International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 2 Issue 11, November - 2013

Using of the expert tutoring programs to improve learning process in Kurdistan Engineering Colleges

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Abstract

The research presents a classification of computer tutoring programs and a definition of an expert tutoring system. It also defines a generalized (ETS) architecture and describes the particular expert tutoring system, which helps an expert to create knowledge bases using the expert systems shell BESS.

INTRODUCTION

In resent years expert systems (ES) have become widely acknowledged. The goal of an ES consists in decision making in a Polly formalized subject obtained from a human – expert. The ES is modeling the human expert's methods of reasoning in the given Shell Approach (SA.)

Expert systems are applicable to various fields' medicine, geology computer engineering and others. The research is devoted to an application of knowledge engineering techniques to development of computer tutoring programs as long as the subject area of tutoring management and organization including pedagogical and psychological knowledge is rather Polly formalized, the application of the artificial intelligence techniques is desirable and necessary.

Main structure of an expert system

It is convenient to divide the development of an expert system into three main modules, as illustrated in Figure [1]:

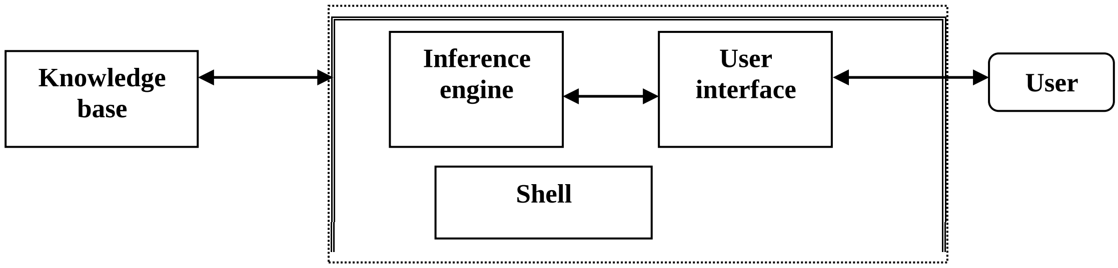
(1) A knowledge base,

(2) An inference engine

(3) A user interface.

A knowledge–base comprises the knowledge that is specific to the domain of application, including such things as simple facts about the domain, rules that describe relations or phenomena in the domain, and possibly also methods, heuristics and ideas for solving problems in this domain. An inference engine knows how to actively use the knowledge in the base. A user interface caters for smooth communication between the user and the system, also providing the user with an insight into the problem-solving process carried out by the inference engine. It is convenient to view the inference engine and the interface as one module, usually called and expert system shell, or simply a shell for brevity [1].

Figure [1] Structure of expert systems



The foregoing scheme separates knowledge from algorithms that use the knowledge. This division is suitable for the following reasons: the knowledge base clearly depends on the application. On other hand, the shell is, in principle at least, domain independent. Thus a rational way of developing expert systems for several applications consists of developing a shell that can be used universally, and then to plug in a new knowledge base for each application, of course, all the knowledge base will have to conform to the same formalism that is ‘ understood ‘ by the shell. According to practical experience in complex expert systems the scenario with one shell and many knowledge bases will not work quite so smoothly unless the application domain are indeed very similar.

Nevertheless, even if modifications of the shell from one domain to another are necessary, at least the main principles can be retained.

In this research we are going to develop a comparatively simple expert system shell and its systems, which will, despite its simplicity, illustrate fundamental ideas and techniques of field. Our development plan will be as follows:

(1) Select formalism for representing knowledge.

(2) Explain of the expert tutoring system

(3) Clear of the knowledge –base

(4) Explain of the theory of Bayses

(5) Design an inference mechanism that corresponds to this formalism in area of the learning and educational process.

(6) Explain some of the subjects which related of this field.

(1) Expert tutoring system

Since computer tutoring programs form a variety of program system let us introduce a classification of them based upon a notation of the pedagogical function implemented by the program.

Consider the following functions [2]:

1.1 Learning

a student has a certain (possible , rather vague) goal stated to him by the teacher or himself while the computer tutoring programs should assist the student to achieve this goal the distinguishing features of this class of programs are :-

One) Availability of all the necessary resources to the student (execution of commands , transformation of information etc,) on his request;

Two) Absence of student's actions control.

