

Chapter 2

SQAR: An Annotation-Based Study Process to Enhance the Learner's Personal Learning

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1 Introduction

Adding annotations to learning objects has grown into a habit at learners. The main goal of most learners for annotating is to memorize his ideas directly on the learning objects to reuse them later. Available annotation tools were not conceived with the aim of assisting learners to succeed in their learning activities. In our approach, the annotation tool can be designed to help the learner to learn more efficiently and to make sure his learning evolution in both knowledge and ability. The target is to study, propose and carry out a new process that use the learner's personnel annotations to enhance his learning activity. So, in order to provide students with such process, we integrate a learning process SQAR steps into a web-based annotation tool WebAnnot. This will enable learners to create their personal annotations directly on their pedagogical documents within their web based learning environment.

This paper is organized as follows: in first section we present the annotation practice, then we describe the learner's personnel annotation. After, the web annotation tools are briefly presented. In the fifth section, we present our approach: the formalism of learner's personnel annotation, the architecture of SQAR process and its modeling. Subsequently, we describe, in the sixth section, the implementation of WebAnnot as a prototype of SQAR process. Then we present, in the seventh section, the experimentation participants, materials, method and disputed results. Next, we give a brief overview of related work. We finish with a summary and an outlook on future research tasks with respect to this topic.

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2 The Annotation Practice

In common parlance, the annotation is a critical or explanatory note, which is written on a text. In computing, the annotation is a concept (predefined) attached to a piece of paper used for search and retrieval information. Formally, annotation can be defined as a value adding note or marking that is linked to an existent information object, representing a record of interaction between the reader and the information object (MacMullen 2005). In the web environment, annotation is a fundamental aspect of hypertext, it increases not only the overall girth of the hypertext, but also its value (Marshall 1998a).

Several studies examined the practice of making annotations on paper as well as the use of annotations and their functionality in the context of hypertext. For example, (Ovsiannikov et al. 1999) carried out a survey to study how people make annotations in an academic research environment. They summarized the joint uses of annotations as “to remember, to think, to clarify and to share”.

3 Learner’s Personnel Annotation

In pedagogical context, there is no formal definition about the learner’s personal annotation, but we find that few authors, like (Marshall 1998b), have attempted to study the characteristics of annotations among students. We also find the work of (Mille 2005) documents; the author considers the annotation as a set of attributes organized in distinct but complementary categories.

Another study of the annotation (Azouaou 2006) which isn’t dedicated to learners, but it more relevant and closer to our context, it is the teacher’s annotation, where the author concludes that the annotation can be an activity and an object added by the user in a material and also a creative activity of the object annotation.

4 Web Annotation Tools

Generally, according to a study (Xin et al. 2005) that focuses on Web users’ explicit needs for personal annotation tools, the users’ annotation (especially learners) needs in the Web environment are similar to those in the paper environment. Thus, to harness the power of new technologies and give electronic documents some of the same note-taking possibilities as paper documents, various kinds of annotation tools and many annotation systems are developed. So, the personal annotations constitute the vast majority of the annotations that Web users, learners included, currently make on the Web (Marshall and Brush 2004).

Considering learner’s annotation’s activity in educative application can have many benefits for learners such as providing them with personalized annotation. However, in order to enhance learners’ personal learning – firstly by leading them to more

undressing and making good annotations on the work's pedagogic document, secondly by providing them with personalized recommendations and advice – we proposed, in our approach, the process SQAR that supply such functionalities in WebAnnot a web annotation tool.

5 SQAR Process: An Annotation Based Pedagogical Process

Our approach comes from the perspective that annotation, created by the learner on his documents during his pedagogical documents, is beneficial and can be used to enhance his learning. Our goal is to propose a pedagogical process based on the learner's personal annotations. To achieve this, we started by analyzing earlier works related to the use of annotation in pedagogical activities and we have identified two kinds of problems:

- The first problem is how to design a learner's dedicated annotation formalism.
- The second one is how to use the annotation activity as a pedagogical activity in a learner process in order to enhance the learning efficiency.

