

Rules to develop an online support system for students with learning disabilities and attention deficit disorder to help them persevere in their post-secondary education

Louise Sauve
TELUQ, University of Quebec / SAVIE
Canada
lsauve@teluq.ca

Abstract: Following the experimentation of an online support system for perseverance in school studies done with 143 SLDs, a few ergonomic rules have been proposed. These rules are based on the very high satisfaction rate of the respondents as it pertains to the organization of the website, the content offered by the site and a high degree of satisfaction with the quality of the textual and visual aspects of the system as well as the media format of the support tools offered on the website. The rules also stem from a very high rate of appreciation of the screening tools for dyslexia, attention deficit disorder and dyscalculia in terms of their layout, their GUI and their contents.

Introduction

Post-secondary institutions in Quebec realize they cannot meet all the needs of students with learning disabilities and attention deficit disorder (SLD) because of lack of human resources, which in turn limits the opportunities of these students of integrating well into the school system and doing well in school. Support measures should be put online to support this clientele starting at the very beginning of their studies, this being said by 82% of those working with students who were interviewed in our study and of which 94% believe that they will have to support SLDs throughout their studies (Sauve et al, 2012). It is in response to this need that this study has experimented with an Interactive Multimedia Support System for Perseverance in post-secondary education (SAMI-Perseverance) which was adapted for this clientele.

We will first present the screening tools and help tools of SAMI-Perseverance related to learning strategies, refresher courses, learning disabilities and attention deficit disorder. Then, we will report the results of the experiment done with 143 SLDs which resulted in rules for ergonomic web layouts that any institution should consider when developing a support system.

The SAMI-Perseverance Support System

S@MI-Perseverance (<http://taperseverance.savie.ca>) is an online Interactive Multimedia Support System for Perseverance in post-secondary studies offered for students with learning disabilities and attention deficit disorder.

For the purposes of this report, we present only the tab entitled *Successful Studies* which deals with screening tools and support tools related to learning disabilities, deficient learning strategies and deficient basic skills in French and mathematics.

Learning disabilities. Three screening tools (dyslexia, dyscalculia and attention deficit disorder with or without hyperactivity) have been developed. They come in the form of questionnaires. For example the questionnaire on dyslexia (Mimouni et al, 2010) proposes that the student must first complete a preliminary section of the questionnaire. According to the results obtained in this section, two options are offered: (1) follow a more in-depth screening of the particular learning disability by using the second section of the questionnaire if the results indicate that this may be necessary or (2) choose to complete an analytical grid of difficulties being encountered in terms of reading and writing if the results show that the student is not likely to have dyslexia. Once the student has completed the second section of the questionnaire or the analytical grid, the system suggests a variety of support tools related to the problems or difficulties being encountered.

Learning strategies. Five screening tools (listening and reading, speaking and writing, managing external resources, management of attention, concentration and memorization and last but not least the management of motivation, stress and emotions) have been developed from Rupp's (2010) theoretical model. The first two are cognitive strategies that relate directly to the knowledge to be acquired and learning to speak properly. The other three strategies deal with self-management strategies for creating favourable conditions for learning. For example, the screening tool for deficiencies in attention, concentration and memorization (Figure 1) contains 11 statements illustrating the difficulties experienced by students; here is an example: "When the teacher asks a question, I cannot or I am not trying to find the answer mentally.". For each difficulty, several tools are available to the student. The student just has to select those that are of interest.

SAMI-Persévérance

Home | Succeed my studies | Tools | Portfolio | Logout

Attention, concentration, memorization - Defining my needs

To hear the text, click on the icon.

By "management strategies for attention, concentration and memorization", we mean all strategies that improve the mental capacity to remain alert and focused on tasks related to learning and to plan and manage efforts for long-term memorization.

We invite you to identify the statements corresponding to your situation in order to find the support tools that are most appropriate for your needs. This grid is an auto-evaluation tool of your self-management strategies for attention, concentration and memorization. Read the instructions before you begin.

