ENHANCING CRITICAL THINKING SKILLS THROUGH ONLINE TOOLS: A CASE OF TEACHER TRAINEES

Soon-Yin Tan [a]
[a] The Teacher Training Institute, TuankuBainun Campus, Bukit Mertajam, Penang, Malaysia.
[a] Corresponding author: soonyin@gmail.com

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Abstract: While the value and importance of critical thinking is without doubt, the challenge for instructors actually lies in enhancing the students' critical thinking skills within the confines of a traditional classroom.The challenge appears to be even greater in Asian countries as Asian students are said to have shown deficiency in the ability to think critically (Kumaravadivelu 2003). Technological advances and the availability of a wide array of teaching resources in the Internet, however, have opened up exciting and innovative instructional techniques that may be used to overcome student passiveness and enhance critical thinking skills. This paper reports some findings of a project that attempts to enhance students' critical thinking skills among a group of 20 teacher trainees in Malaysia, through the use of Intel Thinking Tools, namely, the Visual Ranking Tool, Seeing Reason Tool and also Showing Evidence Tools, which have been developed and made available by Intel Corporation. It looks at the ability of these tools to encourage participation and enhance critical thinking in higher education. It also highlights some important lessons learned in the integration of such tools which might shed light to potential users of these tools. The study reveals that the use of these online thinking tools results in an increase in the trainees' critical thinking ability in completing their assignments.

Keywords: online thinking tools, Intel, critical thinking skills, teacher trainees

INTRODUCTION

Critical thinking is the most important skill for problem solving, inquiry and discovery. It is the systematic approach of skillfully evaluating information to arrive at the most feasible solution to a variety of structured and ill-structured problems (Laxman, 2010; Shah, 2010; Winch 2006). Academically, critical thinking refers to the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action (Michael Scriven and Richard Paul 2003).Such skills are therefore required to enable students to function competently in social, educational and work environments since creative problem solving requires critical thinking. In fact, appropriate ways of handling knowledge and information, that is, 'good thinking' or 'smart thinking' as suggested by Pithers and Soden (2000), become more important than mere acquisition of information.

The issue of critical thinking appears to be more critical among Asian students (Kumaravadivelu 2003). Yang et al (2006) attributed this to the traditional value of preserving interpersonal harmony and respecting authorities which are more emphasized in the Asian culture. Chiu (2009) suggested that Asian students might remain silent for different reasons such as avoiding conflicts or germinating ideas. Besides, the emphasis on

examinations might prompt students to engage in 'non-questioning' and 'non-critiquing' approach of learning which in turn inhibit the development of critical thinking.

Since technology is now widely available, it is therefore essential to integrate instructional strategies and techniques so as to enhance thinking among our students. Such attempts have been considerably facilitated by the availability of a wide range of online tools that can assist instructors in meeting this instructional goal. This study attempts to examine the use of three online thinking tools as supplements to enhance critical thinking and provide practical suggestions for the innovative use of critical thinking strategies via online resources. It is with this in mind that this study was undertaken.

The Intel Online Thinking Tools

Intel, the leading electronics multinational company in the world, has the vision of becoming Sponsors of Tomorrow™, not only through their technical innovation, but through their endless efforts in education, environmental sustainability, healthcare, and many more. Its model of education transformation, which is a systemic approach that is based on research and includes the best practices for improved educational outcomes has included Information Communication and Technology (ICT) as one of the five critical components for transformation. According to Intel, ICT enables improved learning results by providing access to information and content experts, facilitating collaboration, encouraging creation, improving communication, and supporting assessments.

In line with its vision, Intel has designed a number of online tools which help enhance the 21st century skills among students. And, to enhance students' critical thinking skills, Intel has designed three online thinking tools, namely, the Visual Ranking, Seeing Reason and Showing Evidence Tools. The three tools have been incorporated in its Educational Transformation website and are available for any teacher's use free of charge.

The *Visual Ranking Tool* brings focus to the thinking behind making ordered lists. Students identify and refine criteria as they assign order or ranking to a list. They must explain their reasoning and can compare their work with each other in a visual diagram. This tool supports activities where students need to organize ideas, debate differences, and reach consensus.

