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# ASSESSING THE IMPACT OF PRESENTATION MINING ON UNDERSTANDING AMONG VISUAL LEARNERS

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## Abstract

PowerPoint is popular amongst learners since it helps with content organization and note-taking. This does not imply that learning has been effective for all learners, as not everyone can learn by listening and reading simplified content provided on PowerPoint slides. While it may be effective to the aural/auditory learners from the Visual, Auditory and Kinesthetic sensory (VAK) model, it is less effective for visual learners. This paper assesses the impact of presentation mining, which is a tool that extracts keywords and key phrases from a collection of PowerPoint slides and generates a mind map based on the extracted keywords and key phrases. The target group is visual learners, as visualizing the content of presentation slides in the form of mind maps is hypothesized to improve the learning quality, thus making the materials easier to understand and to memorize. To achieve the objective, a quantitative study was conducted by distributing questionnaires to 80 randomly selected students at Asia Pacific University of Technology and Innovation (APU), in Kuala Lumpur, Malaysia. The results of the research indicated a significant increase of students understanding of the learning materials provided using the proposed tool, although some further work is required to improve the aesthetics of the mind map.

Keywords: Learning styles, Microsoft PowerPoint, Presentation mining, Visual auditory kinetic, Visual auditory reading/writing kinetic.

## 1. Introduction

Fleming and Mills [1] classified learning styles into three modalities, Visual, Auditory, and Kinesthetic sensory (VAK). Fleming [2] has expanded (VAK) model by adding writing to become the Visual, Auditory, Writing and Kinesthetic sensory (VARK) model that attempts to account for differences in the way individuals learn. The VARK model divides the visual modality into visual-graphic oriented and reads/write (or text-oriented) learning style to distinguish between different forms of visual information, suggesting that visual learners act better to information presented in charts, diagrams or maps forms rather than to information presented in word format. Visual learners are at a disadvantage when information is disseminated via PowerPoint slides which are better suited to read/write learners who are given the predisposition for text amongst most presenters. The traditional classroom paradigm, although gradually giving way to learner-centric approaches, is still prevalent and is not suited to the learning styles of most learners within higher education today.

Turkington and Harris [3] stated that nearly 66.67% of Generation Y and Millennials are visual learners, accustomed to the use of emojis, abbreviated text, and notation. Prensky [4] popularized the term 'digital native' to refer to individuals born during and after the emergence of digital technologies, for whom the traditional method of disseminating information via structured and sequential presentation slides is incompatible with their method of learning. As such, digital natives are more lucid in the way gather knowledge and information, in which Cornu [5] describes as a 'hypertext' approach.

Further research into learning styles across disciplines establishes a predominance towards visual learners, with such learners constituting 82.4% within the engineering domain [6], 56.5% across the medical sciences [7], and 48.4% in occupational therapy [8]. For visual learners, visualization improves learning efficiency and memory capacity, as well as the learning time itself. Whilst visual learners are capable of absorbing information relatively quickly, their auditory learning capabilities are weak thus making it difficult to learn via oral lectures and reading. Nonetheless, visual learners can multi-task more effectively and can perform a number of tasks such as texting, browsing, when learning. Due to a preference for visual imagery, such learners face obstacles in classrooms where PowerPoint slides are relied upon. To be effective, slides must incorporate more interactive features as opposed to simple bullet points. Figure 1 outlines the basic learning styles from the original VAK learning model.

Microsoft PowerPoint has become the primary teaching and learning aid within most classrooms, providing summarized content delivered via a set of slides which include text, pictures, charts, and diagrams. However, PowerPoint is effective in content delivery in a concise and succinct manner, Weimer [9] suggests that a major drawback of this method relates to content simply being copied by learners. Slides are not used as a basis for further exploration and development of understanding, rather slide content is simply memorized by learners. Xingeng and Jianxiang [10] conduct a study to analyze and evaluate the effectiveness of PowerPoint slides in a classroom setting. Their findings revealed that nearly 30% of the sample struggled to focus during class due to insufficient material. A further 25% respondent stated that such presentations tended to be dull and uninteresting whilst a further 20% felt it be monotonous, often missing key points due to the uniform nature of the content.

Up to 25% of those involved indicated that they were overwhelmed with the information contained on each slide whilst a small number 8% stated that they struggled to follow the overall structure and sequence of the presentation. These findings mirror the research conducted by Cesena and Vernizzi [11], in which visual learners struggle to process the oral explanation that accompanies slides. Visual learners, therefore, struggled to conceptualize the information beyond the slides and are not able to contextually apply the learning material.