In order to give a solution for the first problem, we reuse the learner's personal annotation formalism proposed by Azouaou (2006) (see Sect. 5.1), while for the second one we reuse the functionalities proposed by other personal annotation systems. In particular, we are interested by the teaching aspect functionality, so we propose a new architecture of an annotation tool that integrates the SQAR process steps (see Sect. 5.2).

5.1 *Learner's Personal Annotation Formalism*

The following table shows our learner's personal annotation formalism. We identify three facets with their attributes, the categorization of the annotation attributes in facets is inspired from Mille (2005), and then the facet's attributes are inspired from Azouaou (2006).

5.2 *Architecture of SQAR Process*

We believe that the annotations made by learners do not only reflect their personal interpretation of the document content, but can be adopted by learners within the context of a global process to learn more efficiently and to make sure their learning evolution in both knowledge and ability. Starting from this, we conceive the SQAR process.

To highlight the main expected features in SQAR process, we study some annotation systems among the most popular (YAWAS (Denoue 2000), Amaya (Koivunen and Swick 2001), iMarkup (2004) ... etc.). The result of this study shows that no annotation system is dedicated to the learners, however, these systems offer functions related to the annotation's management (creation, sharing, research ... etc.). Consequently, we distinguish two modules in the architecture of our process:

- The “*Annotation's Management*” module. The functions included in this module are generic ones such as research and sharing annotations ..., these functions usually exist in several annotation systems.
- The “*Assisted Annotation*” module. This module deals with the pedagogical aspect.

To introduce the pedagogical aspect in the “*Assisted Annotation*” module, we propose the pedagogical *SQAR process* (Survey, Question, Annotation and Review). It is an adaptation of the famous study method *SQ3R*, an individual learning technique (Huang et al. 2008). First we will model the SQAR process' steps (see Sect. 5.3) then include it into the “*Assisted Annotation*” module. We present here the architecture including SQAR process.

Our model consists of these main entities: (a) the user who is also the annotator (learner), (b) the document (web page), (c) the annotation interface which includes the two modules: “*Assisted Annotation*” and “*Annotation Management*”, (d) local and distant database.

5.3 Modeling of SQAR Process

To make sure that learners could effectively get knowledge and progress in their learning during the learning activities, we propose the SQAR process for enabling students to access and familiarize themselves with course content and enhance the quality of their annotations. Definitions and modeling steps of SQAR are listed below:

Step 1 – Survey: In this step, learners quickly survey the material, to get an overview of the assigned topic. For modeling this step, we use the online free web service ([GreatSummary online web service](#)), which can automatically generate a short summary of a web page. This summary presents a significant gain of time and efficiency when the learner must regularly fly over some texts or documents when he doesn't have enough time to read all sites that he/she is interested on.

Step 2 – Question: Once students have completed their survey, they use their general understanding of the topic to generate a list of questions, which should serve to direct their efforts and focus their attention during a more thorough reading of the material. For modeling this task, we have two choices,

- In the first one, the system automatically generates questions, which are related to the text.

- In the second one, learner is free to put (use his intellectual efforts) the questions which help him to focus his attention.

Step 3 – Annotation: In this step, learners read the material more thoroughly, making a concerted effort to find the answers to questions they generated in step 2. During the reading phase, students can and should make annotations (such as highlighting, underlining, emphatic text or answers to their questions within the text...). By annotating the text with notes based on paraphrasing or summarizing, students not only increase their ability to recall key pieces of information, but also deepen their understanding. For modeling this task, we propose that the annotation system provides the learner with annotation forms in a single bar.

Step 4 – Review: In the last step, in order to consolidate their knowledge, students need to review it thoroughly. This step can also help learners to find any gaps in their knowledge and to refine any annotations completed earlier. With an aim of helping learners to check and evolve themselves in their knowledge, we propose to automate this step by using a questionnaire for evaluation of learner, afterwards we give him automatically the adequate recommendations. For learner's evaluation, the questionnaire used is composed of both **survey** and **quiz** questions. The reason for using a composite questionnaire was to accurately assess learner's knowledge and to which extent he can use it to answer the given questions. Indeed, a questionnaire compound is considered as an "advanced organizer (AO)" used to measure the degree of understanding of an individual of an e-learning course (Huang et al. 2008). The survey questions are depending on the possible choice in second step quoted above:

- If we opt for the first choice (see *step2 – Question*), the system will answer questions and generate **survey questions** obtained from the document's content on which the learner is working, so the learner's responses of the survey questionnaire were classified into one of the three groups: does not understand, understands to some extent (medium), and fully understands. Each group was assigned a score, "does not understand" was worth one point, "medium" was worth three points, and "understands fully" was worth five points. The score of a survey type questionnaire was calculated using the following formula:

$$x = \frac{\text{No_Understand_Items} \times 1 + \text{medium_understand_Items} \times 3 + \text{Full-understand_items} \times 5}{\text{The number of the survey items} \times 5}$$

- Otherwise (second choice), where there is no questionnaire, the system asks the learner to point out his own understanding degree by checking one of the three choices: "does not understand", "understand to some extent" or "fully understands". So the value of score x is assigned directly.
- The other type of questionnaire (quiz questions) examines the learner with a set of questions on the area of reading material. Then there is no effective strategy to make a good quiz questionnaire covering the topic's content.

Table 2.1 Learner’s personal annotation formalism

Personal annotation’s facets for learner	– Episodic	– User (Learner)
		– Date
		– Place
		– Remembrance situation
		– Learning situation
	– Cognitive	• Domain
		• Studied notion
		• Level of study
		– Physical Anchor
		• Document URL
		• Location of annotation in the document
	– Semantics	– Visual form
		– Syntactic Anchor
		– Free Content
		– Objective (s)
		• Objective (s) of active reading
		• Objective (s) of memory
		– Strength
		• Importance
		• Confidence
		– State
		– Lifetime

Furthermore, we believe that it is better to replace the score calculated from a quiz questions by another annotation score that will be calculated according to the learner’s annotation. More precisely, we propose to combine the attributes “*Confidence and Importance*” in each annotation (See Sect. 5.1, Table 2.1, semantics’ facet) by a value reflecting its semantics (such as *absolute-confidence* by value 5, *null-confidence* by value 1, *average-confidence* by value 3...). Then the score concerning the quiz questions can also be calculated using the following formula:

$$y = \frac{1}{(\text{annotations number})^2} \times \sum_{\text{One annotation}}^{\text{All Annotation}} (\text{Value}_{\text{Confidence}} * \text{Value}_{\text{Importance}})$$

Depending on the score x and y with α coefficient, which is adjusted to the desired precision, the composite score r is calculated as follows:

$$r = a * x + (1 - a) * y$$

Depending on the value of “ r ”, the system determines the exact learner’s familiarizing degree with the document’s topic, and it provides him with appropriate recommendation. Information’s recommendation technique can identify and provide

Table 2.2 The recommendation’s strategy according to the score r in PAML model

Value of score “ r ”	Interpretation (understanding degree the topic)	Recommendations based on		
		Expert annotations	Public annotations: annotator/ numbers of these annotations	Cloud (tag) of words from annotated texts
$0.2\alpha \leq r < 0.3$	The learner is very unfamiliar with the given topic	Links to similar documents annotated with abounding annotations	Shows ten annotators sorted by number of published annotations	Large cloud
$0.3 \leq r < 0.7$	The learner has some under- standing and knowledge about the topic	Links to similar documents annotated with medium annotations	Shows five annotators sorted by number of published annotations	Medium cloud
$0.7 \leq r \leq 1$	The learner fully understands the given topic	Links to similar documents annotated with brief annotations	Shows annotators who publish less annotations	Small cloud

document will be annotated in three versions: brief, medium, and abounding annotations.

Thus, based on each learner’s performance (according to the value of score r), student would then be automatically provided with appropriate recommendations. The recommendation will be sent to the learner according to the strategy presented in the following table:

Case 2 – Autonomous annotation system (without moderator): In this case, the documents would not be annotated by experts, so the recommendations will be made in the same way except that there are no brief, medium or abounding annotations.