The *Seeing Reason Tool* enables students to create visual maps of the factors and relationships in a cause-and-effect investigation. These maps make thinking visible and promote collaboration as students work together to refine their understanding.

The *Showing Evidence Tool* helps students learn how to construct well-reasoned arguments and prove their case with credible evidence. The tool provides a visual framework to make claims, identify evidence, evaluate the quality of that evidence, explain how the evidence supports or weakens claims, and reach conclusions based on the evidence. This thinking tool supports activities where students debate differences, make and defend decisions, and analyze conflicting information.

METHODOLOGY

This study was conducted on a group of teacher trainees at a teacher training Institute in the year 2010. They were a group of twenty undergraduates who were enrolled in the Bachelor of Teaching program in their third semester. As part of the program requirements, they had to attend a course entitled "Thinking With Technology". This course was a weekly two-hour face-to-face session which ran for 15 weeks. The course was aimed to encourage students to think with the help of technology.

At the beginning of the course, the class was divided into 10 groups. All groups had access to either their personal laptops or computers with Internet connections. During the course, they were given inputs on the uses and features of each of the three tools. To make them understand the tools better, they were then required to finish some projects set up by these thinking tools in groups.

The trainees worked in their respective groups. Each group created an account with their own username and password. They were then required to create a workspace which was the teacher workspace. Here, they set up their own projects based on any topic of their choice, based on academic subjects covered in schools. They then played the role of students to complete the projects set up by themselves using the three online tools. They perform this in a separate workspace which was called the students' workspace.

Observations were made when the trainees were doing the projects throughout the course. Observational notes were made using an observational form (Appendix 1).

Elements of critical thinking as shown in Table 1 were observed.

The checklist for the observation was based on the Critical Thinking Rubric by Intel which has been modified slightly (Appendix 2). At the end of the semester, the trainees were asked to write reflections on what they think of the tools and whether they think these tools have helped to enhance their critical thinking.