This class of computer tutoring programs is called further on a learning environment as long as their main programs is to create a friendly environment or her knowledge.

1.2 Testing and diagnosis

a student is tested to determine some of his features in particular the depth of knowledge absorption or the programs, implementing this pedagogical functions, would supply the student with the test questions (tasks) and should appreciate his answers (decisions) as well as correct and explain errors.

1.3 Training

a student acquires knowledge, abilities and skills necessary for carrying out a certain job while computer tutoring programs of this class are called training programs, The characteristic features of them are :

One) Existence of a formal model and an audio visualization of the subject being studied ;

Two) Explicit knowledge of system functioning goals;

Three) Control over students actions ;As a rule, existence of rigid time requirement imposed on the student in order to achieve the given goal.

1.4 Tutoring

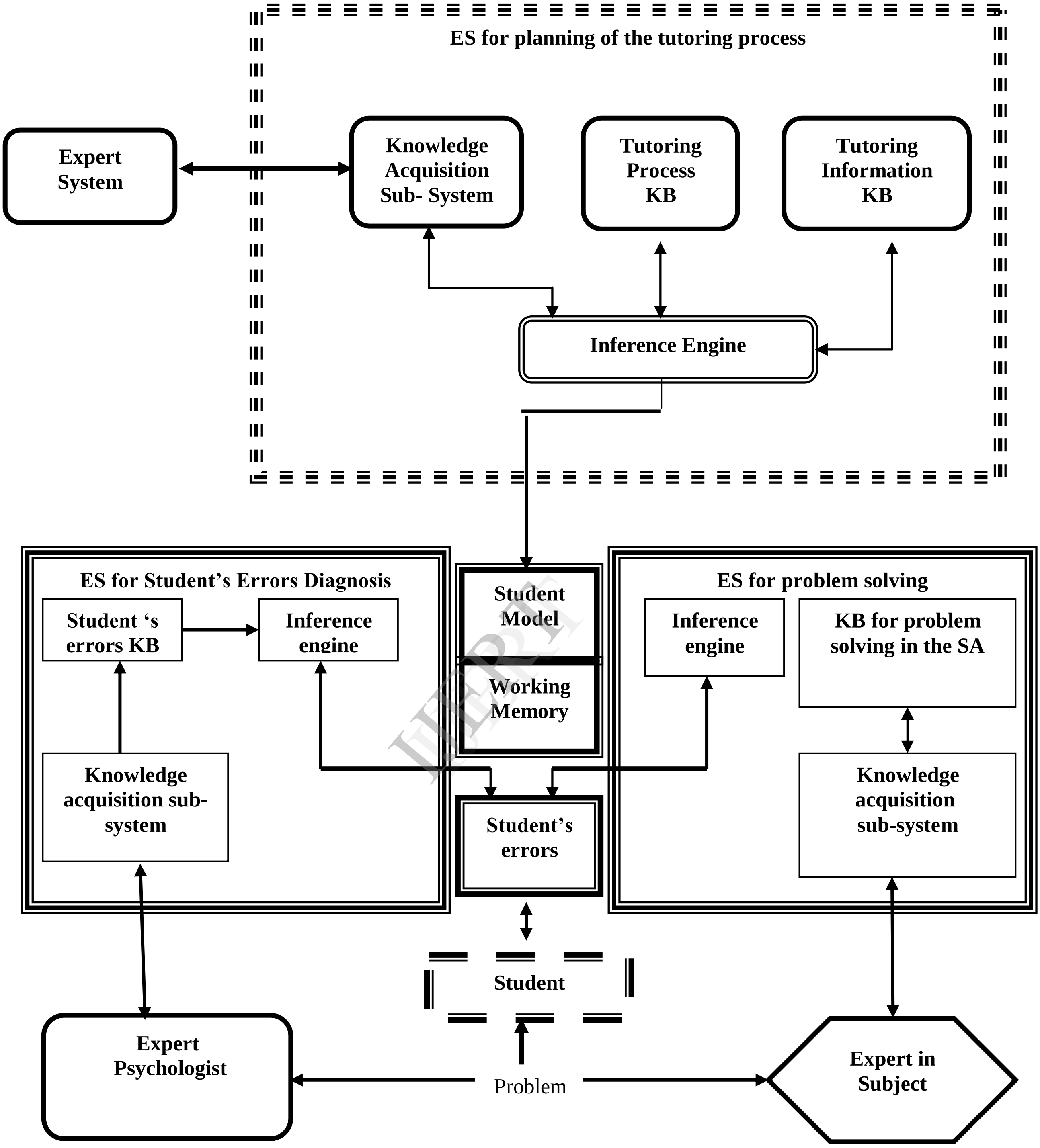
a student acquires knowledge, abilities and skills in program provides all the teacher's functions for learning material provision, control of its acquiring and error diagnosis. This class of programs is characterized by: -

