INTEGRATING CASE-BASED REASONING WITH EVIDENCE-BASED PRACTICE FOR DECISION SUPPORT

Expedito Carlos Lopes and Ulrich Schiel
Computing and Systems Department, Federal University of Campina Grande, Brazil

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Abstract: Evidence-Based Practice (EBP), an emergent paradigm, uses the premise that decision making can be based on scientific proofs available in reliable data bases, usually found on sites over the Internet. However, the procedures of the EBP do not provide mechanisms for retention of information and knowledge strategic of the individual solutions, which could facilitate the learning of different end-users, in the future. On the other hand, Case-Based Reasoning (CBR) uses the history of similar cases to support decision making. But, the retrieval of cases may not be sufficient to give support to the solution of problems. Since both research evidences as well as similar cases are important for decision-making, this paper proposes the integration of the two paradigms for problem-solution support, regarding complex problems. An example of the justice area is presented.

1 INTRODUCTION

Problem is the main element that triggers the process of decision making. When it presents difficulties associated with the absence of available solutions, or even when it demands a great effort to understand why it happens or which are its causes, it is considered a complex problem (Loriggio, 2002).

In 1992, emerged the Evidence-Based Medicine (EBM) that has its primary focus on provide effective counseling to help patients with terminal or chronic illness to make decision in order to cure of illness, extend or increase the quality of their life (Sacket et al., 2001).

Supported in the EBM, was standardized the Evidence-Based Practice (EBP) that uses the premise that decision making can be based on scientific proofs available in reliable data bases, usually found on sites over the Internet, derived from primary studies (e.g. randomized clinical trials) and/or secondary studies (systematic review and meta analysis) carried out by independent research groups (e.g. Cochrane Collaboration on medical area, and Campbell Collaboration concerning crime & justice and education areas). EBP on the medical area involves complex and conscientious decision-making, based not only on the available evidences but also on patient characteristics, situations, and preferences (Sackett et al., 2001). EBP has expanded itself to the healthcare area in general.

Although with some alterations, this paradigm presents itself in several different areas, such as criminal justice, including politics for crime prevention, considering the potential offensive risk of the defendants (Warren, 2007).

On the other hand, Case-Based Reasoning (CBR) uses the history of similar cases to support decision making (Pal and Shiu, 2004), instead of using research evidences. CBR fails when no similar case can be found in the Case-Base. Moreover, the retrieval of cases may be not sufficient to give support to the solution of complex problems.

But, EBP procedures do not provide mechanisms for retention of information and knowledge strategic of the individual solutions, which could facilitate the learning of different end-users, in the future, and preserving evidences used, since they can be modified or removed of the Internet later.

Since both research evidences and similar cases are important for decision-making, the integration of the two paradigms constitutes an interesting research topic to the solution of complex problems. Thus, complex cases and research evidences can be expressed together in a knowledge representation and the integration of EBP and CBR techniques is considered as support for the development of applications that encompass decision making.

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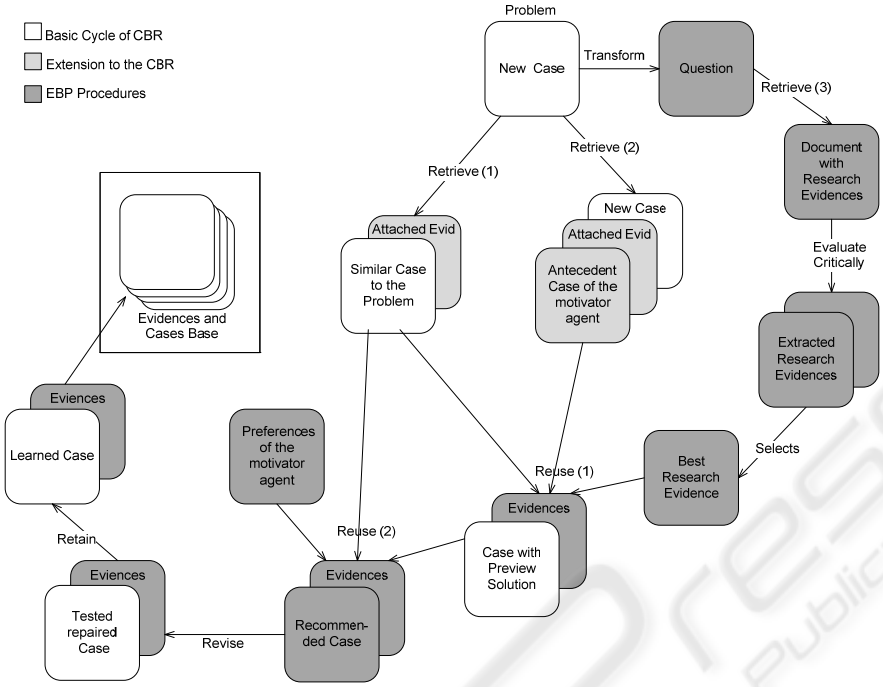

Figure 1: Basic Cycle of Evidences and Cases Processing.