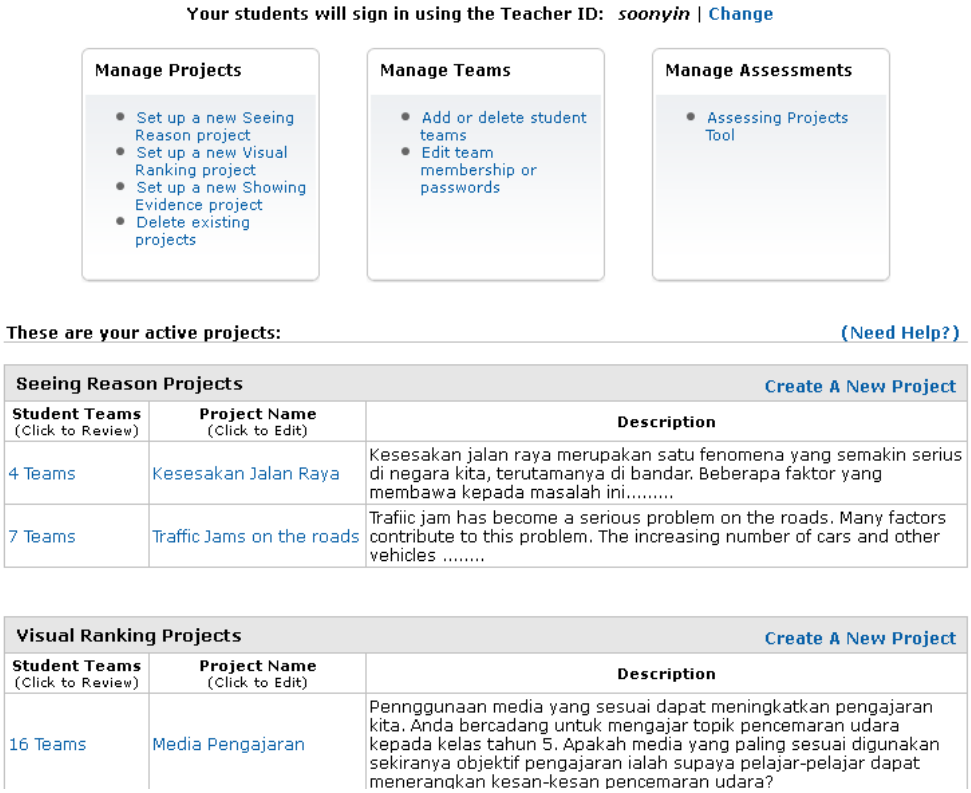

Figure 1: Screen shot of a teacher workspace

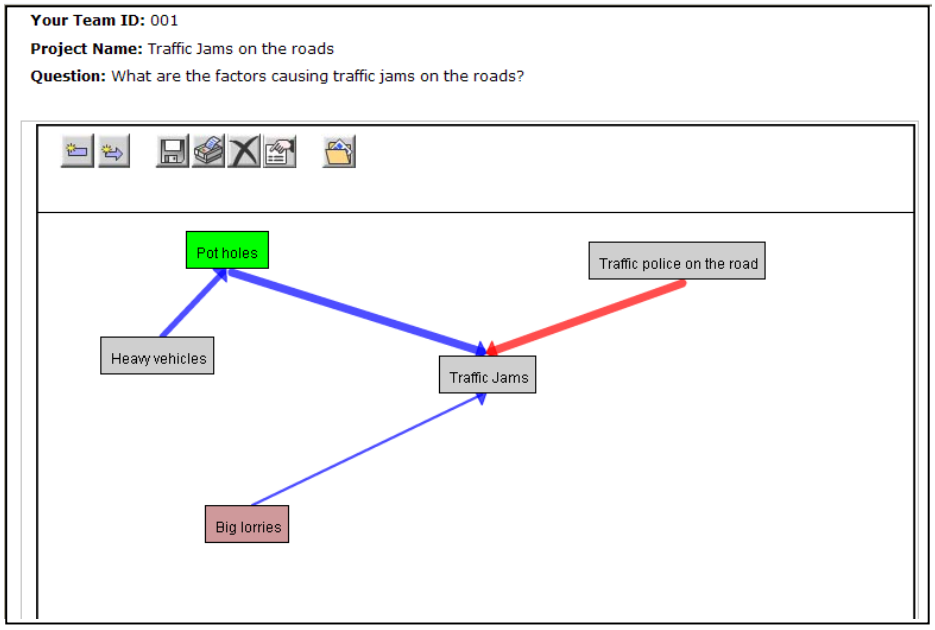

Figure 2: Screen shot of a student's workspace

FINDINGS AND DISCUSSIONS

We shall first highlight some general observations that considerably affected the effectiveness of the project before delving into the detailed discussions.

Collaborative group work proved to be more effective than individual efforts. It is found that students benefitted in many ways from the requirement that they worked in groups. At the beginning, the twenty students were divided into 10 groups to enable them to explore and familiarise with the Thinking Tools. Since this was a novel and new learning experience for nearly all of them, collaboration took place within the groups and students assisted each other and together they managed to learn more on how to use the tools. They were then required to form individual groups of either two or three members. It was observed that the group structure facilitated the learning process and enabled the students to achieve the learning objectives more efficiently. This is consistent with literature, which finds similar outcomes. For example, by performing tests on small groups of students, Gokhale (1995) found that students who participated in collaborative learning had performed significantly better on the critical-thinking test than students who studied individually. Gokhale thus concluded thatCollaborative learning actually enhances critical thinking as it allows students to discuss, clarify and evaluate ideas.

Internet connectivity was an issue of great concern in this project. There were times when Internet connection was not stable and at other times, the connections were too slow. For projects that relied on online connectivity, it is therefore imperative that the institution provides stable and steady Internet connectivity. It would serve well if the teachers concerned made preliminary attempts to ascertain the connectivity and or source for alternative connections.

There are other technology access issues even when connectivity is ensured or available. To use these Intel online teaching tools, every trainee needed to log in using a student ID. Hence every student had to have an account with individual ID. The problem could be overcome by making available to all students a common ID created by the teacher. However, the experience of this project shows that even though attempts were made to use the same ID for all of them, some adventurous students tried to change and use their own ID. This is in itself a sign of creativity and hence should not be discouraged, except thatsome of them later ended up forgetting them!