Statement list :

- I would like to understand my strategies for managing attention, concentration and memorization.
- When a teacher asks a question, I am unable to or I do not try to find the answer mentally.
- I cannot retain everything in my memory.
- I take notes, but I lose too much time doing so.
- I think I have learning disabilities (slowness, lack of concentration).
- I want to be able to determine if I correctly understand the subject matter.
- I wait for inspiration before starting my work or studying for a big exam.
- In the classroom or at a distance, I am often distracted when I attend a course or while doing the learning activities of the course.
- When I take an exam or a test, I feel I have not studied the right things.
- I want to study, but I cannot concentrate.
- I would like to learn different strategies (ex. reading out loud) for keeping my concentration up when I read.
- None of these statements correspond to my situation.

Change my choice of research tools

[Register](#) [Star over](#)

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Figure 1: Screening Tool for difficulties relating to management strategies for attention, concentration and memorization.

Refresher courses for basic skills. Two screening tools for refresher courses for basic skills (math and French) have been developed. For example, the screening tool in mathematics consists of 18 problems divided into 6 different themes: exhibitors, equations and inequalities, functions, polynomials, distance calculations and number systems. The system offers 75 tools in connection with these difficulties.

Options offered to students for identifying their support tools. For each category of learning strategies and refresher courses for basic skills, we offer students three ways to access support tools capable of solving their difficulties: search for tools by keywords, seeking for support through the use of a concept map (Figure 2) or completing a grid of statements about difficulties to specify the needs in terms of the support tools. The support tools that are available are rich in multimedia content and interactivity. They are learning objects and they are reusable on different platforms. Each is chosen according to the needs of individual students and provides a personalized learning experience.

Methodology

In order to validate the contents of the SAMI-Persévérance support tool, we used the *Learner Verification and Revision (L.V.R.)* method. This method focuses on the user, is characterized by flexibility and is well adapted to the context in which the product will be used (Nguyen et al, 2008). It allowed us to identify and

correct errors and problems (Thulal, 2003; Maddrell, 2008) and to effectively validate a prototype being developed with a small sample of the targeted users for whom it was created. This method, also known as a user trial, has also been used in developmental research for learning objects (Sauvé and Hanca, 2008). The process involves validating the prototype through a sample of the target audience in order to measure its effectiveness.

