THE ACCESSIBILITY ANALYSIS OF SENIOR HIGH SCHOOL STATISTICS TEXTS IN INDONESIAN TEXTBOOKS

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The accessibility of text is prominent for students learning through reading. This study aims at analyzing the statistics topics presented in Indonesian school mathematics textbooks. Particularly, the analyses focused on the accessibility of seventeen statistical terms based on five statistics text accessibility attributes. The main findings were that (1) only five statistical terms were connected to students' prior understanding explicitly; (2) the authors are dominantly addressed data as numerical numbers without meaningful contexts; (3) the textbooks emphasize on presenting connections to other statistical terms using three types of meanings of data; (4) most of the purposes of visual refer for organizing and describing data; and (5) verbal information presented in visual information are likely to provide more informative labels yet less informative captions and scales.

INTRODUCTION

Reading statistics texts, identical to reading in other content areas (e.g., Draper & Siebert, 2004; Weinberg & Wiesner, 2011), involves the interaction or transaction between a reader and a text situated in a particular context. Gunning (2003) proposed a broader concept of text readability, which was referred as text accessibility, considers the context of reader and the task. Therefore, this study aims at analyzing textbook using the accessibility framework developed by Idris and Yang for college statistics to reveal the strength and the weakness of the Indonesian school textbooks in exploring the content knowledge of statistics presented in the textbook which may contribute to the opportunity for students learning statistics through reading.

METHODS

The textbooks selected to be analyzed were *Matematika* [Mathematics] for Tenth Grade and Eleventh Grade proposed by the Indonesian government to be widely used in classroom teaching and the topics in this study are data display and statistical measure. A coding scheme was developed by referring to Idris and Yang. Table 1 shows the five attributes and their operational classification.

As for text concreteness, the meaning connections can be categorized as no meaning connection is addressed, connecting to the different term used in presenting the similar statistics concept, or connecting to the similar term used in natural language. As for voice of author, data settled as numerical numbers for the purpose of doing calculation or graphing are classified as data as numerical numbers without context whereas if the context of data is provided, but there is no connection of the contexts, they classified as data as numerical numbers with context. Data used in the analysis for solving statistical problems, by connecting the interpretation of the analysis to the problem are classified as data as numbers in problems contexts whereas data used as object to be evaluated or criticized with the investigative processes involved are classified as data as information for investigation. As for text coherence, the coherence of meanings of data concerns about whether the concept connections are presented as to each type of meaning of data addressed in analysis units. The categories of coherence of meanings of data are which meanings of data are addressed when connecting the focused statistical terms to big ideas in statistics, when connecting to other terms in the different sub-topics or within the same sub-topics, or when connecting to more than one context or context used for previous statistical terms.

As for selective use of visual information, organizing data refers to the visual information provided to organize data to be used for graphing or calculating statistical measures while constructing data refers to the use of visual information to illustrate the procedures on how to display data and the concept being defined in the unit. Describing data refers to the use of visual

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information for reading and interpreting the information presented. Summarizing refers to the use of visual information to elaborate the statistical measures and summarize the distribution of data whereas elaborating refers to the use of visual information to elaborate the comparison within data in visual, between different types of visuals displaying similar data, or between similar types of visuals displaying different data. Generalizing refers to the use of visual information for generalizing the information to population, to predict unknown case, or to make inference about the problem contexts and illustrating refers to the use of visual information as the illustration of problem contexts. As for integration of visual and verbal information, additional information added in the captions of visual information are classified as information about data contexts, data interpretation or procedures, etc. The information for label can include the name of variable provided within the visual, which can be categorized as none, as symbols, as abbreviations. Scale analyzed in this study is specific to the scale of data provided within the axes and data values provided inside the visual information.