1. Existence of tutoring goal ;
2. Implementation of a tutoring technique leading to the given goal and defining a style of communication with the student;
3. Complex solution of the problems tutoring, control and diagnosis.

We call an expert tutoring system in the broad sense a computer program implementing a pedagogical function, which is based upon expert's knowledge.

We call an expert tutoring system in the restricted sense a computer program which implements the tutoring function (i.e. them management of tutoring) based upon expert's knowledge Fig No[2].

Figure [2] Represent of the Planning for the Expert Tutoring System



The ETS in the restricted sense form the most complicated class of ETS, requiring the application of knowledge representation and knowledge processing techniques in different subject area SA as well as the organization of an effective interaction of various knowledge sources, Further on we consider exclusively the ETS in the restricted sense [3].

The classification above enables to isolate the main problems arising when the ETS are being created: -

a) Knowledge representation and knowledge processing in the subject area being the tutoring subject;

b) Development of methods for the control of the student and for the error diagnosis;

c) Development of the tutoring management techniques ;

(2) Structure of the ETS

The architecture of the ETS is based on the following principle model of the tutoring process.

There is a current tutoring goal expressed in terms of the current student characteristics. Until the goal is achieved the following procedure will be repeated :

a) The next task is formulated based on the current state of the student model and the tutoring technique (here we mean a task in the broad sense as any information requiring the students response);

b) The student's answer is compared with the sample solution and error diagnosis is done based on the detected errors;

c) The current characteristics of the student are updated due to the result of the diagnosis.

In virtue of this tutoring model the ETS can be regarded as a set of three interaction expert systems: -

1- ES for problem solving in the SA being studied;

2- ES for student' s errors diagnosis;

3- ES for planning of the tutoring process;

The ES for problem solving (ESPS) is aimed at the acquiring of a sample solution. This ETS component can be as follows [4]: -

a. ES itself based on expert's knowledge in the problem solving for the given SA is poorly formalized.

b. Problem-solver in a well – formalized SA;

c. Program for search and selection of the solution for the given problem in case when the tutoring is based on a set of problems having been prepared in advance.

The ES aimed of error diagnosis (ESED) enables to determine wrong student's ideas about the SA being studied such diagnosis is based on a comparison of the student's answer to the sample answer.

The ES paradigm is diagnosis the symptoms are the differences in the student's characteristics (the student model).

The (ESED) Formalizes the knowledge of an expert –psychologist.

The expert system aimed at the tutoring process management (ESTPM) is dealing with the constrains imposed by the given tutoring material.

The ESTPM formalizes the knowledge of an expert about the tutoring techniques.

The interaction of the ETS with a student is carried out as follows the ESTPM forms in accordance to the current goal the next student's task, which is simultaneously passed to the ESPS.

Later the ESED comparison the student's solution with that obtained from the ESPS by examining the differences the ESED tries to define those wrong student's concepts about the SA, which could lead to such differences, the result of diagnosis leads to a change of ETS ideas about the student, which are mapped into the student model SM. Then forms a new task the interaction with the student takes place through an interface containing the means text, graphic or speech input/output linguistic processor etc., [5] The following knowledge base (KB) can bed isolated in the ETS structure: -

One- Tutoring information KB for the given SA;

Two- student model;

Three- KB concerning possible student's errors ;

Four- KB concerning the tutoring process strategies;

The tutoring information knowledge base (TKB) describes basic notions and problems solving techniques as well as contains notion's definitions and descriptions, Examples tasks and exercises, Unlike the KB for program solving the TKB should explicitly reflect the SA structure and then strategic knowledge about problem solving, on the other hand the TKB can be regarded as a representation of constrains subject to which the ESTPKM is planning the tutoring process.