6 Webannot a Prototype of PAML

To validate our proposals, we have developed WebAnnot a prototype of SQAR as an extension for the Firefox browser. Then, Firefox’s browser interface will incorporate the annotations’ WebAnnot tool bar (see Fig. 2.2). The learner clicks the button named “WebAnnot” to start an annotation session (session is used to identify user’s activities in the process with date, time and page’s URL) providing information on the context learning (assess the attributes of episodic facets, see Table 2.1). Then, new buttons are displayed as shown in Fig. 2.3. The button “Start” enables to

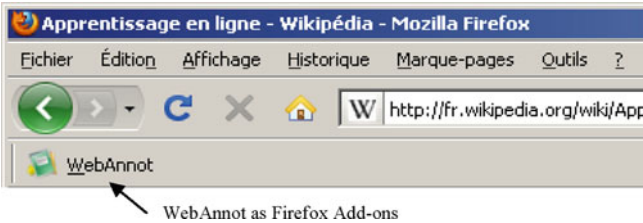


Fig. 2.2 The toolbar WebAnnot interface

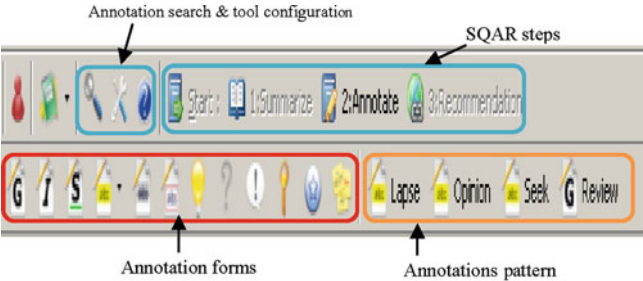


Fig. 2.3 WebAnnot: learner’s annotations tools

begin the SQAR process, the other buttons are relating to other functions such as annotation searching and sharing.

To annotate with WebAnnot, the learner must click on the buttons “start”, so other buttons corresponding to the different SQAR steps are displayed. Then, the button “summarize” provides in new page an automatic summary of the current page, the second step involves the questioning is letting for learner’s intellectual effort, the third button displays annotation’s forms, and the last button will open a new tab containing the recommendations suitable for learners. To create an annotation manually learner selects the transition to annotate. Then, he chose the shape and form semantics appears, the student completed the form and record annotation (see Fig. 2.4). If a pattern exists learner may create an annotation-based pattern (semi-automatic annotation), to make it pass the selection then selects the pattern annotation. To create a pattern annotation learner chooses the form and the target patron, it is recorded last. The intended use of patterns uses is to allow the learner to create patterns (models) annotations and use them immediately to annotate documents.

Regarding recommendation, the system will first calculate the score of the learner to evaluate his level. Subsequently, it queries the server to recover the recommendations according to the score calculated, and then a new page will open with appropriate recommendations (see Fig. 2.5).

