

**PROBLEM SOLVING IN THERMODYNAMICS:
ANIMATION IN ANIMATED MIND MAPPING**

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Abstract

As innovation in teaching thermodynamics, this paper is mainly about the development of animations which are presented in an animated mind-mapping that can be used as a tool in thermodynamics problem solving. Flash8 software is used to design 19 animations related to the topic: The kinetic theory of gases. All those animations are then compiled in a sheet of prez.com presentation software as an animated mind-mapping. Result of the complete mind-mapping can be visualized in Google website if the keywords were entered. It is available as a problem solving tool and also for the tutorial, teaching or e-learning purposes. Although the design focused on the thermodynamics topic, it is also applicable to be performed in any other subject area.

Keywords : prez animation model 2, thermodynamics, problem solving

1. Introduction

Animation is a multimedia element that refers to a dynamic visual display. It also refers to a process of making an object that looks alive or gives movement to something which is essentially static. Since these multimedia elements are capable of expressing a human fantasy into the realm of reality, it allows something quite difficult to explain using words or static images delivered more easily and effectively. It is also a teaching aid that can be categorized as a modern tool to attract students to understand the topics that had been taught more easily and quickly. Visual impact in animation enhances presentation effect which is helpful in achieving learning objective (Boyle, T,

1997). Animation also cheers the presentation of the teaching process. It also allows the emphasis of attention is given to the content that we want to.

The rationale for a theory of multi-media learning is that people learn more deeply from words and pictures than from words alone (Mayer 2001). Further, Mayer's (2001) modality principle states that students learn better from animation and narration than from animation and on-screen text. An evaluation found that students who used ANIMATE improved significantly more on a post-test than did students who did not (Nathan et al., 1992). However, not all student performed by animate (Nathan & Resnick, 1994). Therefore, Nathan and Resnick (1994) suggested that extra guidance can be introduced whenever required to support the intended student-centered interactions.

Reported by Dayal.D (2007), in Australia, TsingHua University in Australia, students who have a good result in physics class do not masters modern physics subject. They lose interest when study as the content of the subject is very abstract, boring and hard to understand. In this case, to overcome this problem, new modern teaching strategies such as problem base learning, case study and concept mapping need to be implemented in order to upgrade students' understanding. Additionally, stated that problem base learning and concept mapping are excellent modern teaching approaches that help develop these skills and are widely use in western universities (Dayal.D, 2007). From constructivist learning theory claim when learners could choose the right information which could present it in well manage and also could integrate it with other knowledge, this will bring them to the meaningful learning (Mayer, 1996; Mayer, 1999a; Wittrock, 1990). Shapiro and Neiderhauser (2004) found that hypertext in computer base instruction is an effective method of enhancing students' ability to integrate concept, do problem solving and build multiple mental representation and understanding.

As thermodynamics is an essential subject in high school, colleges and university, the objective of this paper is to focus on the development of the tool in problem solving of thermodynamics topics; The kinetic theory of gases. The development process involved 2 major phases which included:

- 1) Design of animations using flash8 software and export as a movie in .swf file format.
- 2) Import all animations into prezi.com software and organize them as an animated mind-mapping presentation.

Result of the complete animated mind-mapping is available in the Google website. Keywords set to be entered in the Google website are "prezi animation model 2".

2. Material and Method

2.1 Preliminary Stage

Preliminary stage focused on the content structuring in the animations design. The Kinetic theory of gases topic is chosen and divided into 8 subtopics which are:

- 1) Avogadro number
- 2) Ideal gases
- 3) Deviation of pressure and rms speed

- 4) Mean free path
- 5) The molar specific heat
- 6) The distribution of molecular speed
- 7) Degree of freedom
- 8) The adiabatic expansion

Within these 8 subtopics, 19 animations are developed. Table 2.1 shows the classification of the subtopics with the number of animation created.

Table 2.1 The Kinetic Theory of Gases subtopics with the number of animation created.

Subtopics	Number of animations
Avogadro number	1
Ideal gases	6
Deviation of pressure and rms speed	2
Mean free path	2
The molar specific heat	3
The distribution of molecular speed	1
Degree of freedom	3
The adiabatic expansion	1

Based on table 2.1, the number of animations created is corresponding to the needed of the understanding to the subtopics.

2.2 Phase 1

Flash8 is software which designed to create colourful dynamism animation. Flash8 imply for animations and interactive animations. Phase 1 is about development of animation using the flash8 software. To start the work page, user need to choose create new “Flash document” at FrontPage as shown in the figure 2.2 below.