2 INTEGRATING EBP PROCEDURES WITH CBR FOR DECISION SUPPORT

In the EBP, according to Sackett (2001), what is objectively searched is "the integration of best evidence from research, clinical skill and preference of the patient." Clinical knowledge and experience are used to identify the health state and diagnosis of patients, their individual risks and benefits of proposed interventions. Moreover, the patients worth about preferences regarding private, personal concerns and expectations brought to the appointment are considered in clinical decisions.

Systematically, the EBP includes the steps:

1. Transformation of the problem into a question to be answered;
2. Identifying the best evidence to answer the raised question;
3. Critical analysis of the evidence in order to validate its applicability and its impact in relation to the question;
4. Integrating clinical skills, values and cultural aspects of the patient related to the previously extracted procedures;
5. Evaluation of the efficiency and effectiveness in the results of each step.

In crime prevention, the concept of EBP is defined as: the correlations practice that has been proven through scientific research aimed to reduce the recidivism of offenders. In Warren (2007), EPB principles used by judicial units in order to reduce criminal recidivism are presented. EBP considers the risk and needs principle of the offender, use of risk/needs assessment instruments, integration of treatment and community-based sanctions.

In CBR, the approach to get a solution for a certain problem is based on a comparative analysis of previous realities with a new similar reality. There is an analogical reasoning process based on the degree of similarity in form of deductive inference (Pal and Shiu, 2004; Russel and Norvig, 2003).

CBR and EBP have common aspects such as (i) use of procedures to support decision-making; (ii) be based on a problem presented by a motivator agent; (iii) use of search and similarity measures involving the current situation and previously stored situations; (iv) they presents the results in ranking schemes.

The two approaches can be considered complementary for a good decision-making. While CBR takes advantage retrieving the history of previous cases, whereas EBP aims finding documents containing updated evidence based consolidated research results (see Figure 1).

While CBR search uses a structured case-base, usually presented in the organizational environment of the problem, the EBP approach searches evidence in unstructured document usually obtained over the Internet.

We describe the integration preserving compatibility with the classic model on CBR.

1. Retrieve cases - Obtain cases with similar problems to new case and antecedent cases of the motivator agent. In the retrieve the search is textual and the key terms in the new case are confronted with the contents of the attached evidence, in addition to the content of the founded cases. The similarity calculation considers the attached evidence with its associated weight.

2. Retrieve and process research evidence – It contains four sub-activities:

2.1 - Transform problem in question – it aims to build a template, from a given problem, to conduct the research for documents containing evidence;
2.2 - Evidence Retrieval – obtain documents that contain evidences considering the template previously made. It is based on *Information Retrieval techniques* involving similarity metrics and ranking schemes;
2.3 - Critical Evaluation – this sub-activity includes steps for the selection, the rejection and the acceptance of documents, besides of evidences extraction;
2.4 - Selects the best research evidence – involves the consolidation of evidences showing result presentation and discussion, considering aspect several, e.g., practical decisions, methodological limitations, quality of original material, etc. (Muñoz et al., 2002).
3. Reuses – The first reuse activity treats the construction of new solutions, with mechanisms for adjustments and adaptations, considering (i) similar cases solutions (or part of them), (ii) historical of motivator agent cases, and (iii) the best research evidence confronted with attached evidences to similar cases. It corresponds to classic solution on CBR. The second reuse activity must collect the values and preferences of the motivator agent and request his/her participation in decision-making. Reuse examples: (i) medical diagnosis and treatment; (ii) judgment and designation of activities/service institutions to penal execution.

4. Revise and Retain – The same of the classic model on CBR.

3 EXAMPLE – APPLICATION TO CRIMINAL JUSTICE

This example is applied on a real case of abortion from the State of Bahia Court, Brazil, whose practice is considered a crime. The *subject* of the new case is "voluntary abortion".

The Table 1 contains the general evidence and case structure for criminal justice. A prototype was developed in *Java* language that interacts with the framework *JColibri* using the CBR model (Bello-Tomás, 2004).

The Figure 2 presents data of the problem (fact and his/her author, witness and material proofs).

