2 Virtual Reality Headset [28]
- SONY PSVR2 [29]

Apple Vision Pro could not be reviewed because it has not yet been released.

For these devices three tables with a comparison of different key considerations will be presented in the Results section: Detailed Side Effects, Room, Recommended age, Exposition duration, Cautions.

Regarding research papers, the search for the proper papers was conducted across the main scientific databases: Scopus, Web of Science, Google Schoolar and PubMed. Moreover, some general publications were also taken into account due to the rigor of the studies used. The review period encompassed the past decade, ensuring that recent insights were included, but without excluding previous works if they contribute in a very relevant way. The search parameters were adapted based on the specific focuses of the multidisciplinary investigation and the title, the abstract and the keywords were considered.

3   RESULTS

In the context of investigating VR within education, it has proven challenging to identify research papers that explicitly focus on the subject of informed consent. As previously mentioned, a significant portion of relevant papers originates from the medical field. When papers related to VR do touch upon the subjects of education and consent forms, the information typically pertains to medical treatment rather than the utilization of VR. Consequently, although the initial search using combination of the keywords such as "virtual reality," "consent form," and "education" yielded a substantial number of results (table 1), the majority of these papers were subsequently excluded due to their lack of relevance to the central focus of this investigation.

Table 1: Results of the search syntax "Consent form" and "education OR Virtual Reality"

Database	Number of papers
Web of Science	453
SCOPUS	549
PubMed	185
Google Scholar	129.000 → Google Scholar always include other types of works such as book chapters, book reviews, court opinions, general articles and so on; in addition, it is not compiled by professionals)

After a proper scan, 27 were papers selected for in-depth analysis, but only 10 papers were considered fully relevant to this work. The paper [30] makes a study of the presence of some side effects in a controlled environment; despite the size sample is small, the paper affirms that when individuals know about the side effects, they are more likely to suffer them, which generates an ethical conflict. Authors remark the need of more research with larger sample. The article [31] analyses the current state of the art of the use of VR, enumerate the issues and proposes new research to give solutions to the ethical doubts that currently generates the use of VR, especially with children. Paper [32] critically describes the current situation of the use of VR in education and its research and proposes questions to be solved such as psychological and physical vulnerability, inclusivity, data privacy, ethical content design, among others. This paper also highlights the need of an informed consent that includes psychological effects. [33] makes a comparison between the use of VR in academia and industry and it states that there is a difference also in the ethical treatment. Finally, the paper [34] compiles some studies about the causes of VR sickness and measurement of symptoms. This paper classifies the causes of the sickness in three different categories: hardware, content, and human factors. Regarding the measurement of the symptoms, they are organized in Objective and Subjective.

In other directions, [35] addresses how the reality is represented in VR systems and the ethical aspects and bias associated to that representation. [2] questions the effects of what is done in VR worlds, if "it is wrong to do immoral acts in VR". These concerns are augmented when superrealism is used.

In the realm of mental health, prolonged exposure to VR can lead to psychological problems. Therefore, it is imperative to inform users of these potential risks to ensure their awareness and well-being:

- Addiction [36]: The alternative existence that VR offers to users can provoke a dependence as the divergence from real life aligns more closely with their expectations.

- Unwanted surveillance [32]: Current HMDs include sensors that can collect data that users don't want to share, raising concerns about privacy and data security.

- Self-presentation [32]: In virtual worlds, users have the freedom to shape their representation as they desire. However, this freedom can lead to unintended biases and a sense of detachment from one's actual reality.

- Harassment [37]: The fact of inhabiting a virtual environment can instil the belief in users that their actions hold no real-life repercussions, potentially fostering a rise in harassing behaviours.

- Anxiety [38]: In a multi-stimulant environment the possibility of increased feelings of anxiety arises.

- Isolation [39]: The possibility of living in a self-designed or customized virtual world can lead to find it more appealing than the physical reality.

All these adverse impacts must be explained to users [32], especially in educational environments and, with extraordinary care when minors or vulnerable people are participating. Therefore, an accurate and detailed informed consent form must be provided to the user or to the parents or legal guardians including all these information, that must be delivered in an unambiguous way, so the implied parties can take the decision of participating or withdrawing with great self-confidence.