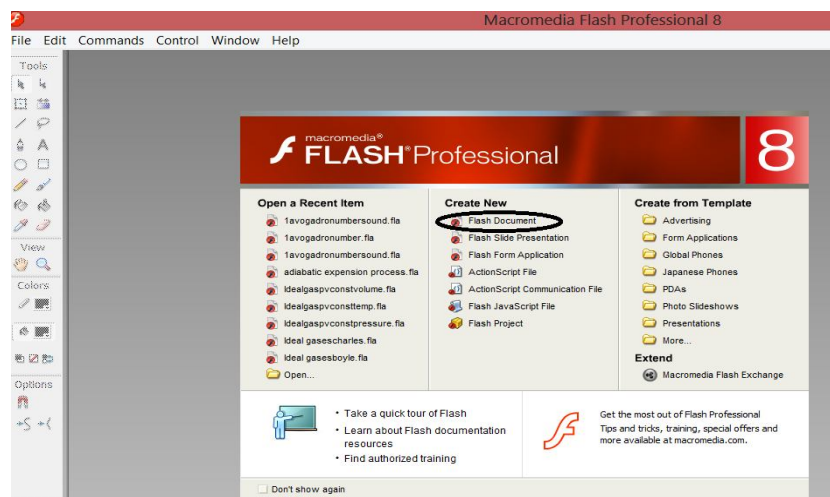


Figure 2.2: Flash8 Software FrontPage

In order to develop the animation there are a few of basic important flash8 environments that user need to know such as menu bar, layer, tool bar, timeline, panel and stage which are labelled in red text in the work page of flash8 as shown in figure 2.3.

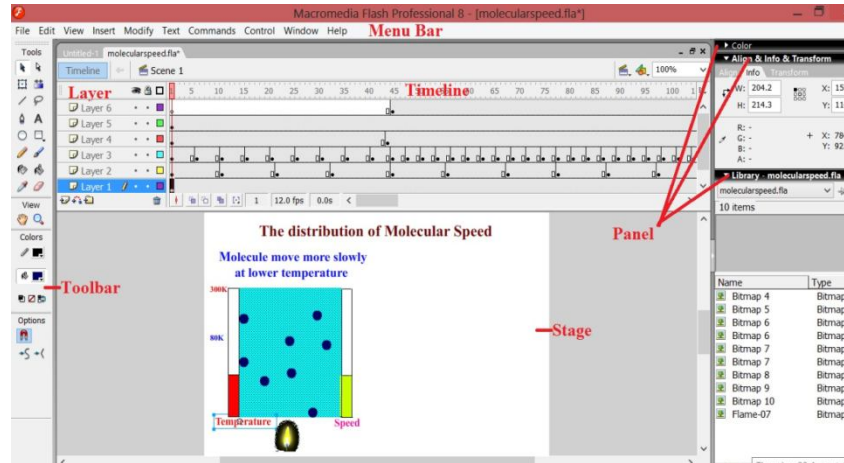


Figure 2.3: Work Page of Flash8

When first start, user need to select insert at menu bar to insert layer as shown in figure 2.4. Layer is function to manage flash8 efficiently. Many layers will give good ordered animation and easy use. User is advised to use different layer for different objects such as image, picture, text or graph to avoid the mix-up frame fact because if they are in one layer, they have to share the same frame. In this case, refer figure 2.4, layer 1 is assigned for the box, layer 2 for movement of the fire, layer 3 for the movement of the atoms, layer 4 is for level of temperature and speed movement, layer 5 for text and layer 6 for the change of the graph.