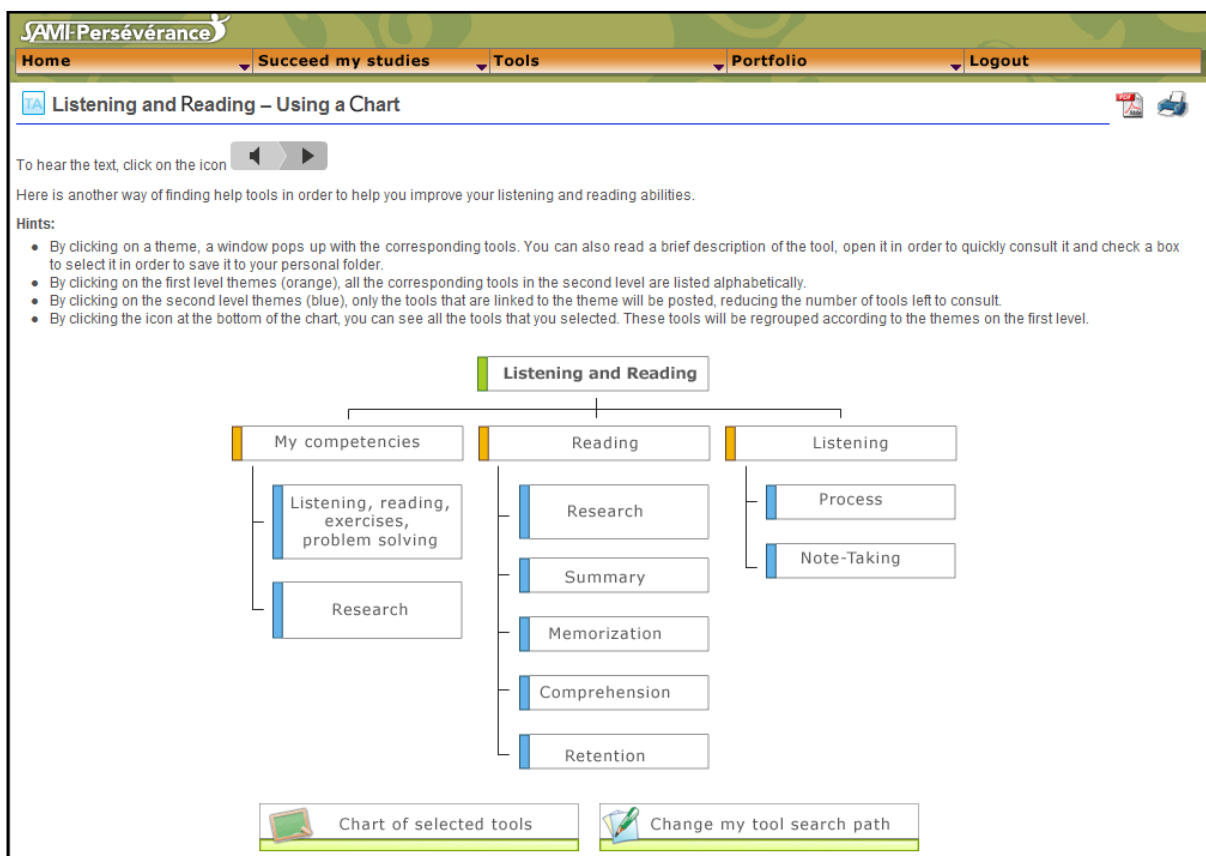


Figure 2: Searching for tools using a conceptual map

The sample consists of 143 SLDs who are registered in SAMI-Perseverance. They read the research and signed a consent form confirming their participation in the evaluation of tools using the SAMI-Perseverance system. Three measuring instruments were used: the mini-assessment questionnaire on screening tools, the mini-assessment questionnaire on support tools and the assessment questionnaire using the SAMI-Perseverance system. These surveys have collected data on the following aspects: (1) the organization of the system, (2) the relevance and usefulness of the screening tools and support tools on the Web site, (3) the design (textual and visual quality) and (4) the media format of the proposed activities of the site.

The evaluation results for the system, screening tools and support tools

Out of a possible score of 5.0, the results show a high degree of satisfaction from the respondents in relation to the organizational aspect of the website (3.92 to 4.20) and the content available through the site (3.80 to 4.21) as well as a high degree of satisfaction with the textual and visual quality of the system and its contents (4.12 to 4.28) and for the media format of the tools available on the Website (from 4.12 to 4.68). Some significant gender differences were observed. The three presentation formats for the tools show significant differences according to gender. For example, men more than women, enjoy hypertext, video and multimedia formats. Women find it easier than men to navigate the tools. These very positive results will guide institutions in creating online support systems that are ergonomically correct.

The appreciation rate of the screening tools for dyslexia, attention deficit disorder and dyscalculia is very high for all evaluation questions. More specifically, the layout of the screening tools was evaluated very

positively (4.46 to 4.86). In terms of the interface, the screening tool that is the most popular is the one for dyscalculia and the least popular (although quite appreciated) is the screening tool for dyslexia. The contents were also evaluated very positively (4.35 to 5.43). The tool whose content was evaluated the most positively is the screening tool for attention deficit disorder, while the lowest evaluation was for the screening tool for dyslexia. The difference between the lowest and highest is very small (0.1). Finally, we note that the lowest reported score is for the effectiveness of the results obtained with the screening tool for dyslexia (4.00), compared to a value of 4.69 for the screening tool for attention deficit disorder. Therefore, this tool seems to be more motivational for taking decisions or making a move, while the other two tools are just slightly less motivational.