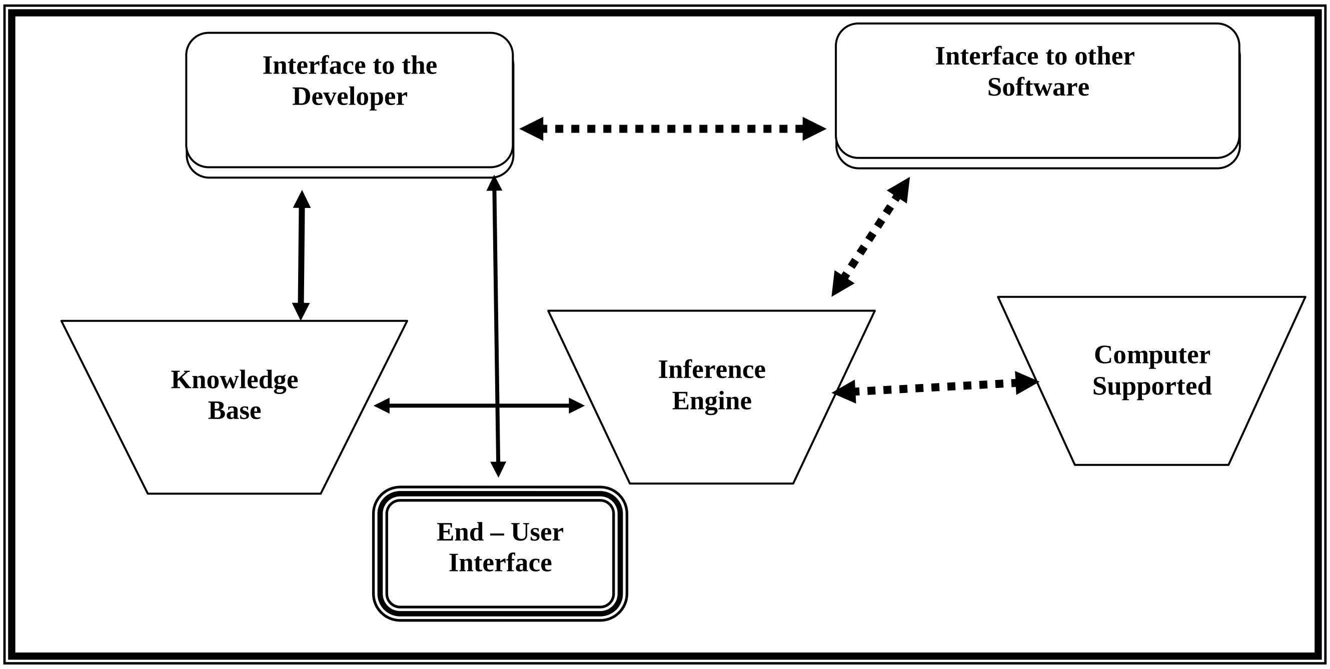
The student model (SM) contains information about the state of student's knowledge, including general integrated characteristics as well as that reflecting the requiring of the current tutoring material, initially he SM is formed in course of a preliminary testing of the student. The tutoring goal is expressed in terms of the SM. There is distinction between an overlay SM and a model of errors [6].

The former is a subset of the expert knowledge model in the SA and, as rule, has a set or a network representation, each state of which corresponds to a tutoring unit the acquiring of which is controlled e.g. theorem notion or topic.

There is a value related to each state showing the degree of the acquiring (e.g. " knows –does not know ", or a probability estimate) The latter is a set of elementary actions which lead to the problem solutions both wrong and correct. Wrong behavior of the student is modeled by the substitution of on e or more correct actions by the wrong ones in this case the SM is not a subset of the expert model.