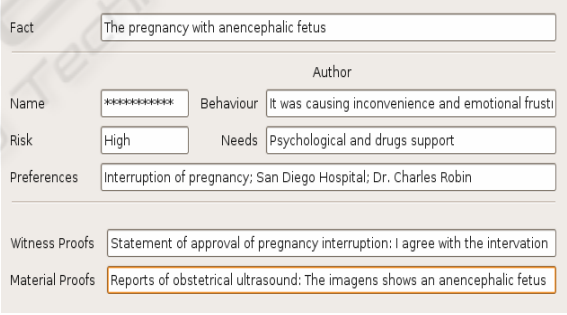

Figure 2: Data of the problem.

Table 1: Evidence and Case Structure.

Structure	Attributes
Problem (fact)	Description, Objective, Circumstances, Author (Name, Adress, District, Conduct, Behaviour, Needs, Risk condition, Preferences), Witness proof (Name, Content, Date), Material proof (Organization, Content, Date, Responsible person)
Research Evidence	Question, Defined terms, Keywords for search, Sources, Search criteria, Result (Type of study, Considerations), Discussion
Solution (trial)	Sentence, Criteria, Recommendation (Permit, Institution)
Outcome	Final situation, Consequences, Final comments
Learning	Procedures to case solution, Comments search for evidences

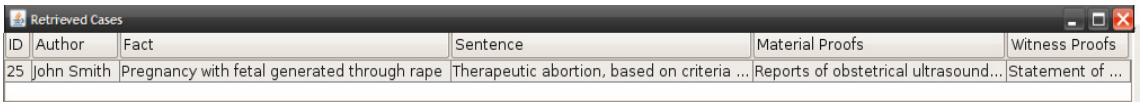

Figure 3: Retrieved case for judgment support.

One similar case about therapeutic abortion was found in the Evidences and Cases Base, but it isn't sufficient to give support to the solution, forcing the judge to search by research evidences (see Figure 3).

The activity *Retrieve and process research evidence* began with the transformation of the problem in a question. Initially, defined terms, keywords, sources and search criteria are informed. After analysis of the documents retrieved, the history of retrieve, the results and discussion are informed agree with the Figure 4.

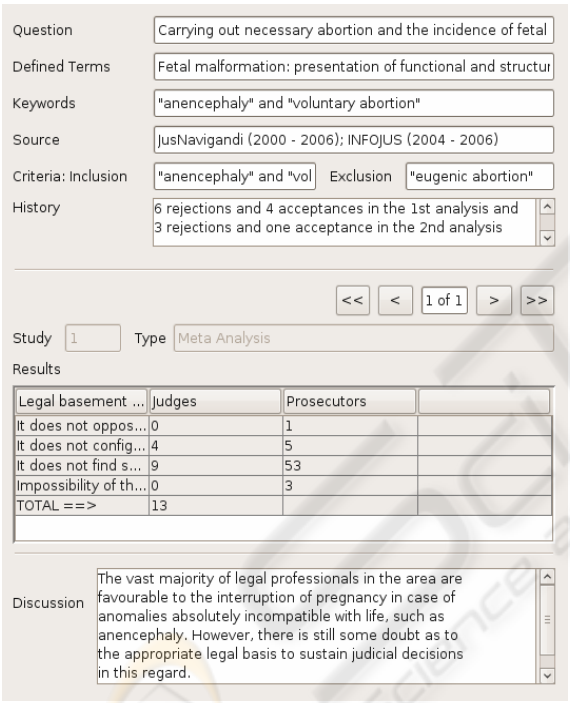

Figure 4: Template of the search for evidence.

The first activity *reuse* was based in evidences attached to the case, discussion, and the court *sentence* was in favour of the "voluntary interruption of pregnancy", based on *criteria* of the Brazilian Penal Code. Aiming to *learning*, *procedures to case solution* describe the steps that it took to reach this verdict coming to be used in the activity *retain*. In the second activity *reuse*, the preferences of the pregnant woman were agree with the list of indicated hospitals (*institutions*) and medical surgeons of the court. In the decision with recommendation, the court attended the recommendation of the concerned pregnant. It was consigned a charter authorizing the surgery (*permit*) as soon as possible and awaited the final outcome.

4 CONCLUSIONS

This work proposes the integration of CBR with EBP for decision support. The activities of the basic cycle of CBR and the systematic steps of the EBP in the medical and justice areas served of bases for built this propose.

The main contributions are: (i) representation of the EBP procedures; (ii) knowledge representation to retain cases and evidences together; (iii) extension of CBR regarding evidences attached to the cases; and (iv) the representation of the EBP procedures integrated to CBR.

Future researches encompass the formalization of the computing model towards Evidence and Case-Based Reasoning and the creation of a semi-automatic Evidence-Oriented Information Extractor.

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