3.1 Proposed structure for the informed consent form

Hence, based on the conducted research, the essential sections to be incorporated into the informed consent form are as follows:

- In the information sheet, the content and the sequence of elements to be included are as follow:
  - o Complete name of the Principal Investigator in charge of the project.
  - o The institution responsible for carrying out the research.
  - o Funding entity (if applicable).
  - o A brief but clarifying abstract of the project and a complete description of the part of the project that requires the participants.
  - o An explanation of the type of participants and the reason why the participants have been chosen.
  - o Information on the activities that are going to be developed and the actions that the participants will be involved.
  - o Time required to finish the participation.
  - o Side effects that can arise.
  - o Risks and protocol to follow for any of them.
  - o Benefits of the research for general public and for the participant in particular.
  - o Data treatment and the name of the person who is in charge of it.
  - o If relevant for the investigation, a protocol of results sharing must be reveal to the participants to allow them if they agree or disagree.
  - o The right to withdraw the participation in the research activity.

- In the part of the certificate of consent, a statement must be written indicating that the participant has understood the entire document and gives the proper permission to participate in the activities. The signatures of the participant and the researcher or person responsible for the activity are essential. In addition, the date and place must be included.

As already mentioned, this part must be written in the first person and in a completely understandable manner and without any ambiguity.

What makes especially different the informed consent form of an investigation that use VR in education are the sections of Side Effects and the section of Risks. There are some of them that are unequivocally linked to VR but there are others that will depend on the devices used in the activities.

In the following tables are detailed the side effects, different recommendations and cautions that appear in the Security and Safe Guides of the analysed devices:

Table 2: Side effects

DEVICE	SIDE EFFECTS
Sony PS VR2	Motion sickness, nausea, disorientation, blurred vision, or other discomfort.
Meta Quest	The VR system may cause a variety of symptoms, including seizures, loss of awareness, eye strain, eye or muscle twitching, involuntary movements, altered, blurred, or double vision or other visual abnormalities, dizziness, disorientation, impaired balance, impaired hand-eye coordination, excessive sweating, increased salivation, nausea, lightheadedness, discomfort or pain in the head or eyes, drowsiness, fatigue, or any symptoms similar to motion sickness.
HTC VIVE	The side effects of using the headset are not explicitly mentioned. However, the guide recommends consulting a doctor before using the product if you have pre-existing serious medical conditions, psychiatric conditions, or if you are pregnant or elderly. It also advises not to use the product if you are sick, fatigued, under the influence of intoxicants/drugs, or are not feeling generally well, as it may exacerbate your condition.
HP Reverb G2	The headset has several side effects that users should be aware of. These include discomfort, property damage, and personal injury. Some people (about 1 in 4,000) might experience light flashes or patterns, severe dizziness, seizures, eye or muscle twitching, or blackouts. Such seizures are more common in people under the age of 20. Anyone who experiences any of these symptoms should discontinue use of the headset and see a doctor.

Table 3: Recommendations

DEVICE	ROOM	AGE	BREAKS
Sony PS VR2	Play Area of 2 m × 2 m (6 ft 7 in × 6 ft 7 in) or larger	+12	15 min. every 60 min.
Meta Quest	Always ensure your play space is free of hazards	+13	Every 30 min. More breaks if discomfort
HTC VIVE	Users should use the headset only in a safe environment and be aware of their surroundings before using the headset to avoid injury while using it.	+13	A 10- to 15-minute break every 30 minutes is recommended.
HP Reverb G2	Clear and safe area, free of obstacles, tripping hazards, or anything that may block you from moving around freely.	The guide doesn't specify a recommended age, but it cautions against children using or accessing the product. If older children use it, adults should closely supervise.	The guide does not provide a specific recommended time for taking breaks, as it may vary from person to person.

Table 4: Cautions

DEVICE	CAUTIONS
Sony PS VR2	If user has any ailment or injury that may be affected by the vibration function or any ailments or injury to body parts such as the head, bones, joints, or muscles of your hand or arm, do not use the vibration function of the VR headset or the vibration function and the trigger effect function on PlayStation VR2 Sense™ controller. If user uses pacemakers, defibrillators, programmable shunt valves, or other medical devices, do not use the vibration function of the VR headset. If user is in an area where wireless network use is prohibited, such as in hospitals, do not use the wireless networking feature of the PS VR2 headset. If user has a history of epileptic seizures or any other serious medical condition, it is recommended that you consult your doctor before using the PS VR2 headset.