To enhance the visual learners' learning when using PowerPoint slides Kasinathan et al. [12] have developed a presentation mining system that extracts keywords and key phrases from a collection of PowerPoint slides and generates a mind map based on the extracted keywords and key phrases. The automated approach of generating a mind map from an ordinary set of PowerPoint slides could potentially improve the learning experience amongst visual learners. This due to the visualization of simplified bulleted text, showing the connections or relationships between extracted keywords or key phrases. Aside from the visualization of the links in the content of slides, mind maps clearly highlight the most important keywords and key phrases from each slide, so that the revision time for any learner going through the slides can be minimized.

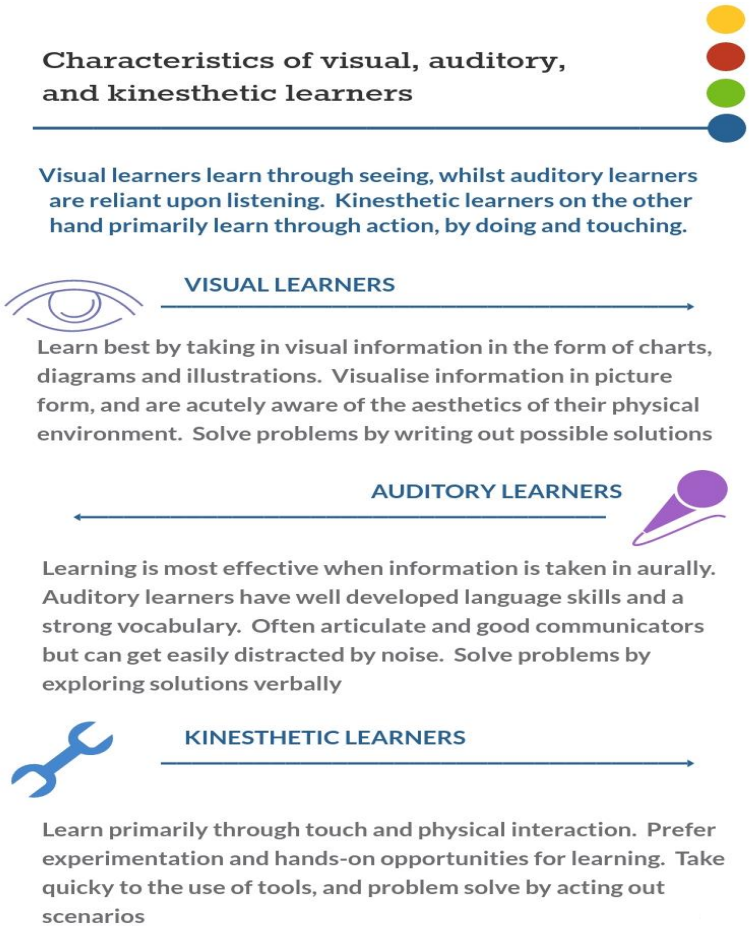


**Fig. 1. Characteristics of VAK [13].**

Figure 2 shows the reconstruction of keywords and key phrases from PowerPoint slides into mind maps. Note that the nodes in thicker lines represent the main topics in the PowerPoint slides.

