# Mind Mapping as a Learning and Teaching Tool in Agricultural Higher Education in India

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## ABSTRACT

*The study aimed at investigating the efficacy of mind maps in teaching over conventional comprehensive text; comparing both of these teaching methods; and finding out the binary association with several independent determinants. The experiment comprised two groups, one group was fed information as a mind map, others were fed comprehensive text. Results indicated that the respondents using comprehensive text took 186.69 seconds on average; whereas the respondents under mind map completed the test in 132.99 seconds. The t-test and chi-square tests indicated that gender does not influence the performance of the respondents whereas background, the language of primary education and profession has some influence under different testing situations. The results establish that the mind map is much more efficient in communicating the instructions concerning both comprehensibility and time to assimilate. Conclusively, a few futuristic research questions and inputs for relevant policy interventions have been identified.*

***Key words :*** *Time efficiency; Quality learning; Agricultural education; Critical thinking; Mind map.*

**M**ind mapping also called idea mapping, is defined as the visual, non-linear representations of ideas and their relationships *(Biktimirov and Nilson, 2006).* According to *McDermott and Clarke (1998),* Mind maps are multi-sensory tools that use visuospatial orientation to integrate information, and consequently, help the learner organize and retain information *(D'Antoni and Pinto, 2006).* Formal mind mapping techniques began with extensive research on psychological parameters *(Buzan, 1974)* and are useful in showing sub-topics of a domain creatively and seamlessly *(Eppler, 2006).* Mind maps comprise a network of connected and related concepts which involve different line thicknesses, colors, pictures, and diagrams to aid knowledge recollection. Besides creating an association of ideas, it helps in memory retention, *Beyerbach(1988)* found that such kind of maps makes changes in students' thinking too. The mind maps have become popular as a learning tool

since it is easy to learn and apply, provide a concise hierarchic overview, easy to extend and add further content *(Buzan, 1995),* and encourage creativity and self-expression. Pictographic methods have been used in the preparation of training manuals for undergraduate students in agriculture *(Soam et al., 2019)* and have been found an excellent instructional material. Mind maps support teachers and students to explore and elaborate upon a core curriculum, by nurturing, examining, and replacing student questions *(Stokhof et al., 2018).* Mind mapping has been used in a variety of disciplines including Optometry, Economics, Executive Education, Medicine, Marketing, Finance, English, etc. But, there were very limited studies on mind mapping concerning students and teachers of agricultural higher education *(Supriya et al.,2013)*, extension education *(Singh et al., 2009)*. So, the purpose of this study is to investigate various backgrounds of the respondents and quality parameters, whether the mind maps are efficient in

communicating the information to the seekers than comprehensive text concerning both time required as well as comprehensibility *(Venkattakumar and Sontakki, 2014)*. The present study was undertaken to measure the effectiveness of the learning and training effectiveness *(Thammi Raju et al., 2022)*. The present study also links the earlier findings of strong association with reading and critical thinking *(Commeyras, 1990)*, and proven hypotheses that critical thinking training of teachers yields better Cognitive Reflection Test (CTR) performance *(Janssen et al., 2019)*.

Agricultural Education is a comprehensive, vibrant, and dynamic science and is imparted in India by 74 public-funded Agricultural Universities with over 165,000 UG and PG students, and about 85 private general universities are providing agricultural education to about 50,000 students. Quality agricultural education is the primary aim of the National Agricultural Education and Research System to achieve Sustainable Development Goal- 4.

Therefore, the appropriate introduction of 'Mind Mapping' tools for various purposes will not only enhance critical thinking but also saves learning time, especially for the students who had a rural background with the medium of instruction in local languages i.e. other than the English language will specifically be benefitted.

## METHODOLOGY

The study included 119 postgraduate students and 48 assistant professors who represented 167 subjects from various agricultural sciences fields and had 2-3 years of teaching and/or research experience. The experiment was done out after the group was separated into two subgroups. A subject-neutral hypothetical case 'Politicians in India' was given as a comprehensive text in English (of 231 words) to one subgroup consisting of 78 subjects and the other subgroup comprising 89 subjects was given a 'Mind Map' of the same hypothetical case consisting of the same information. The mind map used in the study is given in Figure 1.