Many trainees found the thinking process too challenging and would easily give up on it. As the students were not used to thinking critically, there were many instances where some just wanted to change their topics as a way to escape from the difficult thinking process. This is where teachers have to help and guide them so that they are able to think critically. Teachers have to provide lots of guidance to help them think so that they do not give up easily. This project therefore shows that teachers have to play a very important role in the integration of these thinking tools. They have to guide the students' thinking so as to encourage them to think critically – giving hints, clues and guiding questions. As Jamie McKenzie (1998) stated in the article "The Wired Class", "The teacher is on the move, checking over shoulders, asking questions and teaching mini-lessons for individuals and groups who need a particular skill. Support is customized and individualized". Only through these that integration of technology in the classroom will be successful.

Initially, most trainees were seen to have difficulties identifying the most important parts of the information. This was shown by the many chunks of information they tended to gather and put forward for the topic they were doing. Different students would put forward distinctly different information which was respectively regarded as 'important'. While this was a weakness, the flip side of it was that it triggered arguments among them as to the relative importance of different students' propositions. The arguments served the very purpose of this project, which was to enhance the critical thinking ability of the students! As they argued, they had to think hard to come up with reasonings to support their respective propositions. Towards the end of the semester, they showed improvement in their ability to identify important information.

Language seemed to be another major problem faced by them. The web site where the thinking tools are is written in the English language. This posed a problem to the many trainees who were used to Malayas the medium of instruction throughout their schooling life. Again, teachers could help by explaining to the trainees the content of the sites if necessary.

Further discussions of the findings will be done based on the five elements of critical thinking listed in Table 1 above for each of the three thinking tools.

Identifying Important Information

All the three tools encouraged trainees to identify important information. As they were given the opportunities to decide on topics of their liking, and also to surf for information on those topics, problems of over-abundance of information were common. Also, as they had to put forward their choices in a limited space provided in the students' workspace,

identifying the most important information becomevery critical in their projects.

As an example of how this thinking tool works, in a project entitled "Ways to sustain environment" set up using the Seeing Reason Tool, the trainees were asked to put forward the cause and effects of factors in the sustainability of the environment. Here, some of the factors suggested by the trainees were, 'community work, '1 person 1 tree' program, 'trash throwing'.

To begin using this tool, the trainees did some reading by surfing the Internet based on the topic "Uniqueness of Our Environment". Besides, they also brainstormed on the factors related to the topic "Uniqueness of Our Environment". They then jotted down the main points related to the topic. As there were abundance of resources on this topic in the Internet, the trainees need to identify the most relevant and important factors which they wish to include in the map. These important factors were then organized using the Seeing Reason Tool in their workspace.

In the process of identifying the factors, much thinking had to take place. To decide on only the best factors, they have to differentiate between the most important from the least important factors. Next, they have to think of the type of relationship between factors. It was observed during the project that the trainees had problems prioritising, the information and they had arguments among themselves as they could not agree on what important factors to be included as their answers.

Similarly in the Showing Evidence Tool, trainees were told to include relevant information only as evidences, they had to identify which were the more important ones. In the process of identification, the trainees had to analyse the source as well as relevance of the information. They had to use their own judgement, based on their prior and existing knowledge to decide on the importance of a piece of information. Trainees were seen to argue with their partners on the importance of information. To do all these, they need to communicate to their partners.

To determine the importance of any piece of information, the trainees had to analyse the sources as well as relevance of the information. They had to use their own judgement, based on their prior and existing knowledge to decide on the importance of a piece of information. Trainees were seen to argue with their partners on this. Towards the end of the semester, the trainees were seen to have improved in their skills in identifying the most important information.