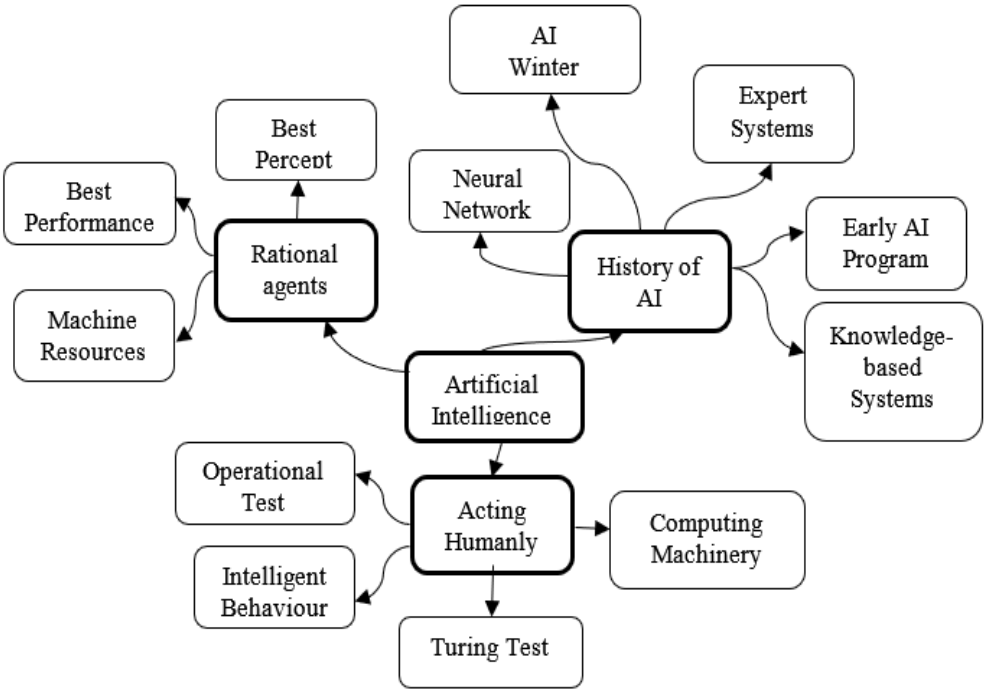


**Fig. 2. Reconstruction of keywords and key phrases from PowerPoint slides into mind maps.**

Presentation mining system is anticipated to benefit especially the visual learners because they can see connections between the key concepts in the learning material. Among the tangible benefits from presentation, mining system improves learning time among the visual learners, learning is faster, and the learners become more creative in solving complicated and tricky questions because of understanding through a graphical representation of information. Moreover, the intangible benefits include more flexible pedagogy in reaching out visual learners, since it creates a sense of belonging in class when the visual learners feel engaged, as well as a medium to maximize their learning potential.

## 2. Methods

This study is based on a quantitative research questioner to evaluate the effectiveness of the presentation mining system in addressing the needs of visual learners. Questionnaires serve as the instrument for data and feedback collection due to their suitability for statistical measurement. The proposed questionnaire was conducted to measure the respondents' understanding when utilizing a presentation mining system. It is performed amongst 80 randomly selected students at APU in Kuala Lumpur, Malaysia. The questionnaire was structured to assess a group of learners based on their learning style. The questionnaire consists of two sections. Section A discusses the respondent's demographic information, Section B aims to

investigate the respondents' attitude towards a presentation mining tool and the extent to which it helped to facilitate their learning. A questionnaire was chosen as the data elicitation tool primarily due to the volume of individuals that could be targeted within a relatively short period of time. The presentation mining tool was evaluated by 80 randomly selected students who agreed to take part in the study and complete the questionnaire once their evaluation of the tool was complete. Table 1 lists 23 objectives contained in Section B together with the respective findings on learning styles.

**Table 1. Questions, objectives, findings for determining learning styles.**

| Question No. | Objectives | Findings |
|---|---|---|
| **1.** | Determine the preferred method of learning when a learn encounters a new subject | Visual learners tend to immediately read the written instructions, whilst auditory learners will wait and listen to the explanation provided by the instructor. Kinesthetic learners prefer the hands-on approach, immediately aiming to familiarize themselves with new equipment. |
| **2.** | Explore which of the senses, aural, visual or touch, is the most effective means through which learning takes place | Visual learners defer to a map, whereas auditory learners will ask for directions. Kinesthetic learners rely on their own faculties to seek them through, utilizing tools such as a compass. |
| **3.** | Investigate how learners access new information | When cooking, visual learners tend to (prescriptively) follow a written recipe. Auditory learner seeks guidance from friends (conveyed orally), whilst kinesthetic learners opt for experimentation or trial and error. |
| **4.** | Explore how learners with different learning styles interpret and disseminate information | When required to teach others, visual learners tend to provide instructions in written format. Auditory learners provide verbal explanations, whereas kinesthetic learners prefer demonstrations. |
| **5.** | Explore how learners utilize action, language, and images to communicate | Visual learner gravitates towards images, auditory learns to prefer language, and kinesthetic learners communicate through actions |
| **6.** | Investigating learner interests based on activities undertaken frequently | Visual learners are likely to visit galleries and museums to indulge their preferred sense whilst auditory learners are likely to socialize with friends and listen to music. Kinesthetic learners are likely to opt for sporting activities or anything that requires physical exertion such as DIY. |

| Question No. | Objectives | Findings |
|---|---|---|
| **7.** | Determine the difference in idea representation and application amongst learners | Considering shopping habits, visual learners prefer to imagine themselves in a specific outfit, as opposed to auditory learners who would gather feedback from sales assistance. Kinesthetic learners are unlikely to do both and instead of choosing to try and test the outfit by themselves. |
| **8.** | Investigate methods learners use when collection useful information | When gathering information about a holiday, kinesthetic learners are likely to visualize and imagine themselves at a destination/holiday, whilst visual learners would prefer to browse brochures. Auditory learners prefer to hear recommendations. |
| **9.** | Identify learning preference and behavior when engaging in brainstorming activities. | Auditory learners will go over problems and solutions mentally before acting, kinesthetic learners will be tactile with the writing instrument as they brainstorm, whilst visual learners focus on words/images when engaging in brainstorming. |
| **10.** | Investigate how learners evaluate objects and arrive at a decision | Kinesthetic learners will engage with the products through touch, visual learners will base their purchase decisions based on color or other visual cues whilst auditory learners will base their decision on sales' person description. |
| **11.** | Investigate how learners execute short-term memory | Visual learners will remember an object/text by looking at it for a prolonged period, auditory learners will repeat words to themselves, whilst kinesthetic learners will learn by acting or performing an action. |
| **12.** | Investigate how learners respond to stress-induced anxiety and how this affects their learning behavior | Under stress, visual learners are likely to imagine the worst possible outcome of the situation, auditory learners will talk to themselves continuously whilst kinesthetic learners will pace around the room. |
| **13.** | To determine how learning styles, shape preferences where note taking is concerned | Auditory learners are likely to speak over notes, visual learners will jot down points and diagrams whilst kinesthetic are likely to imagine what is being said. |
| **14.** | Explore how learners best present ideas | Whilst presenting, visual learners will use images to convey what they mean, auditory learners will look towards using examples and anecdotes to explain their position whilst kinesthetic learners will discuss whatever topic they are presenting. |