The subjects in both subgroups were given time to read and understand the case. Subsequently, three questions, two multiple-choice and one open-ended were asked. Each subject's time spent answering all three questions was recorded. In the end, the number of questions each subject successfully answered was also calculated

The data on time taken for completing the test and scores obtained by individual subjects in the experiment were analyzed using descriptive statistics. The Student's t-test was employed to compare the means between two groups. The Student's test was also used for comparing the time taken based on gender, background, language of education and profession.
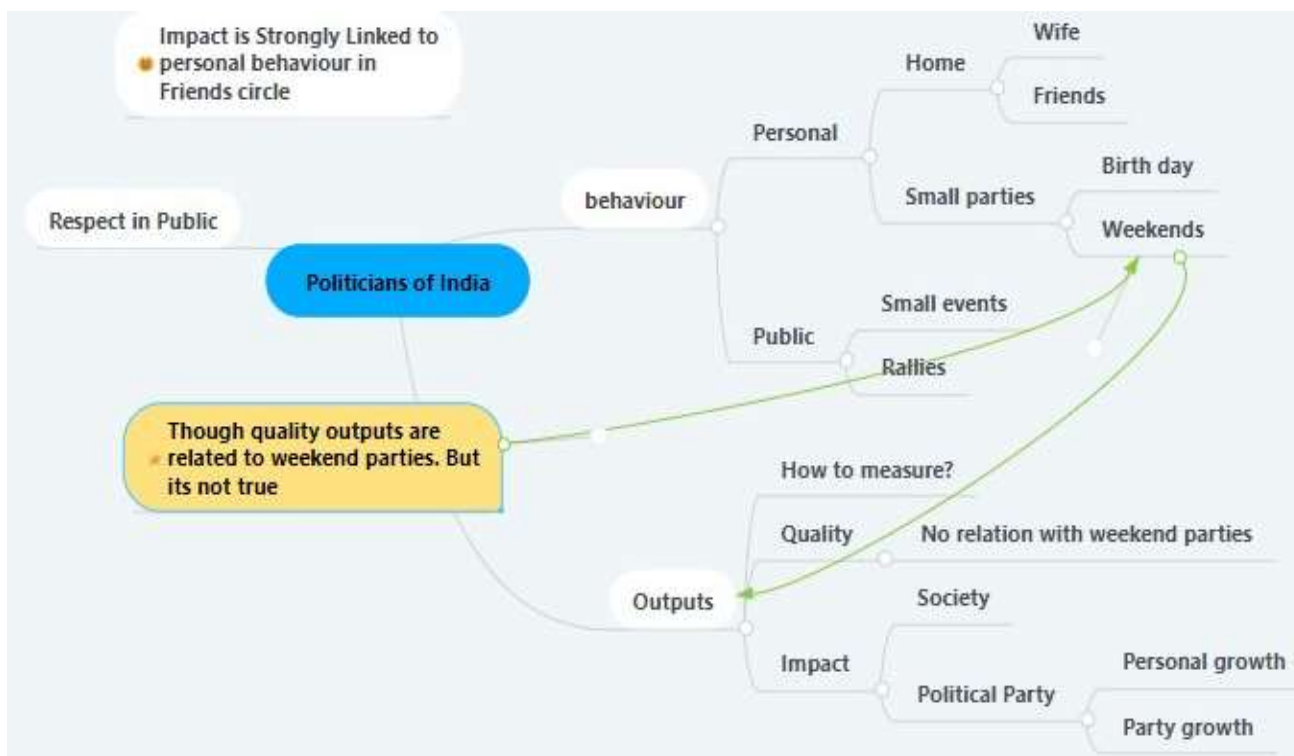


**Figure 1. A mind map of a hypothetical case study on politicians in India used for the experiment**

The scores obtained under the two situations were compared using the chi-square test. The chi-square test was also used to check the association between the performance of the subjects with their gender and background.

## RESULTS AND DISCUSSION

The descriptive statistics of the experiment are given in Table 1. It is evident from the table that it takes less time for the subjects to grasp the information using mind maps. Subjects in the mind map group took less time to complete a test (31 seconds) than those in the full-text group (56 seconds). While a comprehensive text group subject (386 seconds) took longer to complete the test than a mind map group subject (300 seconds). *Mergendoller and Sacks (1994)* observed that concept of maps help in better instructional strategy and intellectual stimulation. Similarly, for most people, mind maps are much easier to follow than verbal or written descriptions *(Larkin and Simon, 1987)*. Besides, it is clear from the density plot given in Figure 2 that the subjects using the mind map could complete the test much earlier than subjects using comprehensive text irrespective of the scores obtained. Besides taking less time for completing the test, subjects under the mind map scored more correct answers which establishes that mind maps are more efficient in conveying the right message (Table 1). The result is in line with other studies establishing that pictures and structured diagrams are more comprehensible than verbal descriptions *(Davies, 2011)*.