From the observations of the students' engagement during the session, it is found that students began to appreciate the importance of : (a) Organising their thoughts to come up with a list of information (b) Evaluating and attaching priority/importance to the information they have collected (c) Defending their choice and explaining to other group members on their priorities (d) Thinking critically whenever a piece of information is given

Evaluating Sources

In the project, students were required to look for evidences for a claim that have been put forward. One of the criteria for the choice of evidences is the reliability of their sources. In this case, the trainees have to evaluate the sources of the evidences. This element was seen regularly in the Showing Evidence thinking tool. They were seen to compare reliability of sources among newspapers, anonymous articles in the Internet, articles by knowledgable authors, gossips and so on. This element was seen in this Showing Evidence Tool because they need to rate the evidences before they could carry on with the projects. In the other two tools, the trainees did not do any evaluation of sources. In conversations with the students while they were involved in this stage of the project, the students reported that they now began to realise that not all sources were equally credible and reliable. In the process of comparing and discussing with their group members over the sources of information, they came to realise that they had to be critical and selective. This observation confirms that the students had made some progress in achieving the aims of this project, which was to enhance their critical thinking capability.

From the observations of the students' engagement during the session, it is found that students gradually learnt the importance of: (a) Identifying the source of information (b) Setting criteria to differentiate sources which are reliable from those that are not (c) Prioritizing information according to reliability of sources (d) Having evidences for any claims they make.

Making Inferences

In Figure 3, students were required to look for evidences for a claim that have been put forward. Evidences which they have put forward need to be varified. As not all information they obtained from the Internet are relevent to the claims, they need to first discuss with their partners concerning the relevance of each evidence.

Table 1: Elements of Critical Thinking

No.	Elements of critical thinking
1	Identifying Important Information
2	Evaluating Sources
3	Making Inferences
4	Learning Independently
5	Communication