| Question No. | Objectives | Findings |
|---|---|---|
| **15.** | Identifying how frequent activities influence learner interests. | Visual learners pursued artistic interests such as films, photography, viewing artwork; whilst auditory learners preferred to speak to friends and listen to music. Kinesthetic learners preferred to partake in activities such as dancing and sports. |
| **16.** | Investigating learner preference when interacting with people. | Preferred interactions for kinesthetic learners are those which take place over an activity, such as a meal or game. Auditory learners prefer speaking on the telephone whilst face to face meetings were preferred by visual learners. |
| **17.** | Exploring how learners from first impressions when meeting new people | Visual learners observe attire and base first impressions on this. Meanwhile, auditory learners formed impressions based on how people spoke and sounded whilst kinesthetic learners' impressions through body language and movement. |
| **18.** | Explore how learners determine situations that triggered anger within them and their initial reaction to this. | When angered, visual learners will choose to go over and replay the situation in their mind to determine the cause of their emotion. Auditory learners will react verbally, through raising voices and explaining how they feel. Kinesthetic learners are likely to react physically by slamming doors or stamping their feet. |
| **19.** | To examine learner preference in remembering people. | Visual learners will remember faces, auditory learners gravitate towards names whilst kinesthetic learns to remember actions taken or base this on an individual's conduct. |
| **20.** | Exploring how learners interpret body language | When determining whether an individual is being dishonest, visual learners will focus on eye contact and movement. Auditory learners will focus on the voice and focus on any change in pitch for example. Kinesthetic learners, on the other hand, focus on body language and non-verbal cues to pick up on any 'suspicious' movements. |
| **21.** | Explore how learners use body language when socializing | When socializing visual learners prefer maintaining eye contact and acknowledging one's presence through their gaze. Auditory learners use words and verbal expressions when greeting individuals, whilst kinesthetic learners prefer making physical contacts such as hugs or handshakes. |

| Question No. | Objectives | Findings |
|---|---|---|
| **22.** | Examine how learners store ideas for later recall. | In order to store ideas and new concepts, visual learners showed a preference for note taking, auditory learners preferred repeating ideas to themselves both mentally and verbally, whereby, kinesthetic learners preferred to practice the activity or visualize themselves applying the idea. |
| **23.** | Determine learner preference for expressing a complaint. | Visual learners preferred to put down their views in writing. Auditory learners preferred to complain verbally via telephone conversation. Kinesthetic learners preferred to contact an office directly in person. |

Upon grouping, respondents were assessed as to their learning preferences. The objective was to identify the preferred learning style amongst the visual learners when they use Microsoft PowerPoint for learning and required respondents to select the presentation format which most effectively conveyed information to them. Figure 3 illustrates the choice of presentation format presented to respondents, whilst Fig. 4 assesses the type of slide presentation style that the learners preferred.

