

Article Title	Use of augmented reality and gamification as support tools in the development of technical skills for the insertion of students who start internships in the company
Authors	Abel Jesús Broncano Osorio Bachelor of Administration, Technical Professional in Automotive Me- chanics Niky Rodolfo Macedo Flores, Technical Professionalin Automotive Mechanics Renzo Ronald Samamé Saavedra, Technical Professionalin Maintenance Mechanics
Institution	SENATI - National Industrial Work Training Service
Country	Peru
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1. SUMMARY

In this project, an augmented reality simulation model is made for the training process of metal mechanics and automotive mechanics projects that are carried out in SENATI - Zonal Ancash - C.F.P. Huaraz, within the maintenance mechanics and automotive mechanics workshops, through gamification using the learning management system as a support tool in the development of technical skills to achieve insertion to students in the practical work of companies.

The innovation is based on the 3D scanning of all the physical parts of real automotive and industrial equipment, then the 3D files will be rendered, to be processed in the Unreal Engine game engine [1], which offers us the option of being able to distribute it as a multiplatform to be able to apply gamification in teaching-learning.

Likewise, the project generates a significant learning scenario in the seminars of practical complementation during the process of disassembly and assembly of equipment; In order to optimize productivity, reduce downtime in the development of tasks, the percentage of accidents and get operators to comply with the tasks assigned in the scheduled time of maintenance and / or repair.

This had to be done by making a diagnosis of the teaching processes with two groups one that carried out traditional teaching without the use of software and the other group doing their work but using the software thereby verifying the times, distributions of machines, distributions of students through a survey with a population of no less than 71 students. In order to find with the Pareto chart 12 causes of immediate attention for the improvement of productivity, we also apply simulation models in two possible scenarios being able to optimize the best simulation in 5 hours working from 8:00 am to 1:00 pm where the group was able to conclude with the tasks and become familiar with all the equipment before executing the tasks.

As a result, productivity can be obtained based on the time of assembly and disassembly of a team, in relation to the schedules assigned for the seminar courses of practical complementation.

2. INTRODUCTION

This initiative arises from the need to improve technical skills in the insertion of students who start internships in the company, through the use of augmented reality and gamification as support tools through simulation of a virtual environment that can improve the teaching-learning process.

The main problem is in the teaching-learning process with real equipment, students can deteriorate equipment due to poor assembly and disassembly, due to a lack of skills, previous practices and suffer accidents, because this is a new knowledge that requires skills to be able to master and be familiar.

In reality in person, it is not possible to have equipment for each student causing possible agglomerations and that the development of the operations process is not complied with.

When making the statement of the problem in which the need to establish an investigation on the simulation of a virtual work environment is focused, where the student without previous knowledge about disassembly and assembly of industrial equipment, can perform these virtual tasks where assemblies and disassembly are carried out, repairs without the risk of



damaging these expensive equipment and being exposed to serious accidents and even environmental incidents. To achieve this, from the pedagogical point of view, it is necessary to create mechanical repair scenarios in an industrial machine workshop, which were visualized using augmented reality to increase the level of immersion and interaction with the parts of the equipment, sounds, equipment and instruments, tolerances, typical of the mechanical environment. In addition, to motivate and establish challenges in learning in the management of industrial equipment, it was decided to apply gamification, since it facilitates the incorporation of dynamics and mechanics typical of video games, for teaching purposes.

Another important aspect is the current context of the pandemic by Covid 19, which shows the need for this type of proposal, because it is confined to a work environment in virtual mode. Therefore, this situation encourages to assume pedagogical challenges that improve the student's training process and develop the competence of professional action.

Objective General.

Carry out the implementation of a learning management system with the use of augmented reality through gamification as support tools in the development of technical skills for the insertion of students who start internships in the company.

Specific objectives.

- Diagnose the current operation of virtual simulation systems for the teaching processes of augmented reality and gamification, applied in the development of technical skills for the insertion of students who start internships in the company.
- Apply the augmented reality and gamification learning management system in the current operation of production systems for teaching-learning processes.
- Reduce the percentage of accidents in the use of equipment and work machines, since the student will develop knowledge about the assembly and disassembly process.
- Determine the improvement of teaching-learning by evaluating the percentage results, which can be measured through work times, errors during assembly and disassembly, use of instruments and equipment; To achieve familiarity with real machines, encouraged healthy competition among students.

Scope.

A clear sequence with measurable and achievable goals, without neglecting the use of augmented reality and gamification.



3. DEVELOPMENT

Figure 1

Traditional method



Note. Development of teaching processes applying the traditional method [Capture], Matechmáticas - Use of augmented reality and gamification, 2022, <u>https://youtu.be/0vvCbf50oz0</u> [2].

Figure 2 Scanning Parts



Note. Scanning of all parts of automotive or industrial equipment to obtain the file in 3D. Taken from Artec 3D [Capture], Ready. Set. Scan. – With Artec Leo, it's that easy, 2022, <u>http://www.artec3d.com</u> [3][4].



Figure 3 Checking the Scan



Note. Scan verification on the computer screen. Taken from Artec 3D [Capture], Ready. Set. Scan. – With Artec Leo, it's that easy, 2022, <u>http://www.artec3d.com</u>.

Figure 4 *Rendering the 3D File*



Note. Rendering of the 3D files of the parts, correction of textures and internal details. Taken from Artec 3D [Capture], Ready. Set. Scan. – With Artec Leo, it's that easy, 2022, <u>http://www.artec3d.com</u>.