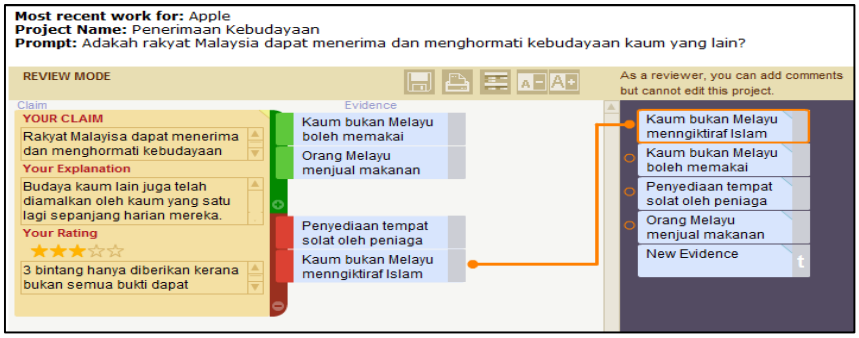

Figure 3: Screen shots of Showing Evidence Tool

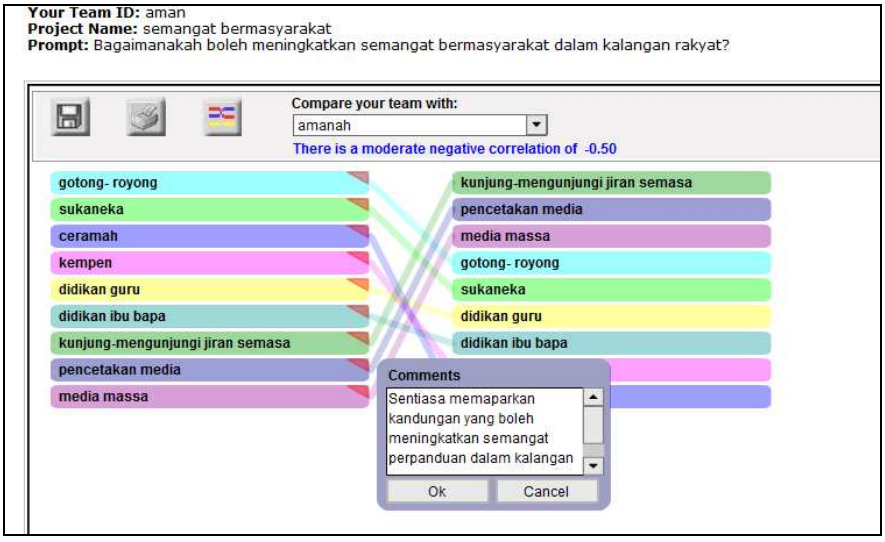

Figure 4: Screen shots of Visual Ranking Tool

They did this by weighing the reliability of the source. This is more so if they use the standard version of the tool. As they were told to include relevant information only as evidences, they had to identify which were the more reliable ones. In the process of identification, the trainees had to analyse the source as well as relevance of the information. They had to use their own judgement, based on their prior and existing knowledge to decide on the relevance of a piece of information. Trainees were seen to argue with their partners on the relevance of information. For example in Figure 3, there was a claim that Malaysians are able to accept and respect cultures of different races. They looked up many evidences which they thought could support the claims. However, since they were so much evidences on this issue, they needed to identify the most relevant ones. Some of the evidences included, "Non Malays are seen to wear their own traditional dresses", "Each race can sell its own traditional food openly". Before they could accept or reject these evidences, the trainees needed to analyse the sources of the information and used their own judgement to infer and then to decide on the relevancy of the information.

In using this tool, the students do not only support their claims, they can also refute the claim with appropriate evidences.

This tool allows opportunities for trainees to consider the quality of their evidence in terms of the sources as well as their relevancy. Besides, they also decided on the strength of the evidence to support their claims. They also linked evidences to their claims and provided their reasonings as to why a particular evidence supports their claims. By doing so, they need to evaluate the sources, communicate their views to their partners. More importantly, they made inferences and drew conclusions about all the evidences they had gathered.

Through the observations of the students' engagement during the session, it is found that students learnt to: (a) Verify evidences they found (b) make inferences based on their own judgements and prior knowledge

Learning Independently

Learning independently here means that the trainees are able to organize themselves to try to learn more ideas and concepts on their own, without much guidance from their teachers. In the process of looking for new information, arguing, analyzing, making inferences, the trainees are learning all the time. For example, Figure 3 above, as they looked for evidence on the claim that Malaysians are able to accept and respect cultures of different races, they learnt about the real meaning of 'respect', 'culture' and so on. At the beginning of the course, the trainees depended more on the teachers on what and where to look for information. However, as time passed by, they were seen to get less help from the teachers.

From the observations throughout the course, it is found that students began to (a) Realize that even to look for resources, they have to think (b) Realize that to get accurate information on the topics they are learning, they need to analyse the topics carefully.

Communication

As the trainees had to work in group, communication skills were widely demonstrated in this study. They were seen trying hard to express their views, choices and preferences to partners of their groups. They need to explain clearly their opinions to their partners and giving good reasons for it.

In using the Visual Ranking Tool, the trainees rank a list of items given to them (Figure 4). Before they could rank, they need to discuss with their partners each of the items. As explanations are required for each of their choice for ranking, the trainees were seen discussing among their group members. They tried to put forward their choices to their friends. The screen shot below shows a sample of project using the Visual Ranking Tool.

In the process of using this Visual Ranking Tool, the trainees were seen to be communicating all the time. They collaborated and negotiated their reasoning with their partners. This process really made them think hard as to how to put their ideas across to their peers.

According to Gokhale (1995), "Proponents of collaborative learning claim that the active exchange of ideas within small groups not only increases interest among participants but also promote critical thinking". The shared learning gives students an opportunity to engage in discussion, take responsibility for their own learning, and thus become critical thinkers (Totten, Sills, Digby, & Russ, 1991).

In the process, they need to analyse and to identify the most suitable explanation to be given for each item. The most interesting part was when each team compared their answers with that of another team. Here they were required to discuss the differences and similarities of their rankings. They were seen debating with the other team, each trying to defend their answers. This tool also displays how closely the lists match and shows the correlation between two rankings. Much analysis and judging of information were done at this juncture. Other teams also contributed their opinions.

