



Computer Supported Training of Joint Investigation Teams

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Our project aims at developing a virtual tool for training Joint Investigation Teams (JITs) on conducting interrogations of suspects in transnational organized crime. To design an effective training tool that supports collaboration and, at the same time, provides training on collaboration, we propose to combine computer-supported methods for interaction and collaboration with an ITS, extended to train teams. This becomes particularly important when training targets cognition and behaviours of team members that should work together as one.

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1 Introduction

Globalisation and open borders came with many benefits from new communication options to easy forms of commerce. At the same time, these benefits created new opportunities for criminal activities creating a steep increase in transnational organised crime [17]. In order to tackle transnational crime more efficiently, new European conventions and modern methods of investigation were created. One of these methods is the formation of a Joint Investigation Team (JIT). A JIT is a team of representatives of law enforcement and judicial authorities from several Member States that work together to fight complex cross-border criminality in a close police and judicial cooperation between States [8]. However, it is a complex process that requires the development of a myriad of skills that allow law enforcement agents to cope with different cultures, laws and methods, as well as, know how to conduct cross-border teamwork. The acquisition of such skills can hardly occur without training. Hence, in our project, we aim at creating a tool for computer supported training of JITs taking into consideration the team structure, its constraints, the characteristics of the task and the individual skills of the team members.

In general terms, a team is a group of individuals, with high task interdependency, that work towards common goals, engaging in *taskwork* and *teamwork* alike [13]. Although all teams are different and created with different purposes, it is well established in the literature that effective teamwork enhances team performance in a task [13]. Therefore, team training should not be focused only on how individuals perform a certain task, but also on building a teams ability to function effectively. For that reason, it is our goal to create a tool that offers more than collaboration support, we want to support collaboration learning.

To that end, we take advantage of the nature of CSCL combined with an Intelligent Tutoring System (ITS) to support training on communication and interaction between the team members of a JIT. An ITS is a computer systems with intelligence aimed at providing tutoring and training on a specific topic usually without the intervention of a tutor [7]. It has been shown these systems are effective in supporting learning in algebra, law, reading or medicine, very well defined domains. It is our stance that an ITS can be extended to ill-defined ¹ domains, such as collaborative settings or team training as long as combined with technology that provides a media of communication and a scaffold for team members interaction, which is the very nature of CSCL[15]. Capitalising ideas from ITS to support collaborative and individual learning is not new in the CSCL community [10, 11]. In fact, some works exploit such approach by either including feedback mechanisms [1] or offering support to the interaction between the learners. Yet, researchers have only investigated the effects of learning by collaboration and how that collaboration can be supported. Little emphasis has been given to actual training of teams and to how Computer Supported Training of Teams (CSTT)² can leverage from the structure of an ITS, with a few exceptions [3, 14]. A very recent work by Bonner and colleagues [4] highlights the challenges of expanding an ITS architecture to small groups, stating

¹The expression ill-defined is used when the domain knowledge lacks a systematic way to characterise success.

²In the literature we can also found the term Computer-Based Training of Teams.

that the building blocks of the system will depend on the team structure, task and what is expected from the tutor. Building on these fundamental aspects of teams and team training, in this paper, we describe how we take advantage of ITS and CSCL together to support the training of a team, which performance depends very much on interpersonal dynamics, a clear definition of inputs and output of a team and on a comprehensive representation of the task.

2 Requirements for designing a tool for training JITs

The design of a tutoring system for teams will depend on three components, as highlighted by Bonner et al. (2015) [3]: The *general characteristics of the team* (its structure and skills), *the task* the team has to perform and the *role of the team tutor* (adaptability and feedback). By using a taxonomy to characterise JITs, we intend to systematize design decisions to guide the description of functional requirements of the software. Below, we describe JITs according to these three factors, which are summarized in Tables 1, 2, 3 and 4.

The Team. A JIT is a team of representatives of experienced law enforcement agents and judicial authorities, who investigate complex cases of transnational crime [2]. It can be composed by as many members as necessary, but for training purposes we are considering 4-element teams, including a leader. The role of the leader is to help the team get to goal completion. The other elements of the team do not have any specific roles and are assumed to possess the same skills. Also, a main characteristic of a JIT is that individuals are geographically distributed, their communication should be synchronous during training and team members may not know each other before hand. Furthermore, two skills are necessary to be in a JIT: to know how to perform the task effectively and manage the other team elements (leader-specific task).