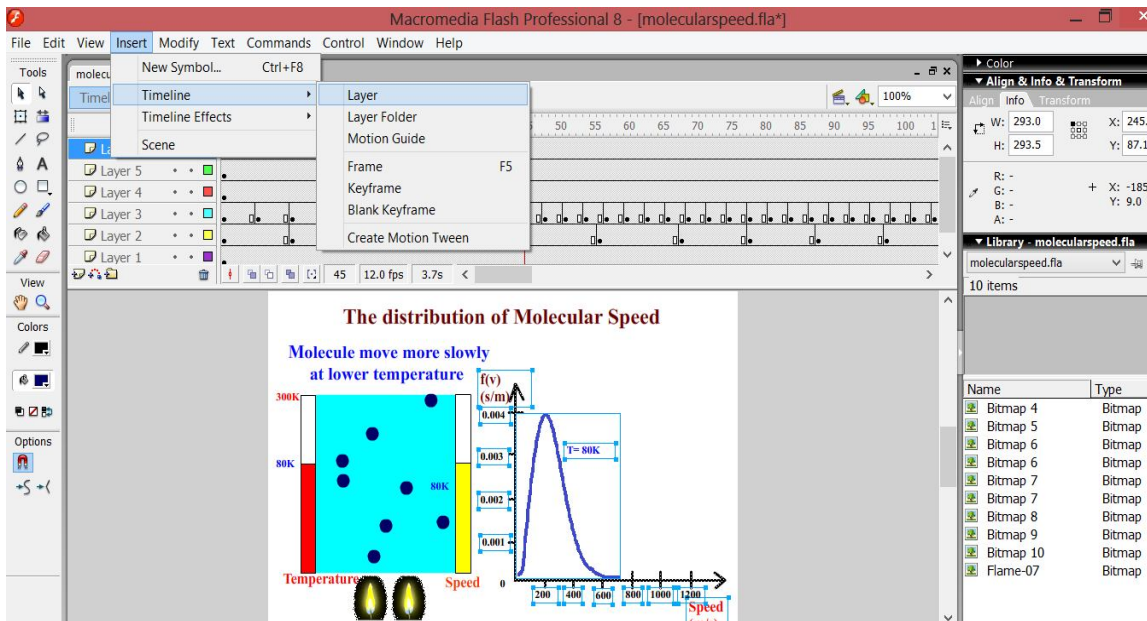


Figure 2.4: To Insert Layer

The next step is to insert frame and keyframe in the planned timeline for a movement of an object. User has to right click at the frame on the assigned layer as in figure 2.5 or the function is also applicable at the submenu insert at the menu bar.

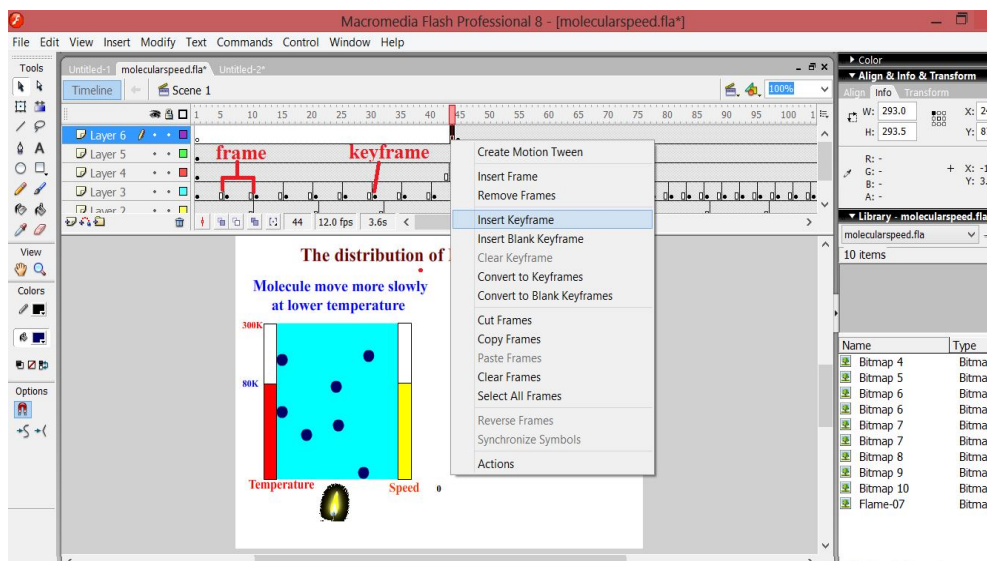


Figure 2.5: To Insert Frame and Keyframe

Next, draw or insert the object in the stage. Initial object is inserted in the created frame at certain timeline and position of the object is changed in the next keyframe and at the next timeline to generate animate movement. As seen in figure 2.6 below, layer 6 at timeline 45, figure shows the graph of the distribution of the molecular speed at low temperature. While at layer 6 timeline 129 as in figure 2.7 shows the distribution of the molecular speed at low and high temperature. At the correspond timeline in Figure 2.6 and 2.7 there are also different at fire, movement of atoms and level of temperature and speed which defined in the other layer. This process is repeated to generate more movement in all animations.