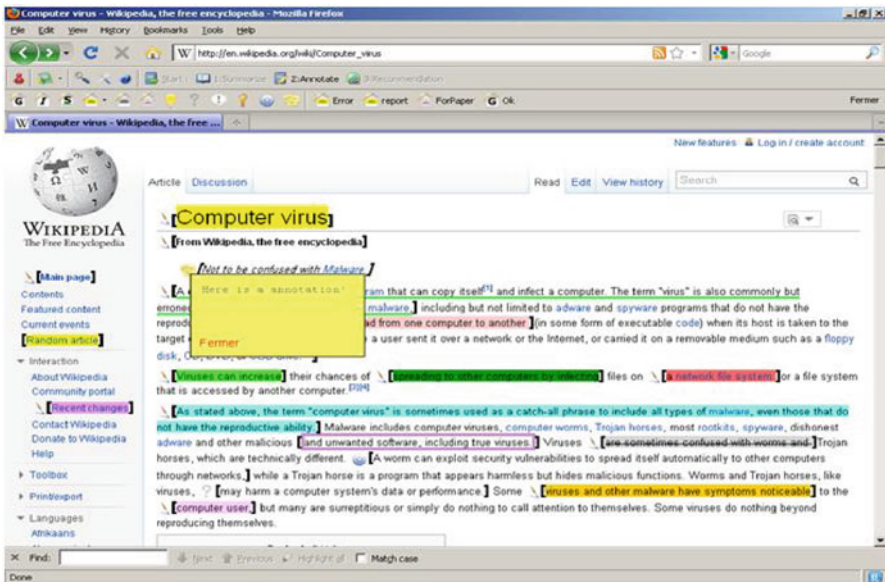


Fig. 2.4 A web page annotated with WebAnnot

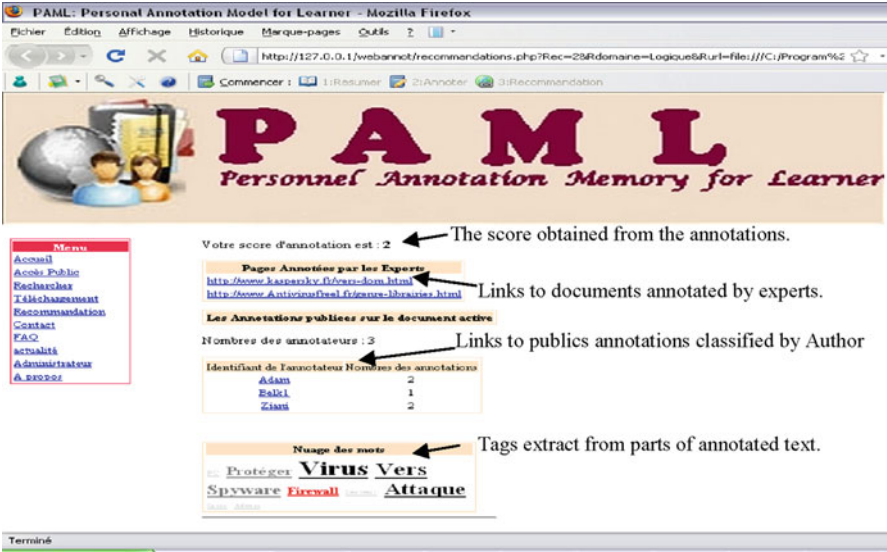


Fig. 2.5 Recommendation page automatically generate by WebAnnot

7 Experimentation

The experimentation goal is to compare the results of learners after studying the same documents (lessons in web format) in three different situations:

- **Situation 1:** studying with annotation by using of WebAnnot tool (in this case the annotation activity is a part of the SQAR process steps).
- **Situation 2:** studying with annotation without using WebAnnot (no SQAR process), so we have developed a simple annotation tool made for making textual annotations.
- **Situation 3:** studying without annotations.

7.1 Participants, Materials and Method

Thirty undergraduate students participated in various tests of this experimentation; we separated the students into three groups of ten persons in order to examine them in the three situations described above. Thus:

- Group A: Studying in the *Situation 1*.
- Group B: Studying in the *Situation 2*.

- Group C: Studying in the *Situation 3*. This Group is constituted of learners who are not used to annotate during their learning activities.

We trained the group of students that meet the Group C learners who are not or rarely used the annotation activity during their learning while the rest of the students, whom identified their annotation habit as medium or high, were assigned randomly to their groups.

To give more value to the experimentation, each group is examined in his situation several times using several tests, therefore we have prepared some documents related to different subjects but they are all in linked to the learners' study themes. For each document we prepared a combined "multiple choice quizzes" with maximum score of 20. In regard to the group A which needs access to the distant database server (see Fig. 2.1), we have already alimented it using annotated documents which are similar to documents that students are used during the experimentation.

8 Results

During the experimentation, five different tests are performed. First, students read, a single document, depending on the situation we have previously set for each group. Then they are asked to answer the related QCM.

We present below the results of a single test and then the overall results.

In the first test, the following table shows the number of learners in groups according to their results (note/20: score obtained after replying the QCM questions concerned the studied document), Thus, each result is considered:

- Good: if the score is higher than fifteen,
- Middle: if the score is between ten and fifteen,
- Weak: if the score is less than ten.

Most of the learners in Group A have obtained good results, while less than half of students in group B, have good results, while in group C only one learner has good results.

Similarly, if we analyze the results for all the tests (see Table 2.3) we note that group A has better results, in many good and/or average scores, than the group B and C. The latter has the worst scores.

Figure 2.6 shows the number of learners by group according to their results, but this time we took for each learner, his average score in all tests, then we conduct a classification according to his average score.