Figure 3 gives the boxplots for the score-wise time taken by the subjects under both the situations
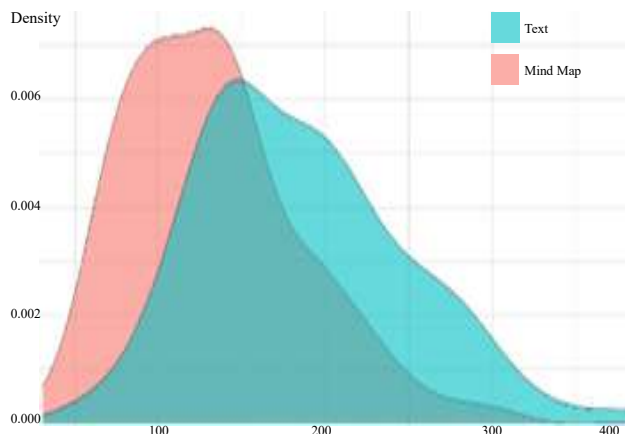


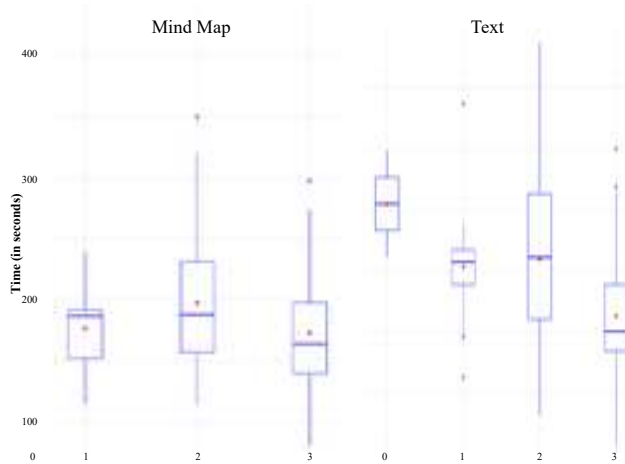**Fig. 2. Density plot of the time taken for completing the test**



**Fig. 3. Box plot for the time taken by subjects to complete the test under different situations**

which establish that the time taken is less when the mind map was used. The average time taken by the subjects scoring 0,1, 2 or 3 is less than their respective counterparts reading comprehensive text.

The performance of the subjects in the experiment can be evaluated using two measures viz., time taken for finishing the test and the score obtained in the test. At a 5% level of significance, the results of the Student's t-test show that there is a significant difference in the time taken by the participants to complete the activity. (Table 2). The subjects took more time for answering the questions under comprehensive text than that mind mapping. Similarly, the chi-square test conducted to check if there is an association between the scores obtained and whether the information was provided as text or diagram is also found to be significant at 10%

**Table 1. Descriptive statistics of the experiment on critical thinking**

| Parameter | Comprehensive Text | Mind map |
|---|---|---|
| Time is taken by the fastest subject to complete the test (seconds) | 56 | 31 |
| Time taken by the slowest subject to complete the test (seconds) | 386 | 300 |
| The average time taken by all the subjects (seconds) | 186.69 | 132.99 |
| Average score | 2.282 | 2.483 |
| Percent respondents obtained a score of 0 | 2.56 | 0.00 |
| Percent respondents obtaining a score of 100% | 50.00 | 55.05 |

**Table 2. Results of the tests for comparison of averages**

| | Test statistic | p-value |
|---|---|---|
| Student's t-test for time | 5.931 | <0.001 |
| Chi-square test for a score | 6.744 | 0.080 |

level of significance. This indicates that the scores obtained by the subjects under the network diagram are generally greater than that of comprehensive text. The students are more variable towards the new learning environment *(Fordham, 1978)*. It is also clear from Figure 3 that most of the subjects under the mind map are completing the test much before the subjects under the comprehensive text. These results suggest that the time required for understanding concepts is less when we use mind maps, as well as network diagrams, which are useful for better understanding.

The average time taken to finish the test and the average score obtained for each category when information is provided as comprehensive text and network diagram and the overall experiment are given in Table 3. The results of the Student's t-test for comparison of performance concerning the time taken among different subject categories and the results of the chi-square test for checking the association between scores and different subject categories are given in Table 4 and Table 5 respectively.