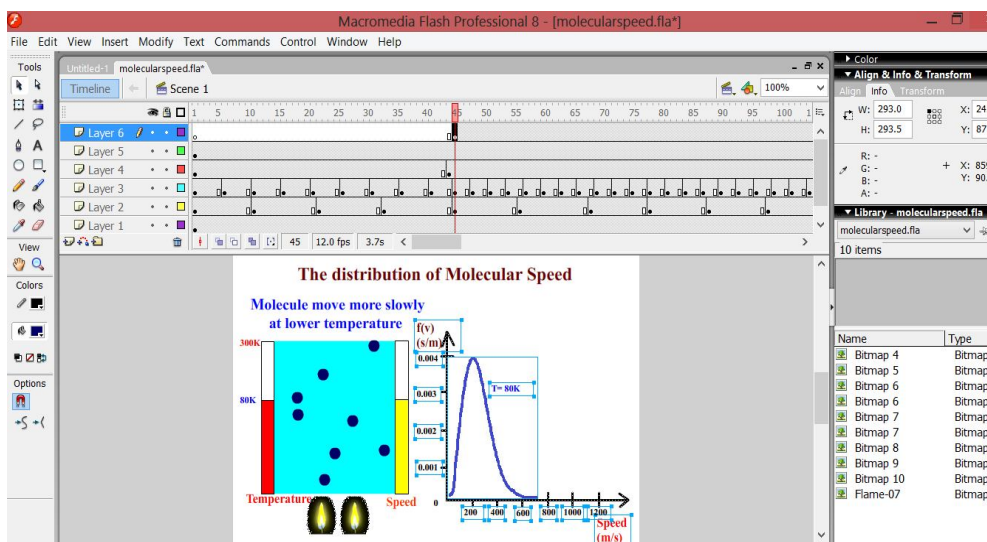


Figure 2.6: Layer 6 at Timeline 45

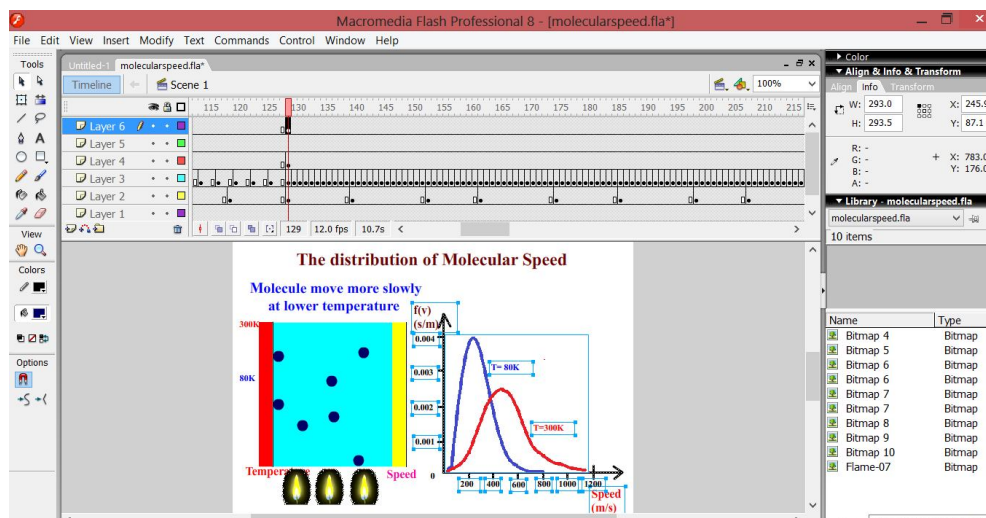


Figure 2.7: Layer 6 at Timeline 129

Finally, when complete the design of all frames, “.fla” file is exported to “.swf” file as shown in figure 2.8. This step is important as continuously in phase 2, prezi.com software only can recognize animation in .swf file format.