The student's errors knowledge base (SEKB) contains a catalogue of possible student's errors and rules for checking the hypothesis about the wrong student's ideas which have led to the given errors. Such checking is based on the differences in the student's solutions and that of the ESPS as well as the current state of the SM. The tutoring process knowledge base (TPKB) contains knowledge about planning and organization of the tutoring process, general and particular tutoring techniques. There is a hierarchical structure proposed to represent the TPKB enabling to isolate the levels of pedagogical, strategic and tactic knowledge [7]. The knowledge is represented in the form of rules determining a type of tutoring influence. The choice of the next rule is defined due to special meta – Rules, which depend on the current tutoring goal and (SM) in general the TPKB, can be considered as meta-knowledge with respect to the other KB. The structural schema of the ETS is shown on fig [3].

Fig.[3] Represent the structure of an Expert System Building Tool
(Solid lines represent basic relationships, and broken lines represent related aspects)



(3) BESS

an expert system building tool, BESS is an expert system shell (bayse expert –systems with the diagnostic/ prescriptive paradigm, BESS uses Bayesian approach for

decision making.

3.1 Bayses, method Bayesian theories presuppose that for any event there exit an exact a prior probability showing how commonly an event occurs in the general population, and the problem is to calculate the a posterior probability of an event upon the occurrence of another event. A posterior probability depends on received information and a prior probability. This decadence is expressed by the Bayes theorem[3]

Bayes, Let H1, H2…be an infinite sequence of mutuality exclusive events, such that:

U Hi= Q and p(Hi) >0 for I=1,0 Where Q is a general population . If S is and event for which p(S) >0 then p(H is)= p(S Ihi) *p(Hi)/IP(SIHi) * p(Hj),,I=1,0 .

A similar result takes place for a finite sequence of mutually elusive events H1… Hn , that satisfy the theorem's conditions in the research we use the following notations , we call events Hi hypotheses and symptoms –S, Then p(Hi) will be the a posterior probability of the hypothesis Hi for the given symptom S, p(Hi) – the probability of an occurrence of the symptom S in the presence of the hypothesis Hi and p(hi) the prior probability of the hypothesis Hi.

3.2 BESS knowledge base structure, The knowledge base has the following organization, and hypothesis is associated with hypothesis name a prior probability of the hypothesis, number of symptoms, which can confirm or reject the hypothesis, texts of diagnosis and prescriptions, and the very symptoms, Any symptom of the hypothesis is associated with the symptom name, a probability of confirmation and a probability of rejection [6].

As the system BESS asks the user for the real values of symptoms are associated with the corresponding questions and intervals of the possible answers.

3.3 BESS inference engine, BESS inference engine uses the strategy offered in [1].

The essence of the strategy is as follows, all symptoms have the weights, which show the role of the symptom in the inference process, and the system asks the question about the symptom with the greatest weight.

The weight of the symptom S is the sum of maximum changes of the probabilities of the events that can occur in all-N hypothesis, to which this symptom can be applied. Due to user's answer the probabilities of the hypothesis are recalculated and hypotheses are classified. The inference continues until the solution is found or all symptoms are looked through [8].

3.4 BESS explanation subsystem

during the inference or after it a user may ask the system how it came to this or that decision and why means of one of the directives 'how' and 'why' on 'how' directive the subsystem gives the inference protocol from the first step of the inference.

3.5 BESS knowledge acquisition

an interaction with an expert in BESS is carried out by means of the knowledge acquisition subsystem.

This subsystem consists of the hierarchical set of the screen editors, which allow expert to create, save, delete, rename the knowledge base, to edit the knowledge base on the level of hypotheses, symptoms and symptom values of hypothesis.

3.6 BESS interface

The interaction with a user is carried out by means of menu, forms and patterns. The user's answers on system queries can be alternative ([Yes/No]), linguistic ([High/Middle/Low]), or inter from a finite interval ([-n, +n]), During symptom editing an expert may choose the type of the answers which suits his application domain.

(4) Expert tutoring system BETS

(Expert tutoring system on Bayes method's application) is an example of ETS [3]. Which is aimed at teaching experts to formalize their knowledge by the bayes method and at giving recommendations on BESS using Bet's structure. BETS only fixes errors of experts that's why there is no problem solver in tits architecture.