The Task. The motivation behind the creation of JITs is to have a tool that allows law enforcement agents to engage in joint or parallel investigations (including interrogation of suspects) without the bureaucratic aspects of current methods, which are currently creating obstacles to cooperation between countries. In this project our focus is on training interrogation of suspects and its preparation, in anti-drug trafficking. The interrogation of suspects in cross-national investigations requires the following capabilities: **1)** high coordination skills; **2)** interrogation competencies respecting team decisions; and **3)** being able to engage in collaborative decision-making, taking into consideration the legal framework of the different countries. This implies that interdependence between team members is high, because the task cannot be completed individually. A prototypical scenario that describes the preparation for interrogation is the *Hidden Profile Task* [16]. It is a problem-solving task where individuals hold different pieces of information and a team can only reach to an optimal solution if team members communicate effectively.

The Tutor (*the Virtual Trainer*). A classical approach in ITS, when dealing

with ill-defined domains, is to include a human tutor³ in the loop and allow him to have an active role. Yet, in our project, the human tutor has a passive role and can only provide offline feedback to his/her respective trainees. The *Virtual Trainer* has a more active role, as it monitors the training session and provides feedback to the team and each trainee individually and as a team. Moreover, it should have the ability to adapt the training session to the needs of the team and individuals (e.g. varying the level of complexity of the task or distribute hidden information differently). The evaluation of the team and its members strongly rely on the computer supported modes of interaction and therefore it is inferred by a set of indirect cues. The set of competencies enumerated in the previous paragraph guide this process.

Table 1: Structure characterization of a JIT

Structure				
<i>Leadership</i>	<i>Organization</i>	Communication	<i>Roles</i>	<i>Location</i>
Low	Task and Teamwork	Interaction with Team	Leader (only)	Distributed

Table 2: Skills characterization of a JIT

Skills		
<i>Level of Familiarity</i>	<i>Skill Division</i>	<i>Learning Culture</i>
Low	Task and Teamwork	Interaction with Team

Table 3: Characterization of a JIT tasks

<i>Solutions</i>	<i>Interdependence</i>	Routine	<i>Complexity</i>	<i>Time</i>
Coaching	Very High	Always the same	Variable	Dependent
<i>Information Exchange</i>		Environmental Fidelity	<i>Type</i>	
Mostly Speech		High	Problem-Solving	

Table 4: Characterization of a JIT tutor

<i>Pedagogy</i>	<i>Feedback</i>	<i>Adaptability</i>	<i>Environmental Context</i>	<i>Evaluation</i>
Coaching	Visual, After-Action Review	To team and to individuals	Embedded into the application	Learning goals and CSCL support

³The human tutor, in our project, is the individual that decides to initiate a training session and has to coordinate with other tutors in other countries. A trainee is associated to the human tutor in his/her respective country.

3 From requirements to the learning tool: Bringing together CSCL and ITS

In this project, we aim to build a virtual reality environment to which the trainees from different countries can connect to, to have access to a realistic setting where they engage in cross-national teamwork (**synchronously**) and have hands-on experience interviewing (virtual) suspects. This set-up intends to cope with location issue and at the same time create a setting **close to realistic scenarios**. Support training in this kind of settings (and to a team) is not straightforward and for that reason we rely on **computer-based technology to keep track of the interactions** and thus support the ITS. In order to allow users to prepare the case individually, discuss and collaborate with their peers and practice joint interrogations with a *Virtual Suspect*, it provides the team the following tools: **1)** a video-conference tool that enables the communication (among team members and the observation of an interrogation; **2)** a personal space where each trainee is able to explore the casefile and prepare the interrogation by him/herself; **3)** a collaborative space, where the JIT prepares the interrogation by making use of a shared display (similar to a white/bulletin board); and the *Virtual Interrogation Room*, where trainees interrogate the virtual suspect. These elements form the *User Interface*.

With the focus on learning, the integration of an ITS allows us to continuously assess students knowledge in order to be able to adapt the system to their needs. Our stance is that such tool can be used to the training of teams, as long as researchers find a comprehensive way of representing the *Domain*⁴ and make a clear separation of the *Trainee* and *Team Models*. A classical architecture of an ITS is characterised by 4 basic components [10]: the *Domain Module* (expert knowledge), the *Student Module*, the *Tutoring Module* and the *User Interface*, described above. Below we describe the decisions made according to the outlined requirements, summarized in Tables 1, 2, 3 and 4. Those are highlighted throughout the text.