The figure below shows the consensus of sorted out average scores in each group, this graph displays a comparison between the students according to the method followed during this investigation.

Table 2.3 Number of students by group depending on the results type

Results	Number of students		
	Group A	Group B	Group C
Good (score \geq 15)	6	4	1
Middle ($10\leq$ score $<$ 15)	3	4	4
Weak (score $<$ 10)	1	2	5

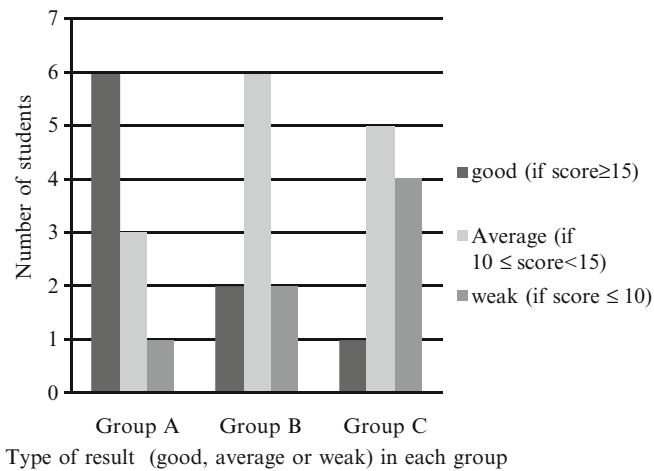


Fig. 2.6 Number of students classified according result type

9 Discussion

An interesting result comes out from our experimentation, is that the way followed by the learner to study (read) a handout has an important role on its concentration and its general understanding of the document to be studied:

- Group C learners, who don't use any technique or method for reading the documents offered in different tests, are less effective comparing to Group B learners who use the annotation activity.
- Group B learners are often less effective comparing to Group A learners who follow the SQR process.

In general, we can explain the advantage of Group A versus Group B, and both versus Group C, either in terms of numbers of students who are classified good (Table 2.3 and Fig. 2.6) or in terms of overall consensus of their average scores (Fig. 2.7), by the following arguments:

- Group B learners use annotation activity by putting annotations on several passages and/or paragraph.... These annotations allow them to concentrate better

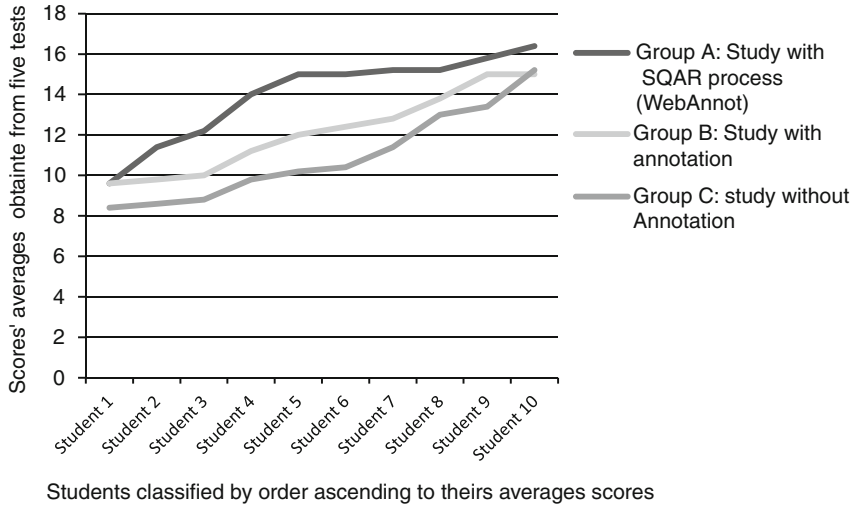


Fig. 2.7 Consensus of scores averages at students according to group study method: SQAR process, with and without annotation activity

and learn more concepts and ideas during the document reading, so they are better memorized comparing to Group C learners.

- The results of Group A are better than of Group B, because the learners of the first one are studying their documents in a more detailed and efficient way compared with those of the second group, they followed the SQAR process steps that requires them a lot more effort:

- Reading the summary of the studied document
- Answering the related questions
- Annotating the document
- Consult the recommendation page (see Fig. 2.5) that enable them to see their colleagues shared annotations (see Sect. 5.3 – step 5).