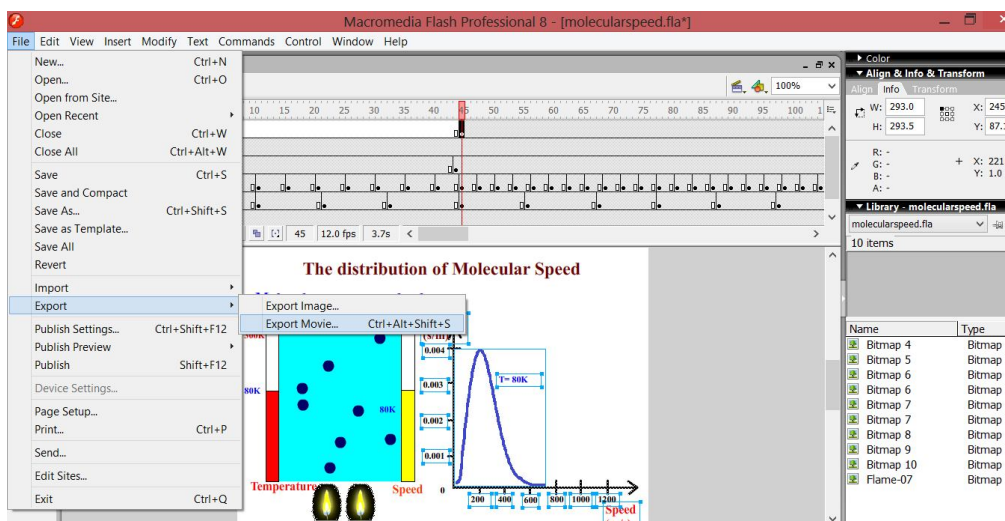


Figure 2.8: Export Movie

2.3 Phase 2

Prezi is a presentation software which appear as avirtual whiteboard that allows people to see, understand and remember ideas. The zoomable characteristics of prezi let people enjoy when exploring ideas in the slides. The new approach in Prezi is the two way presentation as people could actively interact with audience (S. Cameron, 2013). In Phase 2, the mind-mapping presentation slide will be developed in prezi software. First to enter the software, google the prezi.com and click log-in in the prezi-Ideas matter web page as shown in figure 2.9. If user first time log-in, registration must be done to create new account. User can follow the step guided in the web page.

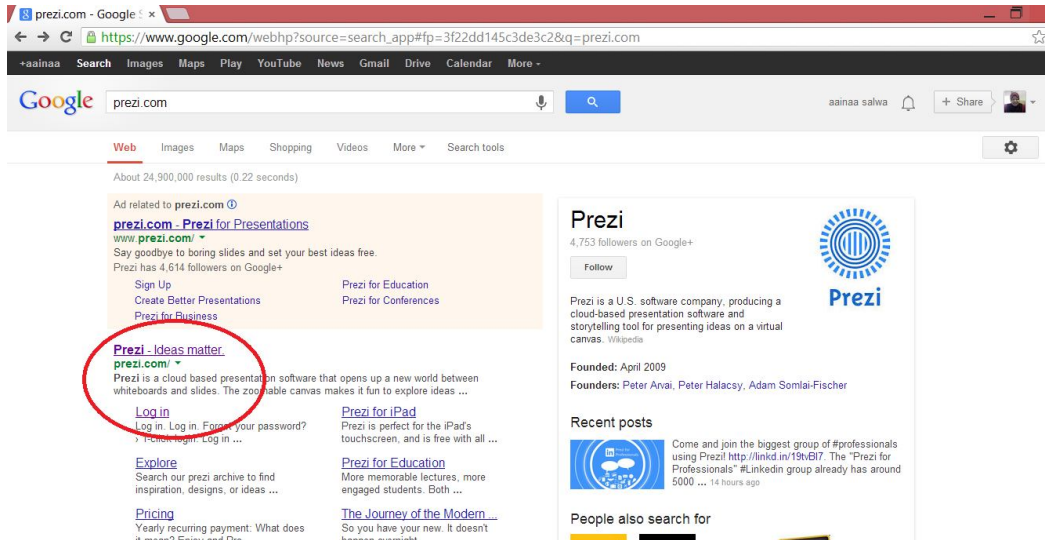


Figure 2.9: Prezi.com Software

After log-in in the created account “aainaasalwamohdnajib”, the page will appear as in figure 2.10. To create a slide presentation, click new prezi and the page will ask user to choose a theme for the slide. The theme can be chosen as in figure 2.11. The created slide, can be updated or changed anytime when enter the web page by clicking edit at the presentation slide.

