A SIMULATOR FOR MILITARY TERRAIN STUDY

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Abstract

One of the biggest concerns in planning a military operation is how to explore the terrain, avoid collateral damage and accomplish the mission. During that process, military planners study the topographic and tactical aspects, gathering detailed information to better advise superiors in their decisions. Learning how to prepare for that terrain study takes time and practice, and inside the classroom is difficult. In this context, we propose "Simulador Virtual para Estudo Topotático do Terreno (SVETT)," a simulator that uses resources usually found in classroom inserted in 3 interfaces (Virtual Reality, Projector and Constructive) that can help instructors to ease teaching the abstract subjects of a terrain study and standardize the knowledge learned from students. The Brazilian Marines Simulation Center developed SVETT and evaluated it with 54 students. The results suggest that using SVETT first, students found participating in the field exercise easier because of their previous contact with the region.

CCS Concepts

• **Applied computing** → **Interactive learning environments**; **Military**; **Computer-assisted instruction**.

Keywords

Virtual Reality, Learning Environments, Terrain study, Interaction

1 Introduction

To conduct military operations, planners must make a comprehensive analysis of the operating environment, its components, actors and their relationships [10]. Those factors will influence the operation planning process, which is done by highly trained personnel, capable of interpreting all topographic and tactic data, which normally involve aspects related to relief, enemy, vegetation and climate, known together as operational aspects of the terrain [11].

Teaching and training military personnel about this type of activity is sometimes difficult within a closed classroom. Therefore, students are usually taken to different regions in Field Exercises (FE), so that they can have better contact with the terrain and understand what should be considered for their study. Even participating in those FE, it is quite difficult for the instructor to explain to students the subject given the abstraction needed to visualize, for example, the coordination measures for an operation in the area, the best place to plan a position for a certain military facility, a company moving to an objective and so on.

Based on the worldwide trend where the development of different categories of simulators [8] enables higher quality training and the consequent preparation of the Troop, always considering the fact that a real exercise should never be replaced, a great opportunity arises from the following question: Is it possible that the concatenation of the concept of a Learning Environment (LE) and resources usually seen in classroom can offer educational capabilities to better understand terrain analysis even before the presence in field?

In this sense, Brazilian Marines Simulation Center (CSimCFN) developed, for training purpose only, a simulator called SVETT (In English: Topographical and Tactical Terrain Study Simulator). This simulator has the purpose of facilitating the transmission of knowledge by the instructor, as well as unifying the students' understanding using its tools. The objective of this study is to evaluate whether the platform resources can offer both education and capabilities for real situations to better understand terrain analysis in the Basic Terrain Study. We developed SVETT and evaluated it with 54 students. The results suggest that, using SVETT first, students will find it better when participating in the Field Exercise because of their first contact with the region in classroom.

2 "Simulador Virtual Para Estudo Topotático Do Terreno" (SVETT)

To ease instructor's teaching conditions and standardize student's knowledge, SVETT was developed exploring resources usually seen in classroom, like a pen, but inserting those resources at any region created by the instructor or modeled from the real world. All students and instructors are immersed in that area and interact with each other within three interfaces developed with the aim to increase accessibility to the study and to explore terrain aspects elaborately. This section explains more about the simulator.

SVETT was developed at CSimCFN. We used Unity [7] as development engine, with 3D assets and graphic objects created using Blender [1]. Also, the terrain was obtained using the asset Real World Terrain [9] and the communications layer was made possible by using Mirror [3] and PostgreSQL [5]. For the purposes of development and experiment, we used one desktop with a RTX3070Ti connected to three TV 82", one tablet Galaxy Tab A8 [6] and two

OCULUS QUEST 2 [4] Head Mounted Display (HMD). Those devices were connected to each other through a router [2],but there were no tests focusing on connections quantity because of budget limitations. All this equipment was used to iterate between a total of three interfaces, detailed in the next paragraphs.

As the aim of the simulator is to help in the study of the topographic and tactical aspects of any region. Some possibilities include: drawing in the terrain to help mark important measures like the limit between platoons, inserting static objects like military facilities, viewing Military Map grids, pointing to a place and calling other users to look at that place, and showing a compass to help with orientation.

The interaction in the scene created happens through any of the three interfaces developed (Constructive, Projector and Virtual Reality Interfaces), which both instructor and student can use as their own demand. All interfaces can observe and interact with each other in the Virtual Environment and differ by the resources available, the view mode and the hardware. Also, all of them observe and interact at the same study area, which can be created just for the study or even modeled from the real world.

The first one, called Constructive Interface, is possible to be used with a tablet or a laptop, both connected wirelessly to the router. We can choose to observe the study area as a satellite image, like a photograph, or as a Military Map. In both cases, this observation is made from the top view and with an orthographic camera pointed down. Also, we can observe each other's interfaces position and direction as a unique symbology standard.

The second interface is called Projector Interface. It uses a desktop connected to a TV or even a projector and can connect to eight screens simultaneously. This interface is only capable of observing the other interfaces and changing its position by flying or teleporting to the new place. The main advantage of this interface is that one can, while giving the instruction to the students, observe the student's faces, to see their expressions and detect if there are any problems in the learning process.

The Virtual Reality Interface is the last one and uses a wireless HMD to get immersed at the study area. This interface interacts with the others on the terrain with an avatar using a military uniform. The user will be deployed above a platform that can move to any place in the area just by using the controller. The main advantage of this interface is the possibility to apply a more detailed study due to its immersion and the possibility to see all objects and annotations at any point of the terrain as if you were in a field exercise and, with that, have a better notion of the planning.

3 Methodology, Results and Conclusion

This work proposed the SVETT, a simulator that has resources usually used in classroom aiming to ease the transmission of knowledge by the instructor, as well as to unify the students' understanding using its tools. The concept that SVETT brings is that it is possible that a Learning Environment (LE) and resources usually seen in classroom can offer educational capabilities to better understand terrain analysis even before the presence in field. We questioned that concept by evaluating it with 54 students in two scenarios. The first scenario occurred in a classroom, where the students received instructions about terrain study using SVETT. The second scenario happened at a field exercise, where the students received instructions without the classroom resources, in a usual way. After each scenario, they filled in two questionnaires each.

Discussing the results, we obtained higher grades (4.67 of 5.00) in questions like "I enjoyed how my instructor taught the simulation", and with "The way my instructor(s) taught the simulation was suitable to the way I learn". With those results, we inferred that the instructor, in some way, learned how to explore the tools and captivated the students' attention.

About the questionnaire that assesses the combination of classroom study and field exercise study, the students gave higher grades in questions like "I felt safer when I received the instruction in the field after having received the instruction through the simulator" (graded 4.69), and also with the question "The concept of instruction consisting of the use of the simulator followed by Exercise in the field in the same region of the simulator facilitated my learning." (graded 4.66 with the second smaller standard deviation 0.47), which helped us to infer a positive answer to our main question: "Is it possible that the concept of a Learning Environment (LE) and resources usually seen in classroom can offer educational capabilities to better understand terrain analysis even before the presence in field?".

Building on these results, as future work, we aim to improve the terrain detail and resolution, enhancing some major points such as rivers and roads. Also, we look forward to evolving some other functionalities, such as time of the day, weather, visibility conditions, and so on. We also intend to evaluate the concept of this instruction with more advanced courses such as the Brazilian Marine Officers Advanced Course, the Amphibious Warfare Course, and the Infantry Sergeant Course, and incorporate objective human performance metrics in the next cycle of testing to better capture the Return on Investment (ROI) of SVETT.

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