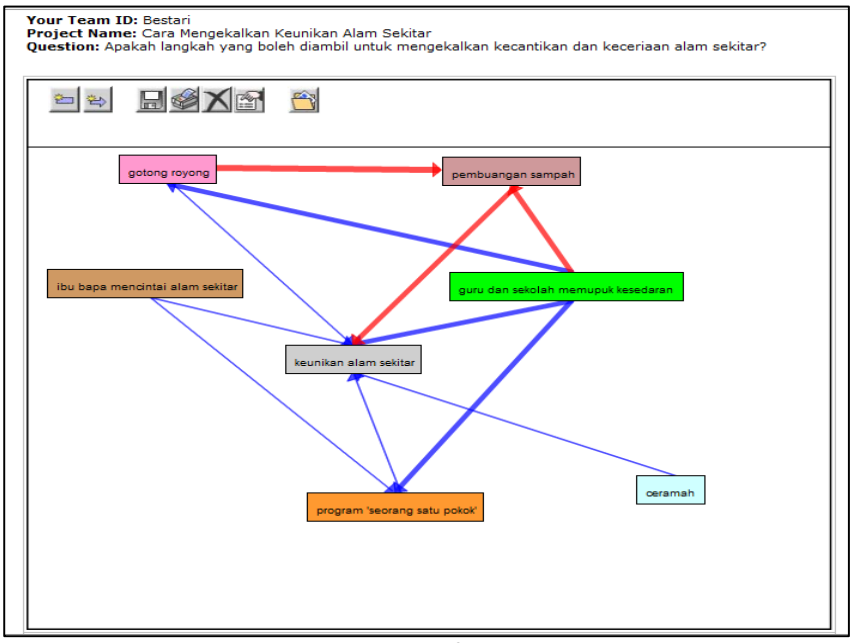

Figure 5: Screen shots of Seeing Reason Tool

Table 2: Mean Score of Elements of Critical Thinking

No	Elements of Critical Thinking	Mean Score
1	Identifying Important Information	3.0
2	Evaluating Sources	2.4
3	Making Inferences	2.3
4	Learning Independently	2.8
5	Communicating	3.1

In Figure 5, in a project set up by the trainees on the topic “Communal Spirit”, they were asked to rank ways to increase communal spirit. Items given were: community work, telematch, talks, parental guidance, teacher guidance, visits to the neighbourhood and mass media.

In the Seeing Reason Tool too, trainees need to discuss their choice of relationship between factors they had identified earlier. They also express their decisions on the type of relationship between factors.

In this tool, different thickness and colors of the arrows indicate the types of relationship among the factors (refer Figure 5) A thick blue arrow shows a positive relationship between two factors while a thin blue arrow shows a weak positive relationship. On the other hand, a thick red arrow shows a strong negative relationship whereas a thin red arrow indicates a weak negative relationship. A black arrow may be used to show a neutral relationship. The above screen shot shows that there is a positive but

weak relationship between “community work” and ‘‘sustainability of environment’. On the other hand, there is a negative relationship between ‘trash throwing’ and sustainability of the environment. At the end of the project, a causal map was produced.

The next challenge that they need to do was to identify the types of relationship between and among the factors in the map. In other words, they need to show how these factors interact with each other in cause-and-effect relationships. Some of the factors in the example given here are: community work, one pupil one tree programme. Much discussions were observed as trainees debated about the relationship between factors. They were also seen to discuss and argue about the strength of the relationship. In using this tool, the students were seen to communicate a lot among the group members.

In short, this tool allows trainees to create "causal maps." It enables them to discuss among each other the factors, organize them according to how they influence or affect a problem. The tool supports cycles of investigation where students gather what they know, organize that knowledge into a map, and then investigate the relationship which exist among the factors. In the above diagram, different types of relationship are shown by means of the different colors of the arrows. For example, the blue arrows in the above diagram show that there exist a positive relationship between two factors. The strengths of the relationship are shown by the thickness of the arrows. The red arrows in the diagram show negative relationship between factors. As with the positively related arrows, the thickness of the red arrows also indicate the strength of the relationship. Any neutral relationship between factors, if there is any, is shown by black colored arrows.