Domain Module. The *Domain Module* refers to the rules, concepts and strategies that are part of the domain to be learned and includes standards that allow assessing the trainee's performance[10]. It is intrinsically related to the task, and in our context, the central piece of this learning system is a *Virtual Case*, which contains the description of the criminal organisations involved in the investigation and their main characters and operations. Moreover, it contains all events (the criminal *Story*) involving the criminal organization and interactions between characters. The *Story* is represented by a semantic network of events that resemble the structure of autobiographical memory [5, 6]. Our aim is to keep track of the trainees explore different paths (**multiple solutions**) and be able to control the **complexity** of the training session. Furthermore, this representation enables monitoring how trainees explore the story when interacting with the *Virtual Suspect*, which is especially relevant as interrogators should understand how memory works in order to ask the appropriate

⁴In the case of our project we needed to find a clean representation of the domain that is useful for training and easy to use by the tutoring component.

questions to reconstruct the suspect's story [9]. This module also contains information about how the *Virtual Case* is distributed among trainees (similar to a *hidden profile task*), possible questions and answers for the interrogation with the *Virtual Suspect* and the best practices and methodology for conducting joint investigations and interrogations.

Student Module. The *Student Module* represents the actions and knowledge of the team (*Team Model*) and of each individual trainee (*Trainee Module*). It is essentially a dynamic module that must keep track of the trainee's cognitive and affective stages throughout the learning process [10]. In the end, it is expected to outline the trainees' competencies and achievements [18], in a **visual** form and in an **after-action review mode**. The importance of this building block lies on the fact that it holds all the information required by the *Tutoring Module* to provide adequate feedback, performance diagnosis and propose new challenges (supports **adaptability**). It includes, for example, the user profile based on preliminary questionnaires; the files that were accessed by each trainee; the files shared; and the knowledge of the story events in the perspective of both the trainee and the JIT **this is acquired through the user interface**.

Tutoring Module. The *Tutoring Module* is the central component of the training tool since it is responsible for deciding what actions to take and when, based on the domain and student models. It is composed by the *Diagnosis and Evaluation Tools*, which intend to monitor the JIT interactions and decisions, and combine it with the theory on best practices and methodology for preparing and conducting joint investigations (**monitoring of goals**). The Virtual Trainer follows a **coaching** approach, by being aware of the individual learning goals, in order to expand the trainees' personal competencies and expertise. It relies on this knowledge (and on the *Domain Module* god-view) to decide when to intervene and how to present the performance evaluation to the trainees and to the JIT. Yet, previous interviews with law enforcement agents made us aware that most feedback can only be presented after the interrogation is completed (e.g. learning goals) although immediate feedback could be more beneficial and privacy issues might be in order. It should be clear what feedback concerns the trainee and what concerns the team.

4 Discussion and Conclusions

The need to support geographically distributed teams boosted the research and development of computer systems that allow for effective collaboration. A set of tools exist that are key to collaborative work, but when it comes to training, we require a deeper understanding of the actions taken by the users. Our approach relies on an ITS architecture capable of integrating a comprehensive domain knowledge, intelligent tutoring and computer-support to interaction. This proposed synergy creates an opportunity for measuring training without relying on self-assessment questionnaires, for instance. Yet, this approach creates a lot of challenges as well, since we

are dealing with an ill-defined domain. While measures for effective collaboration exist (e.g. Rummel et al. [12]) and progresses have been made to create team effectiveness models, a challenge exists to find automatic methods to accomplish it, using the created user interface and available technology. For instance, by using a video-conference interface we intend to get closer to realistic situations, but on the other hand we allow for free speech communication, which is hard to keep track. The problem might be exacerbated when having people from different cultures interacting in their non-native language and through a video-conferencing tool, where social cues to convey meaning during discourse fade away. Furthermore, will the teams show the same behaviour in a virtual multi-cultural context? That is a topic that needs further research [13]. Other major challenge in collaborative contexts is when and how to intervene. An ongoing discussion about in-time feedback and after action feedback exists in the field. While the former allows for in-time correction of behaviour, the latter does not interrupt the action and does not break the learning flow. Adding to this, feedback in our context, is about sensitive information. The comparison between law enforcement agents is not acceptable for them, which restricts the forms of providing information about how a team performed. Additional research is required to understand how to provide valuable feedback and to understand what type of interventions fit this type of application and learners needs.

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