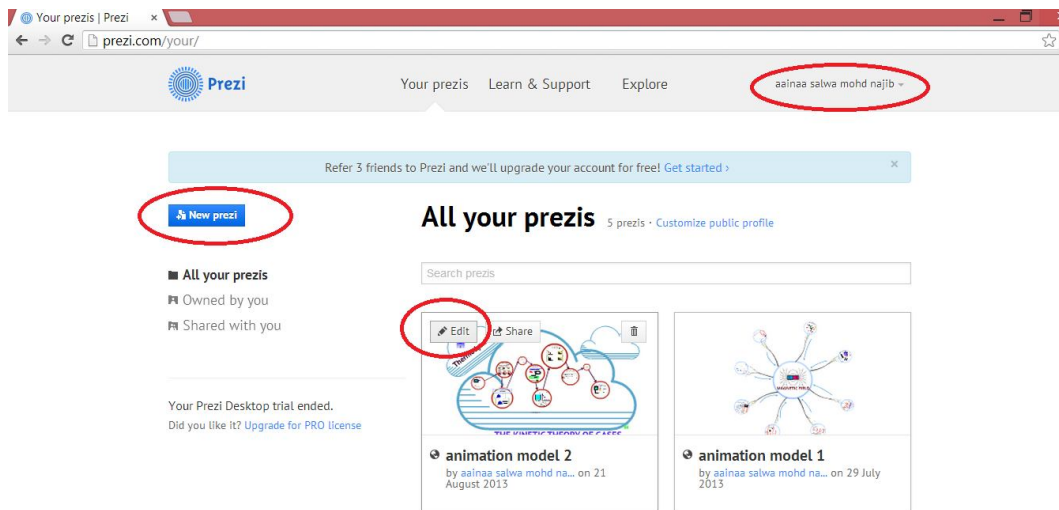


Figure 2.10: Prezi Presentation Slide

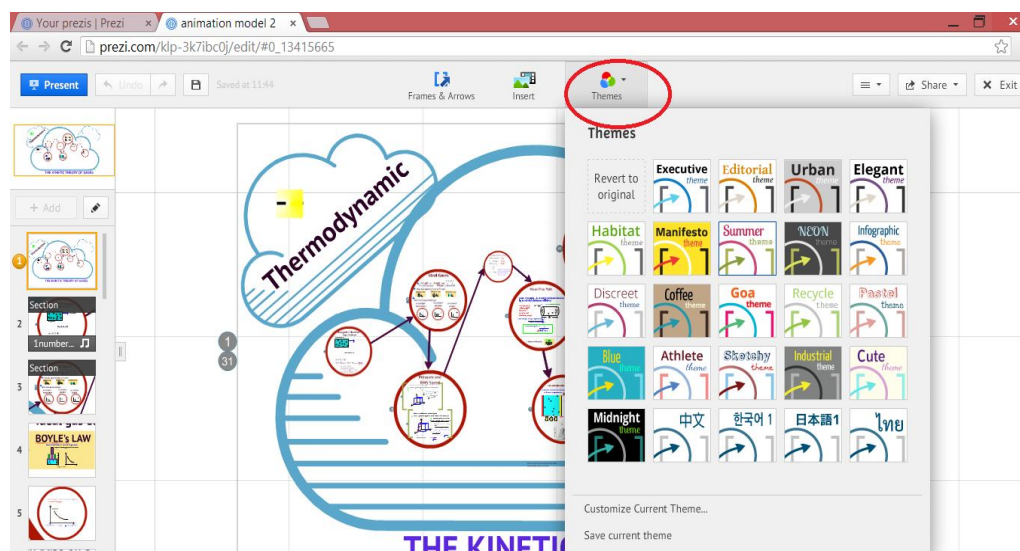


Figure 2.11: Theme Selection

Next, the most important part in phase 2 is to import the .swf file into the slide. As shown in figure 2.12, to insert the .swf file, user must click insert and insert from (PDF, video...), then browse the file from personal computer where it's located.

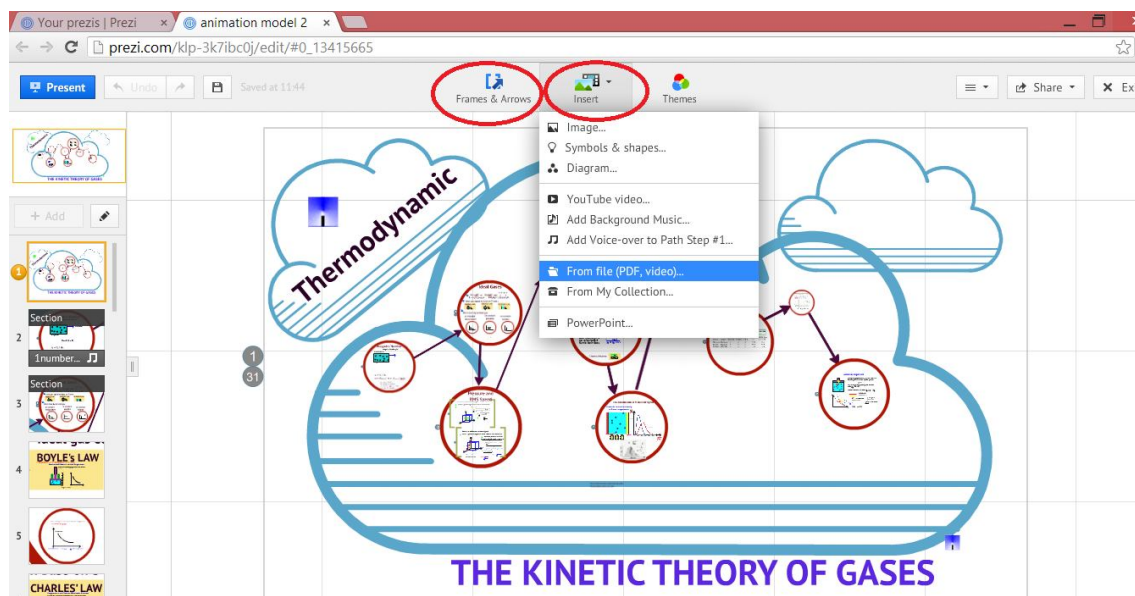


Figure 2.12: To Insert .swf file in Prezi.com

3. Result

The animated mind-mapping presentation slide can be viewed by entering the keywords in the google as in figure 3.1. Slide will appear as shown in figure 3.2. User can view the slide and repeat as per required.