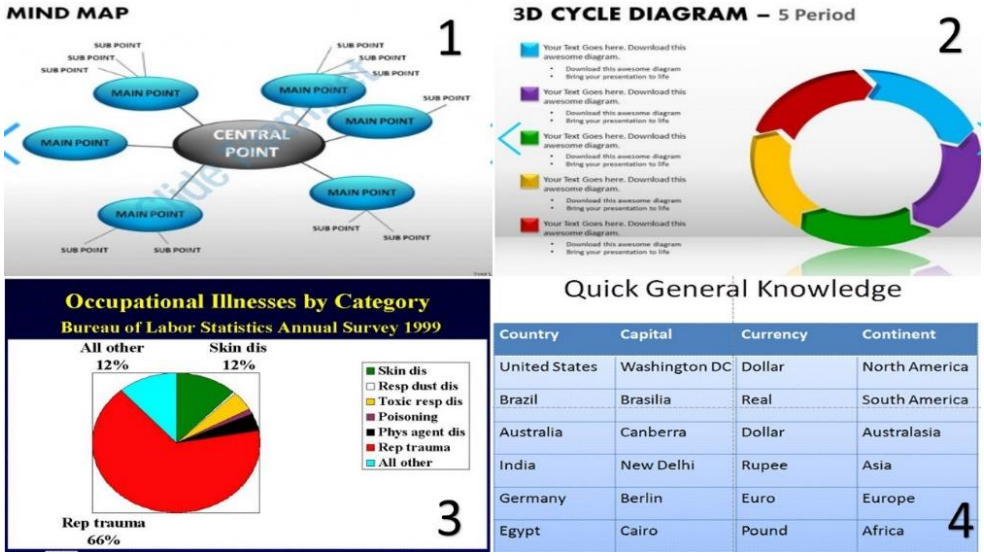


**Fig. 3. Which of the following presentation style helps you to brainstorm effectively.**

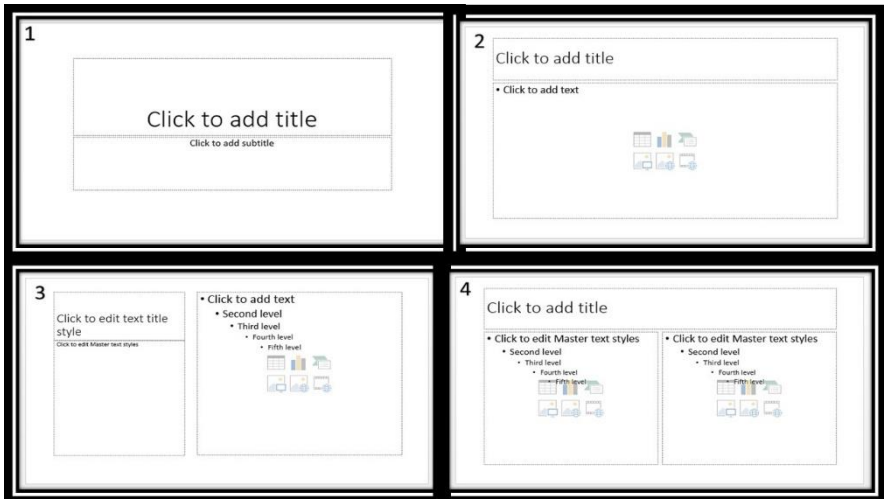


**Fig. 4. Which of the presentation style that you prefer?**

## 3. Results

The majority of the respondents 50% were Malaysian nationals which were not expected, whereby 10% of respondents identified themselves as Indian nationals, the remaining of the respondent originated from across East, South East, South, and Central Asia. In terms of educational level, four quarters were pre-university 62%, undergraduate 24%, masters 10% and 4% doctoral candidates as shown in Fig. 5.

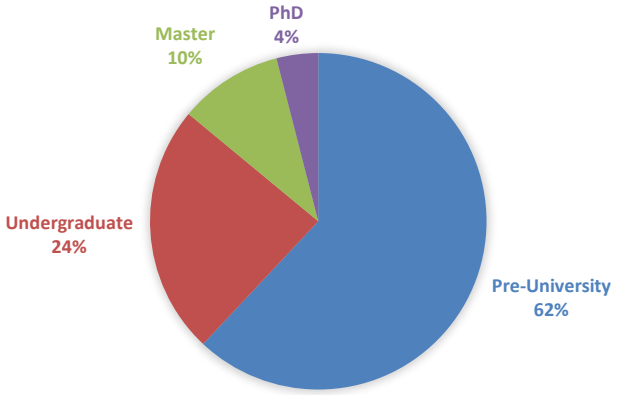


**Fig. 5. Distribution of study area or course program among respondents.**

Section B of the questionnaire consisted of 23 questions form the basis for assessing the respondents' learning style. In keeping with previous research [3] most respondents are visual learners (44%), with a further 17% a combination of visual and auditory learners, 13% a mixture of visual and kinesthetic learner, 13% auditory learners, 4% a mixture of auditory and kinesthetic learners, and finally 9% classified as kinesthetic learners. The distribution of learning styles is indicated in Fig. 6, whilst

Table 2 conveys the percentage of visual learners, aural/auditory learners, and kinesthetic learners with respect to each questionnaire question.