The overall results show a very high level of satisfaction (80% or more) for the evaluated tools. We must specify that the evaluated tools offer rich multimedia content and interactivity as well as requiring between 10 and 15 minutes to be consulted. Respondents find that the support tools are easy to navigate (85.5%), they offer a visual and textual content that is easy to read and understand (84.4%), the tools have caught their interest (80.9%) and they would recommend them to a friend (81.9%). Finally, respondents have examined the content offered by the support tools in their entirety (74.7%) or partially (16.5%) and they believe that these tools have partially (17.2%) or completely answered (70.5%) to their needs.

Some rules for developing online support systems

The very high satisfaction rate of our respondents on the organizational aspect and the content offered on the site allows us to make some recommendations for the future development of online support systems (Sauvé et al, 2012):

The screen display

On each Web page, we avoided information overload as much as possible by questioning ourselves about the essential content to be inserted and respecting, in most cases, the visualization space available on the screen page (the equivalent of a one page double-spaced text). Instead of relying on scroll bars, we avoided long scrolling texts on the Web pages in order to maximize the visibility of the content, minimizing download time and maintaining student motivation. We tried to keep pages to an average length equivalent to one single-spaced printed page (including images or videos). We also ensured that the pages are read in their entirety on the width of the screen without the need to use a horizontal scroll bar.

The web pages are displayed differently according to each user, in particular, the size and resolution of the screen, the configuration of their browser and computer equipment. It is therefore important to define the display area with a predetermined frame that will maintain a display standard for the content on the page from one computer screen to another. However, we must take into account the emerging clientele and empower them to improve their reading ability. In the system, we post a message to the students from the very first time they enter the site, informing them on how to facilitate reading by enlarging the text characters.

Navigating the system

The site should provide easy navigation and must meet certain conditions. At any given time, students had access to the different contents of the system through the use of tabs, menus and sub-menus for navigation which are displayed on all Web pages. We also developed a navigation guide, in two different formats, that explains how the site functions: textual and animated (video demo). These tools have received a very positive evaluation from the students.

During the creation of the online support system, we took into consideration that students have different levels of technological skills: novices to experts. Because experts have less need guidance, we have integrated shortcuts into the system that allows them a faster progression. Having access to a plan of the site at any time is a help tool that was highly appreciated by the respondents.

Throughout the navigation process, students are required to complete grids and answer questionnaires. We paid special attention in helping the students complete these tools by displaying instructions (text and sound) informing them on how to complete them. The respondents showed a high rate of appreciation for the textual and aural instructions which demonstrates their usefulness. In addition, students who completed the screening tools for learning disabilities and attention deficit disorder were doing them in their entirety. We have

included messages in these tools informing the students about the items or content they have not completed thus ensuring they have access to valuable results. For other activities that do not require entire completion, we inserted asterisks to indicate to students what items or content that must be completed.

We also ensured that students do not repeatedly use their mouse (more than three clicks) to access a screening tool or support tool, because it hinders their motivation. It is preferable that students can access with a single click all the elements which they will have to answer for in order to get support.

The site has used known symbols or icons to facilitate the students' actions and to avoid errors due to misunderstanding. Symbols and icons are the same on all the pages of the site and they are located close to the required action on the part of the student.

Finally, we avoided displaying the contents in more than two overlaid windows since it hinders the intuitiveness of the site and causes a loss of focus on the part of students, particularly those with attention deficit disorder.

Readability of the multimedia content

The criteria on which we relied on for the layout of the website have been appreciated. The layout of the text on the screen must facilitate reading and viewing. The text should be arranged in paragraphs, or information units, although well separated to maintain cohesion. In general, the Web page must be organized and well-spaced out with space between the title and the text paragraphs. It is preferable that the words are seamless and the text is justified on the left to increase the speed of reading, particularly for readers with learning disabilities. It is very important that the font and size be chosen to facilitate reading on the screen. It is even suggested to avoid using capital letters for full text, because they affect readability; they are appropriate for brief information such as: title page, title menu, etc... Finally, we must ensure that underlining is reserved only for hyperlinks.