Finally, we can confirm that the process SQAR helps learners to work handouts effectively for their learning. This is due to the fact that that this process is inspired by the validated pedagogical method QA3R method (Marshall 1998a).

10 Related Work

In this section, we first compare the SQAR process with two other similar models, which use the annotation within a learning framework. Then we compare WebAnnot with some other prototypes and tools of annotation system. Several Models have been based on annotations; the most relevant to our project are Mille (2005) and Azouaou (2006).

Table 2.4 Comparison between WebAnnot and some prototypes

Prototype			Yawas for IE 2000 (Ovsiannikov et al. 1999)	WebAnnot 2010
Canon	iMarkup (Marshal 1998b)	Amaya 2001 (Mille 2005)		
Pedagogic aspect	✗	✗	✗	✓
Typing of annotation	✓	✓	✗	✓
The sharing of the annotations	✗	✓	✗	✓
The research by annotations	✓	✓	✓	✓
Semiautomatic annotation	✗	✗	✗	✓

The model of (Azouaou 2006) focuses on teacher’s annotation in order to use it as knowledge’s management tool for the teacher. This model has several similarities with our model (architecture of SQAR process); first, they both are dedicated to educational. Secondly, they both are aimed to document annotation, the two approaches aim at providing semantic annotation. Thirdly, they are both designed to a personal use. In the other hand, there are the following differences; first, whereas teacher’s annotation model is dedicated for teachers, then SQAR is dedicated for learners. Secondly, the model of teacher’s annotation is based only on the annotation, while SQAR is a specific process to improve the efficiently of the learners learning.

In (Huang et al. 2008) the authors propose a cooperative learning environment that uses the annotation services on handheld devices. The similarities between SQAR and ubiquitous is the use of pedagogical method, in Ubiquitous the SQ3R study method is introduced during the individual study phase of cooperative learning activities, but we use and modeling the same method improved to SQAR.

To compare our prototype WebAnnot with other prototype and annotation tools we studied some annotation system among the most popular (YAWAS (Denoue 2000), Amaya (Koivunen and Swick 2001), iMarkup (2004) etc.). The result of this study (see Table 2.4) shows the novelty and the advantage provided by our prototype over some existing prototypes.

11 Conclusion and Future Work

The purpose of this paper is to describe SQAR a new annotation-based study process to support the learner in his learning. We implemented this process as a personal web annotation tool, WebAnnot, by reason of enhancing the learner personal learning in the web environment. The evaluation and the comparison of our process with other study methods showed its very important aid and positive effect on the learner personal learning efficiently.

With the SQAR process the learner will become an active reader of his web based pedagogical documents. The practice of interactive annotation (third step of

SQAR process) allows more powerful and more effective reading for a better understanding such as the annotation is based on a specific formalism, which describes perfectly the characteristic of learner's annotation at three different facets: episodical, cognitive, and semantic.

WebAnnot (the initial prototype of SQAR) shows interesting results to allow supporting the learner abilities at best. Annotation will help the learner to develop his capacity of memorizing and reflective reading, while the recommendations (see Sect. 5.3 – Table 2.2) ensure the assistance of learner for evolving most quickly in his learning activities. Indeed, the architecture of SQAR process has a specific annotation system that is based on four principal parts: User (annotator), document (web page), annotation's interface (SQAR steps, research, sharing...), local and distant databases.

Generally, the findings of the superiority of the students' whom guided by SQAR process showed several factors, such as personal annotation and recommendation, that enhance the learner's personal learning. The main advantage of our process is that it enables the learner's improvement of understanding and memorization of the document they are working on, indeed, according to the experiment results of students whom used the Web annotation, the proposed process study methods can enable learners to engage with documents in a way that aligns with observed practice.

The appreciation of our study process SQAR and its prototype will continue, with more longitudinal studies for better understanding the learner's activity. This will also build up an effective resource for use in the teaching activity as well as for those studying the teaching methods and processes. Therefore, in the next phase of our research, we aim to reach a larger learner population in the experimentation to generalize the obtained results. Further work would include also the integration of our model in an e-Learning platform such as moodle.

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