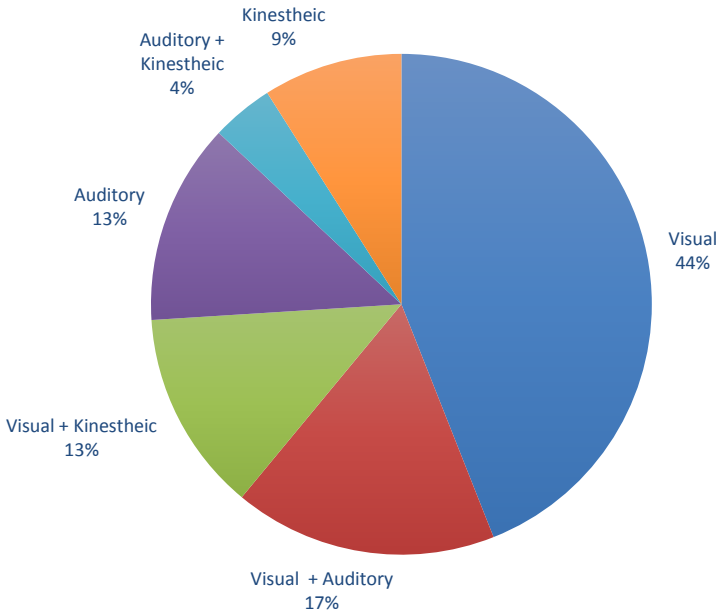


**Fig. 6. Distribution of learning styles among the respondents.**

**Table 2. Analysis of Learning Styles among the respondent.**

| Question No. | Analysis |
|---|---|
| **1.** | 40% reads instruction, 30% listens to explanation, 30% experimenting |
| **2.** | 35% look at the map, 35% asks for direction, 30% uses a compass |
| **3.** | 40% follows a recipe, 40% testing, 20% calls a friend for an explanation |
| **4.** | 40% demonstrates it first, 35% gives a verbal explanation, 25% writes the instruction |
| **5.** | 40% watches how I do it, 35% listen to me, 25% you have a go |
| **6.** | 40% plays a sport or do DIY, 35% listening to music and talking to friends, 25% goes to museums and galleries |
| **7.** | 40% tries and tests them (C), 40% imagines what they will look like in it, 20% discusses with shop staff |
| **8.** | 40% reads brochures, 35% imagine what it would be like, 25% follows the recommendation from friends |
| **9.** | 40% focuses on words and pictures, 40% discusses problems and solutions in the head, 20% moves around a lot and fiddles with pens |

| Question No. | Analysis |
|---|---|
| **10.** | 35% likes the colors and how they look, 35% follows description by salespeople, 30% likes to touch the texture |
| **11.** | 35% by looking at something, 35% by doing something (C), 30% by being spoken to |
| **12.** | 45% visualizes the worst-case scenario, 30% talks over in the head, 25% fiddles and moves around |
| **13.** | 40% writes revision notes and diagrams, 35% discusses notes with other people, 25% imagines making a movement or creating the formula |
| **14.** | 40% talks them through my idea as they do it, 35% shows them what I mean, 25% explains to them in a different way |
| **15.** | 45% watches film or photography, 30% listens to music or talking to friends, 25% taking part sporting activities, eating fine foods, and dancing |
| **16.** | 40% arranges face-to-face meeting, 30% talks through telephone, 30% gathers through activities |
| **17.** | 45% look and dress, 35% sound and speak, 20% stand and move |
| **18.** | 40% raise my voice and tell people, 35% keep relaying in my mind, 25% physically demonstrate my anger |
| **19.** | 35% faces, 35% things that I have done, 30% names |
| **20.** | 40% they try to avoid looking at you, 35% they give funny vibes, 25% their voice change |
| **21.** | 35% "Great to hear from you", 35% give them a hug or handshake, 30% "Great to see you" |
| **22.** | 35% writing notes or keeps printed details, 35% saying them aloud or repeating words and key points in my head, 30% practicing activity or imagine it to be done |
| **23.** | 40% complains about the phone, 35% taking them back to the office, 25% writes a letter |

Finally, Section C assesses the learning preferences among the visual learners. From Figs. 7 and 8, the study concludes that visual learners prefer mind maps as the brainstorming tools and prefer simple slides architecture, containing on titles and its description.

Based on Fig. 7, 50% of the respondents preferred information presented in the form of a mind map, 15% preferred diagrams, 20% preferred information in the form of a pie chart, and 15% preferred the use of tables. As for Fig. 8, 55% of the respondents preferred a slide layout consisting of a main topic and sub-topics, 20% preferred a topic with descriptions, 10% preferred topic, description, and pictures, and finally, 15% preferred topics, descriptions, and comparison of topics. A follow-up questionnaire was distributed to 50 participants with some experience of presentation mining software. Respondents are delineated into students and lecturers, with three quarters falling into the latter category. When asked to evaluate the system's user interface and its usability, most students indicate an over satisfaction with the User Interface (UI) as shown in Fig. 9.