The use of illustrations and videos must be relevant to the content of the tool. Too often designers use a profusion of illustrations and videos to make their content more attractive, but these additions are often cognitive overload and with a display time that is too long thus reducing medium term student motivation. It is recommended that the illustrations do not include too many details, which would prevent students from perceiving the principal idea. The position of the video viewer on the screen should allow good visibility and access at all times to the control buttons (stop / play video, adjust volume, etc...). Displaying the picture or video should not require a waiting time on the computer of more than 2 seconds for it to be displayed on screen. If this is the case and the content is relevant, it is necessary for the system to display a meter or graduated bar to indicate the download time otherwise the students will believe it to be equipment failure. The illustrations and videos must be displayed within the monitor screen. If the images have too much detail or they are too large, the system should provide the option to view them in a new window.

The use of audio content or spoken texts can motivate students and increase their interest in the support tool, especially for SLDs who have reading difficulties. However, sound samples should be used with caution. Sound is a more or less efficient method to present a lot of information or a long list of items that must be remembered, to explain abstractions, or, objects in two or three dimensions (procedures, branched pathways, space, time, etc...). Sound has a higher degree of difficulty when inferring the meaning of certain contexts requiring prior knowledge. Some students do not like learning by aural reception while others do not have that kind of skill, and this for several reasons: acuity, discrimination, knowledge of vocabulary, symbolism, etc... It is therefore necessary that the system offer the option of presenting the content in textual form, in addition to the sound aspect. It is important to remember that the difficulty with aural information is that it fits into the flow of time while the fixed image may remain displayed and be accessible at all times. It is important that the sound be audible and that the instructions to activate the speaker or the computer sound controls (replay audio, adjust volume, etc...) be integrated into the site and available during listening.

The wealth of the multimedia content

The results from the evaluation show that we have proposed screening tools and support tools that are rich in interactivity and multimedia contents, which have varied contents, which are useful and appropriate to the needs and expectations of students. According to the evaluation done by our respondents, these tools maintained their interest and they are interesting enough that they would recommend them to a friend. These

results show that it is preferable to provide support tools that are rich with interactivity and multimedia content and these tools must focus on one specific subject and must take 10 to 20 minutes to complete.

Conclusions

An evaluation of the support system for student perseverance in school done with 143 students with one or more learning disabilities or attention deficit disorder indicates that respondents appreciated, to a very high degree, the support system (the organization of the website and the content offered on the site) and appreciated to a high level the design (textual and visual quality) of the system and its contents as well as the media format of the tools available on the website. They also had a high level of appreciation concerning the screening tools for dyslexia, attention deficit disorder and dyscalculia as well as the support tools for their rich interactivity and multimedia contents. These very positive results reiterate the importance of online systems that take account the needs of students and provide them with timely tools that can help them solve their difficulties during their studies. Given these results, it is recommended to continue the development and testing of support tools that are rich in interactivity and media contents in order to support struggling students. An online research study (Sauvé et al., 2012) shows that the majority of support tools available to students in difficulty are generally textual with little interactivity and very demanding concerning the time needed to explore them.

We conclude this report with the hope that the freely available online tools in the SAMI-Perseverance support system will be reused in the next few years by French post-secondary institutions so they can identify which students are likely to experience difficulties during their studies and then provide support programs designed for them and according to their needs. The use of an online support system as a help measure offered to students provides beneficial elements that have been identified in several studies (Endrizzi, 2010) and which are also repeated in this study. An online support system is therefore one effective method that schools can offer to their students to promote the success of their post-secondary studies. This holds true providing that the stakeholders in the school system and assistance centers take ownership of this system and make a complementary use of it in their interventions with students.

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