Meta Quest	It is recommended not to use the headset in situations that require attention, such as running, bicycling, driving, or handling hazardous objects, whether indoors or outdoors. Additionally, the headset is not for use outdoors as it creates additional and uncontrolled hazards, like uneven and slippery surfaces and unexpected obstacles and vehicles (traffic). Also, the headset may not work properly outdoors.
HTC VIVE	Do not use the product while driving or engaging in activities that require awareness of your surroundings.
	If you've had adverse physical or psychological reactions to similar real-life circumstances, avoid using the product for similar content.
	If you have a history of epilepsy, seizures, loss of awareness, or related symptoms, consult your doctor before using the product.
	If you experience any discomfort, including seizures, loss of awareness, convulsions, involuntary movements, dizziness, disorientation, impaired balance, nausea, light headedness, drowsiness, or fatigue, cease product use and consult your doctor.
	This product is not intended for use by children.
HP Reverb G2	Don't use this headset in the following circumstances:
	When experiencing tiredness, the influence of alcohol or drugs, a hangover, digestive problems, emotional stress or anxiety, or a sickness such as a flu, cold, or earache. Otherwise, the user might increase their susceptibility to adverse symptoms.
	If the user is pregnant, elderly, has pre-existing binocular vision abnormalities or psychiatric disorders, or suffers from a serious medical condition such as a heart condition, HP recommends seeing a doctor before using the headset.
	The headset should not be used while driving or riding in a vehicle or while operating machinery, as use of the headset might cause a loss of balance.
	If the user notices swelling, itchiness, skin irritation, or other skin reactions, they should stop using the headset and see a doctor.

It can be noted that, despite these devices are often used by children under 12-13 years old for leisure objectives at their home, the manufacturers warn that these devices are not designed for them due to their difficulty of use, because they contain small parts or because of the side effects that may occur.

The research team should consider all these recommendations and ensure that they are communicated to the users, parents, or legal representatives in the Informed Consent Form. It is essential to establish a user monitoring protocol before starting the activity, including procedures for potential medical attention if required.

Therefore, the sections 'Side Effects' and 'Risks' should be customized to include the described hazards and undesirable consequences. Depending on the aim of the investigation, the hardware used, the designed virtual world, and the level of immersion and user interaction the level of detail should differ. As already mentioned, the age and autonomy of the participants are fundamental aspects to consider. In any case, approval from an expert ethical committee is, without a doubt, a perfect indicator that the Informed Consent Form is in total compliance with the standards and regulations.

4 CONCLUSIONS AND FUTURE WORK

This paper offers a structure for writing an appropriate Informed Consent Form for educational research involving VR, outlining the necessary sections, the sequence, and their content. It places particular emphasis on addressing Side Effects and Risks due to their significance and particularity.

Virtual Reality continues improving with a very high velocity. This rapid evolution is putting in the edge the research of the ethical consequences of the use of this technology, especially in education, a field that requires more time than other disciplines to adopt new technologies. Therefore, educational authorities must be conscious of the relevance of this issue and dedicate resources to perform more research, to promote innovation, to train teachers and to encourage the responsible and ethical usage.

In addition, more studies are needed to measure and minimize the cybersickness. This is also valid for the psychological effects of the use of VR and for the ethical consequences of the isolation of humans of the real world. In case of kids and vulnerable people these studies are highly appropriate to analyze the pertinence or not of the usage of VR in classroom and what kind of restrictions must be considered. Even knowing that serious side effects of VR rarely occur and, if they do occur, can be easily controlled,

it is mandatory to provide users or parents/legal representatives with a properly personalized informed consent form. The more research is done in this regard, the more accurate the informed consent forms will be, which will increase the safety of the participants in the research actions.

The e-DIPLOMA project is currently developing three innovative educational modules that will be tested with adult students, but also with minors, but over 16 years old. These modules are being designed and developed following a co-design and co-creation. Many of the planed actions will include the use of VR, therefore we need to prepare an accurate consent form. This fact will allow us to polish, test, and subject our customized consent forms to public scrutiny through interviews, surveys and/or questionnaires. The results obtained will be properly analyzed and more conclusions will be obtained that shed light on some of these research questions that are still open and will also allow us to improve the writing to achieve a better understanding by users of the implications of the use of VR in research related to education.

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