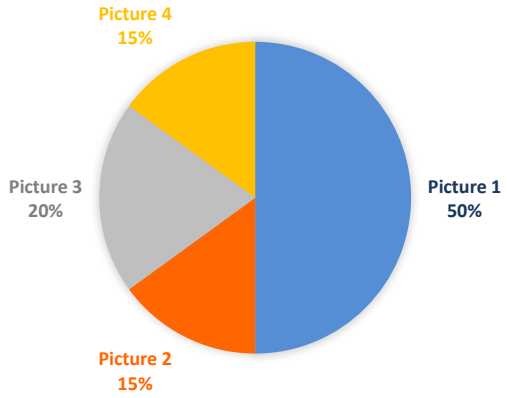


**Fig. 7. Results of respondents' preferred way of information dissemination.**

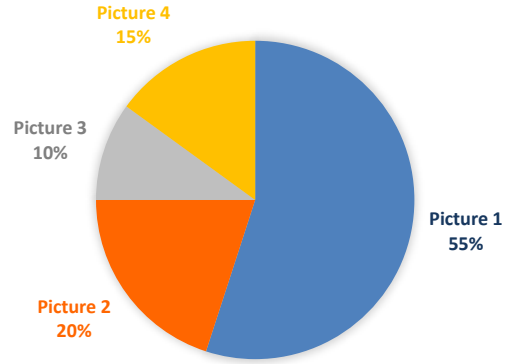


**Fig. 8. Results of respondents' preferred slide structure for the question in Fig. 3.**

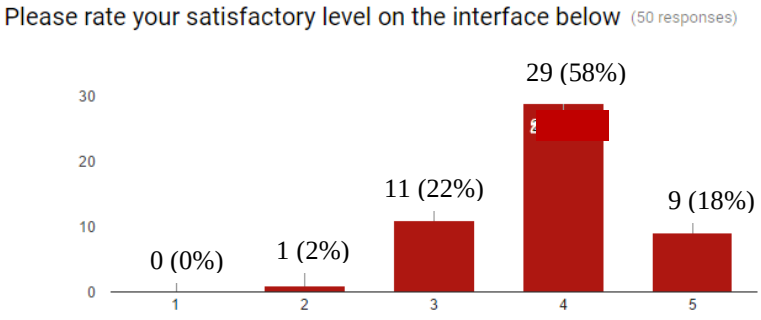


**Fig. 9. Level of satisfactory over user interface on presentation mining.**

Figures 10 and 11 show the satisfactory level in using this system. The overall response is very positive.

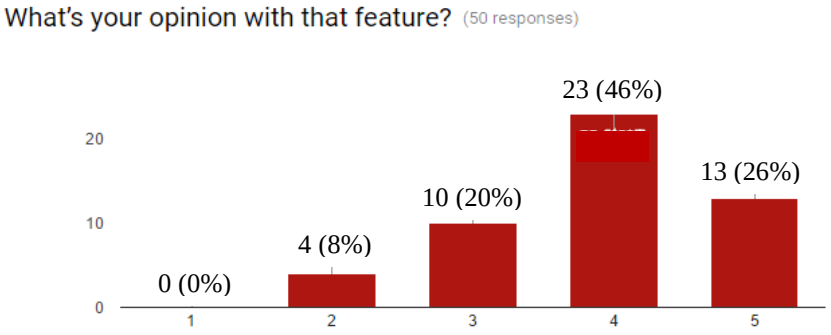


**Fig. 10. Overall satisfactory level of the system.**

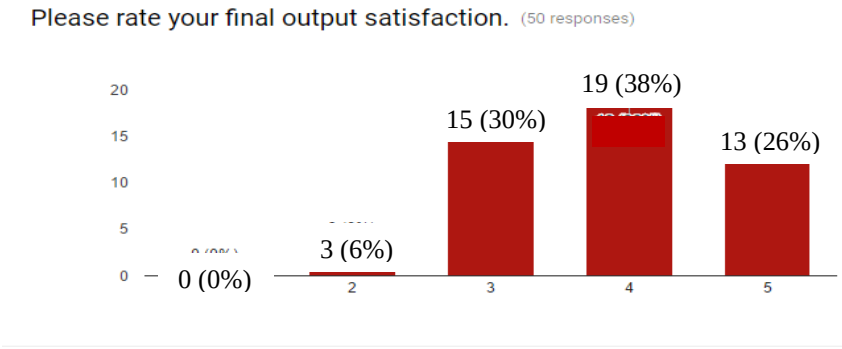


**Fig. 11. Overall satisfactory level with system output.**

The next question was directed more towards lecturers as shown in Fig. 12, as to whether the tool will be useful for students.