Figure 5

Integrating 3D Authoring Tools



Note. Integration of multiple tools to render 3D files. Taken from Unreal Engine⁹ [Screenshot], Gamification of Training | Webinar | Unreal Engine, 2021, <u>http://www.unrealengine.com</u> [5][6].



Figure 6 LMS Development in Unreal Engine



Note. The Blueprint visual scripting system in Unreal Engine is used to create the virtual scenarios. Taken from Unreal Engine [Photo], Toyota evaluates vehicle ergonomics utilizing VR and Unreal Engine, 2020, <u>http://www.unrealengine.com</u>.

Figure 7

Testing in Training Development



Note. Once the LMS is finished, we proceed to the evaluation in Unreal Engine and VR to validate designs. Taken from Unreal Engine [Photo], Toyota evaluates vehicle ergonomics utilizing VR and Unreal Engine, 2020, <u>http://www.unrealen-gine.com</u>.

Figure 8

Student interaction with the platform



Note. Students interact on the platform. Taken from zSpace [Screenshot], AR/VR for Automotive and Welding Training, 2019, <u>https://zspace.com/</u> [7][8]



Figure 9 Application of the Learning Management System



Note. Apply the augmented reality learning management system [9] and gamification in the current operation of productionsystemsforteaching-learningprocesses[Capture],Hyundai Motor Group, VR Technology For Mobility Development – KIA, 2019, https://youtu.be/OuvGsRvgJbg [9].

Efficiency

The learning management system seeks to achieve the following results in the experimental group:

- Achieve the established objectives
- Measure results in percentages
- Measure job times
- Number of errors in assembly and disassembly
- Use of tools and equipment
- Low percentage of injured
- Familiarity with the real machine
- Productivity

Greater number of students served in relation to learning to repair a machine, before making physical contact with a real machine, achieving that all students achieve the use of the equipment virtually by the ease and simplicity of this resource, in virtual environments, computers, cell phones, reducing downtime while waiting for the physical machine to be vacated, Attention Capacity in selection of students for Olympics as a pre-selection of candidates for the contest, attention to monitors in the workshops for training, as you can see you can do many activities with a single resource.

Impact

Comply with all the contents of the Specific Learning Plan of each semester.

Less downtime in the teaching-learning process.

Achieve that the student has an accurate preconceived knowledge of machine repair through simulation.

Positive Users

Educational institutions dedicated to training in industrial work, machine operators that require consultancies on disassembly and assembly of industrial equipment, to improve skills, where the use of simulators for teaching-learning is required.

Companies in the industrial and automotive sector, which require the learning of a technical activity with new personnel and / or area rotation, with less physical risk using the simulator, as a safe learning strategy, lower cost for the use of real equipment.



In the same way, we can account for learning management systems such as:

On the one hand, ELECTUDE that allows fully functional simulation tests of an internal combustion engine, with control modules, sensors, actuators and CAN network, in addition the oscilloscope, diagnostic systems, test board and other tools can be used to measure and read the system, components and cables can be disconnected, removed and replaced to correct the problems [10].

On the other hand, FLEXSim which allows a risk-free virtual environment, you can create dynamic computer models of systems, simulating the real world, taking into account time, space, variability and complex relationships within your system, FlexSim's 3D environment and stunning images allow you to really see what is happening, at a second critical level of validation [1].

The project: "Use of augmented reality and gamification as support tools in the development of technical skills for the insertion of students who start internships in the company"; has occupied the ^{3rd} place in the SENATI INNOVA 2021-2022 course.

The project has been presented to the Center d e Global Linkage de UTEC, for its corresponding review and publication.

4. CONCLUSIONS

- It is intended to evaluate the operation of virtual simulation systems for the teaching of augmented reality and gamification through surveys and the Pareto chart, the possible causes that must be addressed immediately are: the method of projects, large students and insufficient equipment.
- It is planned to apply the learning management system in an experimental group of the maintenance mechanic career during the process of dismantling rotary gear pumps. Likewise, a control group is used, where the development of the same activity is taught with the traditional instructor-machine method.
- The comparison of the results of both groups allows to determine the time of completion of the disassembly of rotary gear pumps, number of errors and knowledge of the parts of the transmission system.
- The learning management system, which is intended to be applied to the students of the experimental group, allows to activate previous knowledge about the use of the equipment, helps to improve the times of completion of the task and strengthens their capacities; Well, initially, a challenging learning situation is created on the platform, in which they perform the simulation of the operation, which helps to achieve a meaningful learning experience and familiarizes students with the pieces of this equipment, then execute the same task in a real case; Therefore, they have favorable conditions to reach the learning goal.
- The traditional method of instruction in the students of the control group allows to show deviations in the fulfillment
 of the learning objective, since the rotation of students is not concluded, the times are very dispersed and the machines
 insufficient for the demonstration of technical and methodical competences.



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AUTHOR'S CURRICULUM(S)

Abel Jesús Broncano Osorio Bachelor of Administration, Technical Professional in Automotive Mechanics - Instructor with 20 years of experience in Automotive Mechanics at the C.F.P. Huaraz - Zonal Ancash - SENATI - email: <u>abroncano@senati.pe</u>, cell phone: 943620216.

Niky Rodolfo Macedo Flores, Technical Professional in Automotive Mechanics - Instructor with 10 years experience in Automotive Mechanics at the C.F.P. Huaraz - Zonal Ancash - SENATI, <u>nmacedo@senati.pe</u>, cell phone: 944992140.

Renzo Ronald Samamé Saavedra, Technical Professional in Maintenance Mechanics - Instructor with 15 years of experience in Maintenance Mechanics at C.F.P. Huaraz - Zonal Ancash - SENATI, <u>rsamame@senati.pe</u>, cell phone: 969553129.