*Comparison of time taken* : Overall, subjects who are female, with urban backgrounds and whose primary education is in the English language performed better than the others in the experiment for the time taken to finish the test. Similarly, relatively younger students, performed better than the working subjects i.e. Assistant Professors. However, gender was not found to be significantly affecting the performance. Similar results are obtained when the information was provided as a mind map, though the effect of both gender and language could not be established statistically. However, there is a little deviation under the comprehensive text, wherein males performed better than females. The t-test results indicated that urban background and primary education in English have a significant influence on the performance of the subjects when the comprehensive text was used. *Lim (2011)* also found that in Korea non-native English-speaking teachers have learned better through mind methods such as concept mapping, and also it has been helpful in process of idea generation, clustering and interpretation.

**Table 3. The category-wise average time taken and scores obtained**

| Factor | | Overall | | Comprehensive text | | Mind Map | |
|---|---|---|---|---|---|---|---|
| | | Time | Score | Time | Score | Time | Score |
| Gender | Male | 148.33 | 2.31 | 158.33 | 2.33 | 133.44 | 2.30 |
| | Female | 133.22 | 2.50 | 166.20 | 2.37 | 112.44 | 2.62 |
| Background | Rural | 158.00 | 2.26 | 175.37 | 2.27 | 140.00 | 2.25 |
| | Urban | 126.53 | 2.53 | 148.00 | 2.44 | 112.02 | 2.59 |
| Language | English | 135.22 | 2.48 | 152.83 | 2.50 | 123.03 | 2.48 |
| | Others | 159.70 | 2.16 | 182.44 | 2.05 | 128.23 | 2.30 |
| Profession | Student | 141.60 | 2.40 | 162.70 | 2.35 | 124.07 | 2.44 |
| | Researcher | 198.89 | 2.35 | 240.66 | 2.12 | 157.12 | 2.58 |

**Table 4. Category-wise comparison of time taken**

| Factor | Overall | | Comprehensive test | | Mind Map | |
|---|---|---|---|---|---|---|
| | t value | p-value | t value | p-value | t value | p-value |
| Gender | -1.545 | 0.125 | -0.590 | 0.557 | -1.685 | 0.096 |
| Background | 3.298** | 0.001 | 2.138* | 0.037 | 2.115* | 0.039 |
| Language | -2.102* | 0.040 | -2.161* | 0.037 | -0.305 | 0.763 |
| Profession | 5.229** | <0.001 | 5.689** | <0.001 | 2.825** | 0.007 |

**Table 5. Category-wise comparison of scores obtained**

| Factor | Overall | | Comprehensive test | | Mind Map | |
|---|---|---|---|---|---|---|
| | Chi-square | p-value | Chi-square | p-value | Chi-square | p-value |
| Gender | 3.018 | 0.221 | 2.844 | 0.260 | 4.025 | 0.143 |
| Background | 11.207** | 0.003 | 3.774 | 0.182 | 9.119** | 0.009 |
| Language | 4.088 | 0.119 | 3.920 | 0.167 | 6.162 | 0.054 |
| Profession | 0.807 | 0.667 | 4.752 | 0.092 | 0.857 | 0.708 |

*Comparison of scores obtained* : Similar to the performance concerning the time taken to finish the test, the performance in the score obtained also varied based on the subjects' background. Overall, the score obtained by females, subjects with urban background, with primary education in English and students obtained better scores than the others. The same pattern was obtained under both comprehensive text and mind map situations. However, the only rural or urban background was found to have a significant association with the score obtained by the subjects in the mind map. No association was found under the comprehensive test situation between score and background information.

## CONCLUSION

Mind map invokes 'critical thinking because the performance in mind mapping on associated parameters was higher than comprehensive text. The study additionally explains the association of respondents' background with performance in terms of time taken and score obtained. Mind map being higher than comprehensive text, and additionally considerably influenced by the background of respondents. Better communication language additionally vies vital role in terms of time potency and rating, respondents well conversant in English, performed higher altogether aspects however lesser time is taken on a comprehensive text. The study clearly shows that language isn't any bar in an exceedingly mind map, hence it is often an efficient communication tool in an exceedingly multicultural classroom setup. Furthermore, it is also evident that for better performance, the educators need training in mind mapping.

## CONFLICTS OF INTEREST

The authors have no conflicts of interest.

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