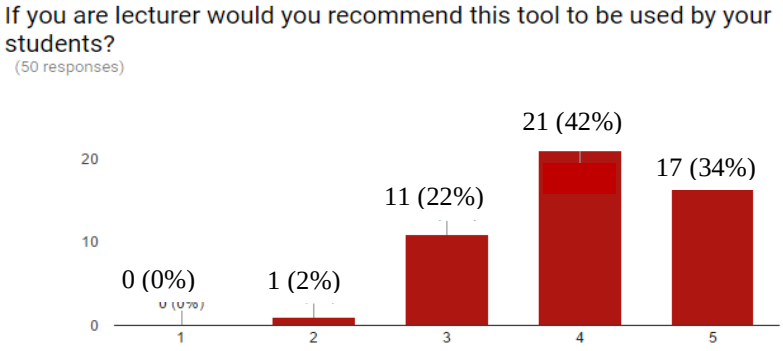


**Fig. 12. Recommendation to students.**

Figures 13 and 14 show the actual usage of the system for students and whether they would recommend to other potential users.

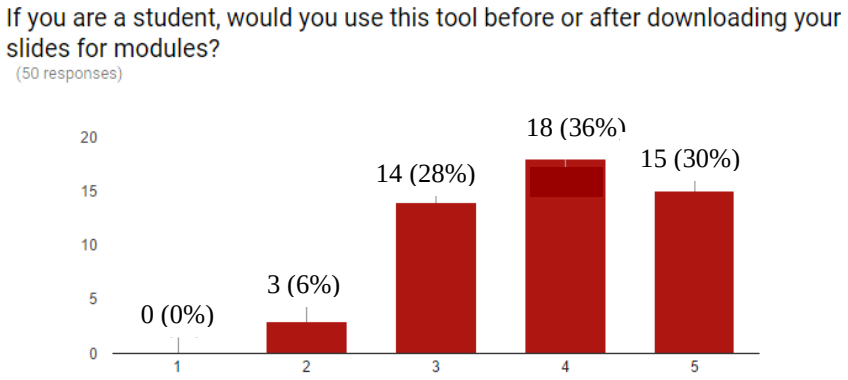


**Fig. 13. Usefulness of the tool to students.**

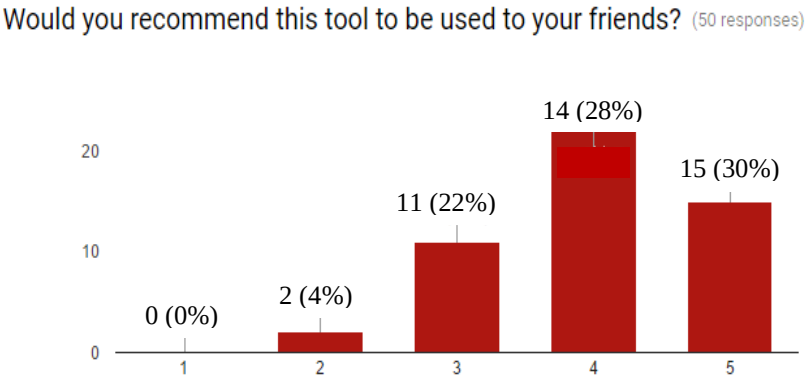


**Fig 14. Introducing and using the software in the future.**

Other overall feedback from the participants can be summarized as follows. On a positive note, software is informative, and features can be used to edit the mind map and design the font. Also, the user can customize the number of keywords shown in the mind map and request for more colors on the nodes. The application has been identified as easy to use and saves time. The generated mind map is easier to understand than drawing one's own complex diagram. Generating the mind map is fast in contrast to the huge number of slides used. Furthermore, the tool is potentially beneficial to everyone and not just students and lecturers, although its benefits as a revision tool are clear to see. As such, positive feedback from students stated that they find the proposed tool useful and easy to use. One of the student's feedback stated that the system had, "*Great features, and if possible allowing the users to simultaneously process more chapters, might reduce the time and the repetitive actions of selecting another file if the users desire to make a mind map for each chapter*".

## 4. Conclusions

This paper has attempted to determine the impact of a presentation mining system upon visual learners. The proposed system produces a mind map which is formulated using keywords and key phrases extracted from a set of PowerPoint slides. Based on the intrinsic characteristics of learning that are specific to visual, aural/auditory or kinesthetic learners research conducted, the graphical representation of information improves visual learners' understanding. As such, the presentation mining system has the potential to reduce learning time and compliments existing presentation software, which can be extended to provide visual maps of the corresponding text-based slides. For future work, it is necessary to evaluate the quality of the mind maps generated by the presentation mining system to mind a means to access the performance of learners. Overall, the feedback gained from the research participants provide guidelines for future improvements to the system, whilst the additional investigation is also required to explore how the system can be further improved to meet the needs of Visual and Read/Write learners.

**Abbreviations**

| | |
|---|---|
| VAK | Visual, Auditory, Kinesthetic |
| VARK | Visual, Auditory, Reading/Writing, Kinesthetic |
| WHO | World Health Organization |

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