From the observations of the students’ engagement, it is found that students began to realize the importance of (a) Explaining their opinions clearly to their peers (b) Defending their points by giving relevant explanations (c) Clear communication among peers as that was the only way to make the others accept their points (d) Arguments which were accompanied by facts (e) Critical thinking in any argument or explanation

From the three thinking tools introduced, the Showing Evidence Tool appears to be the tool which involved the most thinking among students. They have to first identify the relevant evidence, then validate them. Then they have to access the sources of information.

Which critical thinking traits were shown most among the students while using these online tools?

While the thinking tools were intended to enhance critical thinking among the trainees, not all of the thinking traits were equally enhanced in this project.

Table 2 shows a summary of the mean score obtained for each element of the Critical Thinking Rubric.

Of the five traits, namely, (a) Identifying important information, (b) Evaluating sources, (c) Making inferences, (d) Learning independently, and, (e) Communicating, two of the traits achieved band 3 of the rubric. The two traits are (a) Identifying Important Information, and, (b) Communication, with the achievement of 3.0 and 3.1 respectively. The other three traits achieved band 2. While the trait “Learning Independently” achieved a mean score of close to 3.0, the other two are below mean score of 2.5. The mean score for “Making Inferences” at 2.3 is the lowest among the five traits. To be able to make inferences means that the trainees need to look for information that is implied or inferred. In other words, the information is not clearly stated. Language could be a problem here since most of the trainees may have problems to fully comprehend the implied meaning in many of the information obtained in the Internet which are in the English Language. Besides, this is a skill which needs time to be nurtured.

“Evaluating Sources” is also low in the list with a mean score of 2.4. This may not be related to their skills in evaluating sources, but it could be due to their attitude towards the need to evaluate sources of information. Could cultural traits be a factor here? According to Lun (2010), it is also common for the Asian parents to assume that textbooks, teachers, and other elders are authoritative sources of knowledge which should be obeyed by children. They might actively prevent their children from questioning and critiquing these seemingly authoritative sources of information.

Trainees were also asked to write reflections on the three online tools. Most of them felt that the thinking tools have helped them to think critically in one way or another.

Some of their reflections are shown below:

> The showing evidence tool enhances our thinking skills. We have to look for much information and to give evidence for our claim. We also have to give and exchange our opinion.

> The Showing Evidence Tool is an extremely useful tool to get our students to apply HOT skill to substantiate/support/defend their points of views. What makes it extremely useful is that it allows us to visually 'see' and evaluate one another's work!

> We find the Seeing Reason Tool most challenging and involves higher order thinking. This is because in the process of completing the project, we have to gather information from many sources, make references and also to analyses them. In this way, we learn more on the topic. Also, we have to look for strong evidences to make sure all facts are related to each other.

> The Showing Evidence tool involves the highest level of thinking. This is because we have to think of relevant evidences.

From the reflections written by the trainees, generally they agree that the thinking tools have helped them to think deeply about the topics they were doing. They also express the ability of the tools in enhancing higher level of thinking, including critical thinking.

CONCLUSION

As demonstrated in the observations and discussions above, the online tools did promote considerable critical thinking among the trainees. It can also be concluded that the teacher plays a most critical role in the whole exercise. As trainees were relatively new in such an activitiy, the teacher had to first direct the trainees to some possible sources where they could obtain information on the topics of their choice. Initial guidance is important for the successful integration of the thinking tools to obtain the required outcome. The thinking tools could be utilized to supplement traditional classroom activities and promote critical thinking among the trainees. With the primary goal of promoting students' critical thinking, the focus should not be on the tools themselves; rather the emphasis must be on the careful selection of appropriate projects and online tools to meet course content and process goals. Through this creative use of online tools prepared by Intel, academic instructors are able to enhance participation of trainees in higher level thinking, by providing alternatives for students to engage in academic expression, argument, analysing, and organizing of ideas. These tools provide opportunities for trainees to go beyond the mere acceptance of information and facts, to delve deeper into the intricacies, details, exceptions and circumstances of the learning experience that are at the core of critical thinking. The effective integration of online technology is more than a delivery medium; it is an innovative way of learning, which when done successfully, may change the way our students learn. It may also improve the qualities of our students to those of critical thinkers.

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