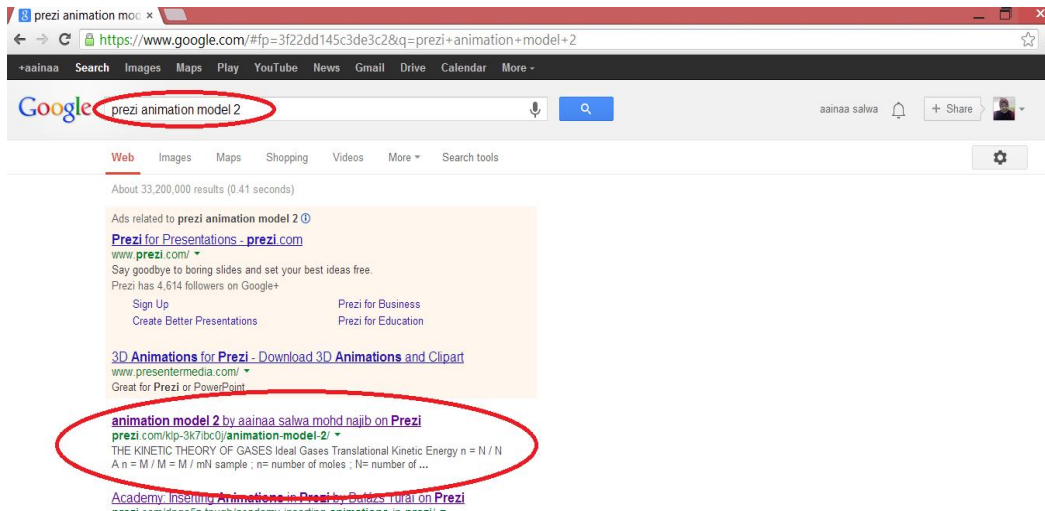


Figure 3.1: Access Prezi Slide

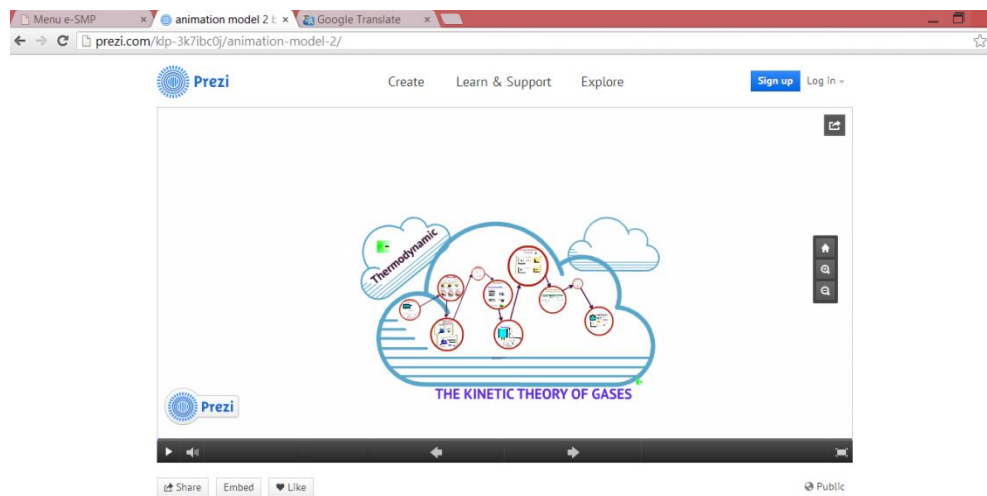


Figure 3.2: Prezi Mind-Mapping Presentation

While, if using creator's account, online presentation can be done as shown in figure 3.3. To start online presentation, link must be sent via email to invite audience. Only 30 audience maximum can follow the presentation.