4.1 The problems to be solved

The ED design process in BESS environment consists of creating and verifying of the KB on a chosen subject area. During the KB creating process on expert solvers two problem; forming/improving hypotheses and forming/improving symptoms.

1. The first problem is divided into two sub-problem; forming/improving hypothesis; removing redundancy and inconsistency among hypotheses.

2. The second problem consists in choosing of a complete and inconsistent set of symptoms.

Every sub-problem is divided in its turn, into the definite sub-problems.

The hierarchy of the problems to be solved in BESS during the ES design process is given in figure (3) an expert behavior on ES design (problems solving) is based on the theoretical and practical knowledge and the skills.

The problems of a lower level of the hierarchy of the problems need more deep knowledge and skills, then that of a higher level the knowledge about the Bayesian approach to optimal statistical decision making belongs to the theoretical knowledge, necessary for problem solving .The practical knowledge is the knowledge about BESS, which supports Bayesian approach.

4.2 Student model BETS

supports pedagogical observation as a teaching method the system enables the expert to choose and solve any problem from the hierarchy of the problems from the hierarchy of the problems and the system interrupts the expert's activity teaches the experts only when it reveals the lack of some knowledge and/or skills.

In this case the expert is viewed as the student and his model is calculated. The student model defines a level of his knowledge and skills student's knowledge are split into knowledge which he would acquire before solving of a problem (let's name them the current knowledge), student 's skills on problem solving are defined by the type of the committed errors and their quantity [7].

A prior estimates of student's knowledge and skills are delivered from the history of the interaction between the student and the system, If there is no such information (student did not solve the corresponding problems)' the assumption is made that these estimates are ' knows' and 'skilled '; As the lack of the student's knowledge and skills have been detected the estimates values are improved .It happens either when the student makes errors or when he asks for the help on the help query the student make the query more precise . The result of his choice initiate's estimate improving process for one of the knowledge types – the basic and the current. Posterior (improved) estimates of student knowledge and skills are used as the prior estimates at the next step of the tutoring process.

4.3 The tutoring process knowledge base

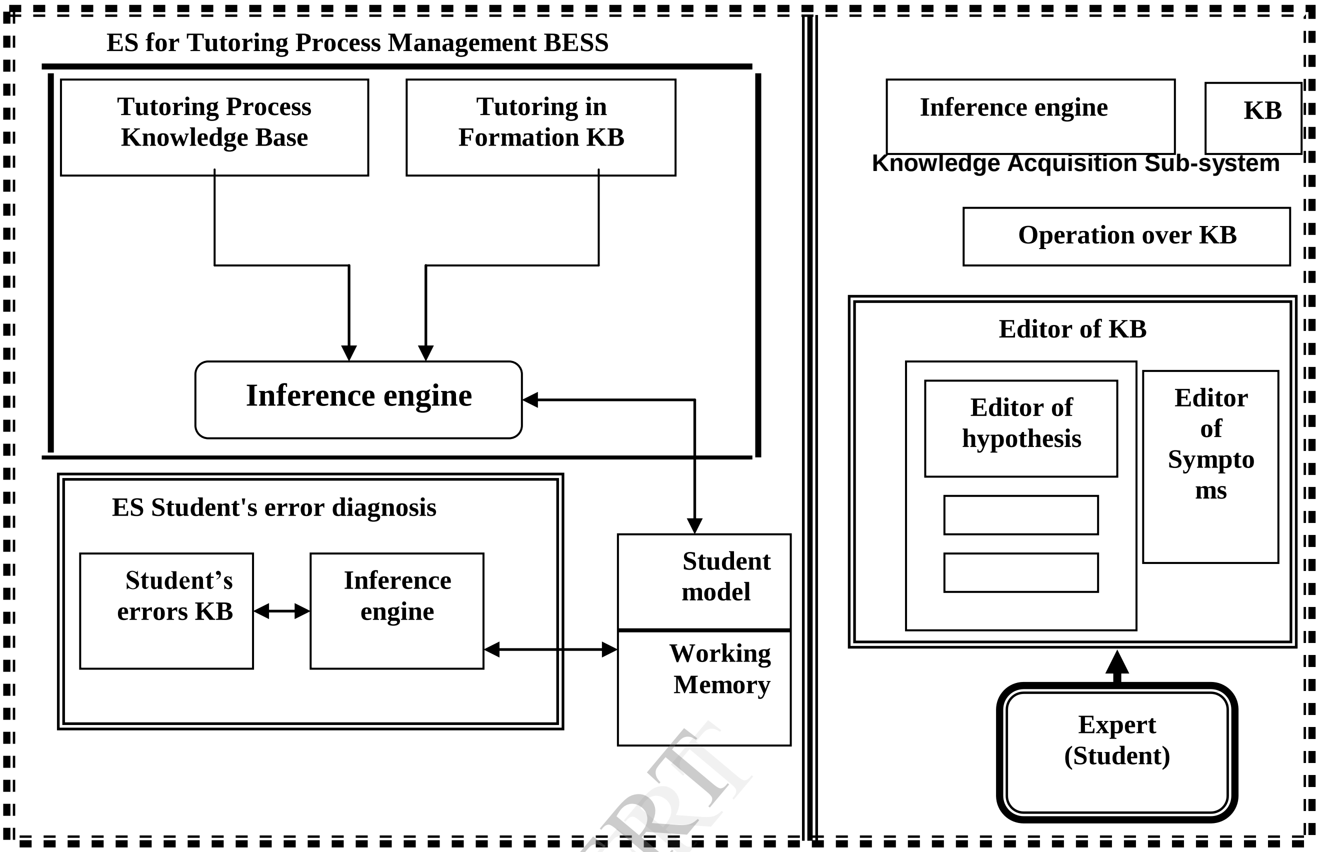
The tutoring process planning is carried out by the corresponding ES on the basis of the current student model and the interaction history and consists in choosing the problem the didactical goal and the approach leading the didactical goal.