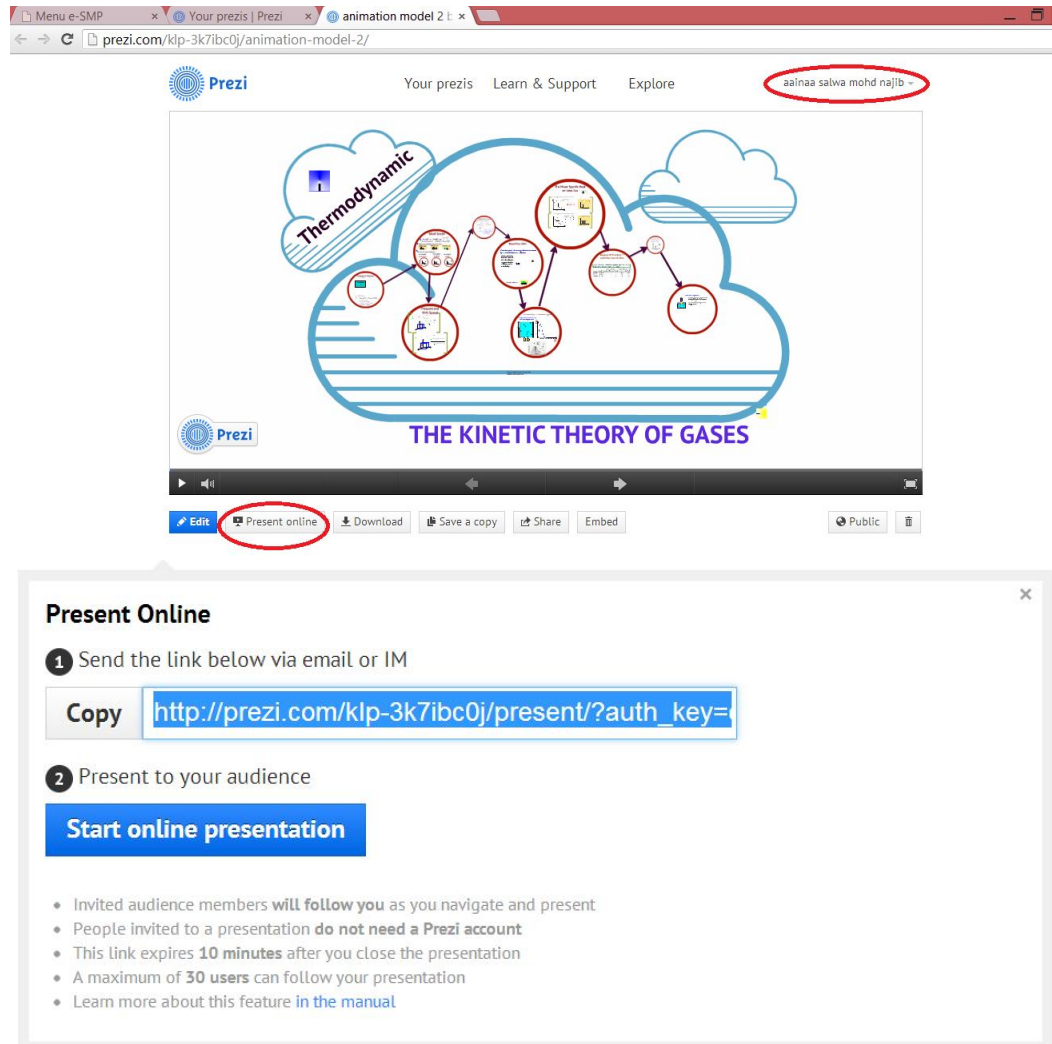


Figure 3.3: Online PreziMind-Mapping Presentation

4. Discussion and Recommendation

Animated prezi presentation slide is easy and friendly use as user can directly access the slide by just google and enter the keywords. To view the slide for problem solving purpose, users no need to own account of prezi.com software. Furthermore, for the creator, online presentation can be performed by sending the provided linkage via email to up to 30 audiences in one time. In this case, the slide also can be multiply use as teaching and tutorial material and even for e-learning purposes. According to the interactive principle (Clark and Mayer, 2003), deeper learning happen when learners are allowed to control the presentation rate than they are not. However, a problem occur that control buttons to start, stop or pause defined in the flash8 software function well are not so

when the animations .swf file imported to prezi.com software. It also happened to the sound imported from .swf file. Thus, the sounds need to be put directly in the prezi.com software and there is no control buttons allocate in the completed prezi presentation slide. Limitedly, for the free package of prezi software, only 100Mbyte of memory are located. User need to pay some amounts which are announced in the website if user wants unlimited memory by download the prezi desktop software.

Suggested more mind-mapping slide and scientific animations will be generated in future. Although the design focused on the thermodynamics topic: the kinetic theory of gases, it is also applicable to be performed in any other subject area.

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