The following algorithm lays in the basis of the planning process; analysis of the current student model…. I.e. definition of the problem being solved and the type of the difficulty.

A hypothesis generation about the reason of the difficulty (for get doesn't know casual error); decision making …i.e. choice of the problem didactical goal and approach leading to the didactical goal.

During the tutoring process planning the ES solves both pedagogical (the choice of the problem and the didactical goal) and psychological (the detection of the failure reason; choice of the approach leading to the didactical goal) problems. So TPKB contains the following knowledge; didactical goals; approaches leading to the didactical goals; hypotheses concerning the expert's failure reasons; hypothesis choice rules; the problem choice rule; didactical goal choice rules, approach choice rules Fig [4].

Figure No.[4] Represent of the ES & KB for Tutoring Management BESS



4.4 The student's error knowledge base

The SEKB contains the definitions of the editor's classes, which may happen during formalizing of expert's knowledge with the Bayes method. Every solved problem associates with the particular class of errors. All errors are defined and classifies in advance for example, a problem " forming/ improving of symptoms" is associated with the following errors; the symptoms have poor information; the symptoms are not informative; the symptom rejects the hypothesis; the hypotheses can be factories for the symptom; the symptoms are mutually dependent; the symptom is absent [3].

Consider and example of the interaction between the system and an expert, Let the expert input the following values as a hypothesis symptom values during the KB editing; " Confirmation" rejection -0.7.

<BESS>: Symptom's values are not informative… P(S\H) =P(S\not H)

Example: - Let us have a hypothesis H & A symptoms, which may reject or confirm the hypothesis, let the hypothesis and the a symptom have the following values: -

(1) the a prior probability of the hypothesis …: 0.01;

(2) the probability of the confirmation of the hypothesis H by the symptom S …: 0.7;

(3) the probability of the rejection of the hypothesis H by the symptoms…: 0.7;

The posterior probability of the hypothesis is calculated by the formula: -

P(H|S) = P(S|H) * P(H)/(P(S|H) * P(H)+P(S| not H) * P(not H));

In the case of the presence of the symptoms and by the formula :-

P(not H|S)= P(S|not H) * P(H)/(1-P(S|H) * P(H) – P(S| not H) * P(not H));

In the case of the absence of the symptoms after corresponding calculations we have: -

P(H|S) = 0.01; P(not H|S) =0.01….i.e.

The presence or absence of the symptom doesn't change the prior probability of the hypothesis.

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