Table1. five accessibility attributes and their classification

Attribute	Description	Operational Classification
Text Concreteness		
Meaning connections of statistical terms	The connections of meanings of statistical terms related to students' prior understanding which are addressed in the text	M0: no meaning connection; M1: connected to different terms used in statistics; M2: connected to similar terms used in other subject; M3: connected to similar terms used in natural language.
Voice of Author		
Approach to meaning of data	Type of meanings if data addressed in presenting statistical terms	D0: No data; D1: Data as numerical numbers without contexts; D1-C: data as numerical numbers with contexts; D2: data as numbers in problem contexts; D3: data as numbers for investigation.
Text Coherence		
Coherence of approach to meaning of data	The presentations of concept and context connections with relate to meanings of data	C0: no concept connection is presented; C1: connecting to big idea underlying the term; C2-1: connecting to other statistical terms from different sub-topics; C2-2: connecting to other statistical terms in similar sub-topic; C3-1: connecting to more than one contexts; C3-2: connecting to contexts used for previous statistical terms.
Selective use of visual information		
Purpose of visual information	The purpose of referring to the visual information in elaborating statistical terms	V1: organizing data; V2: constructing; V3: describing; V4: summarizing; V5: elaborating; V6: generalizing; V7: illustrating.
Integration of visual and verbal information		
Verbal information provided in visual information	[Caption]: The information provided in the captions of visual information	CA0: no caption is provided; CA1: information about data contexts or interpretation; CA2: information about procedures; CA3: information about to which verbal unit the visual is referred; CA4: no information is provided in the caption.
	[Label]: The name of variable provided in the visual information	L0: no variable name is provided; L1: name of variable is presented by abbreviations and symbols; L2: name of variable is presented by abbreviations; L3: Name of variable is presented by symbol.
	[Scale]: The scale of data provided in the visual information	SC0: no data scale presented; SC1: data scale in both axes and inside the visual; SC2: data scale in the axes of visual only; SC3: data scale inside the visual only; SC4: data scale in the title only.

Two co-coders were selected and trained to code several analysis units involved in analyzing textbooks in this study for testing the reliability of the coding. Minimum percentages accepted for reliability coding is 80% (Huberty & Barton, 1990). For some components having low percentages of reliability, further discussions with the co-coders were conducted to figure out the factors of the differences between coders.

RESULTS

We show the result as to each attribute as follows.

Concreteness of Text

Among the seventeen focused statistical terms, there are five terms found to be connected in the whole topics in the textbooks. Three terms are connected to the other terms used in statistics (M1) and two terms are connected to those used in natural language (M3). This result shows that textbooks analyzed in this study do not put much concern on meaning connections of statistical terms which may relate to students' prior understandings.

Voice of Author

Based on the analysis, there are about half of analysis units addressing this component, that is 52,63%. The highest percentages of analysis units addressed data as numerical numbers without contexts (28,07%), followed by data as numerical numbers with context and data as numbers in problem contexts (14,05% and 10,53%, respectively). However, the textbooks do not address the meaning of data as information for investigation (D3) in the topics of data display and measure.

Text Coherence

The percentages of coherence categories of approach to meanings of data as shown in Table 2 are obtained from the total number of analysis units for the corresponding category weighted to the total number of analysis units presenting the corresponding meaning of data. The textbooks present three types of meanings of data when presenting connections to other statistical terms either for different sub-topics or similar sub-topics. The highest percentages are those which addressed data as numbers for presenting problem contexts when presenting other statistical terms in the same sub-topics.

Table 2. Percentages of coherence categories of approach to meanings of data

Meanings of data	Connections					
	C0	C1	C2-1	C2-2	C3-1	C3-2
D1	0.75	0.06	0.09	0.09	0.00	0.00
D1C	0.50	0.00	0.25	0.00	0.00	0.25
D2	0.00	0.17	0.00	0.83	0.00	0.00
D3	0.00	0.00	0.00	0.00	0.00	0.00

Selective Use of Visual

For the purposes of visual information, the textbooks provide only five purposes for referring to visual information. The highest percentages of visual information referred in the textbooks are those for organizing (58%), followed by constructing data (23%) and describing data (12%). Although very few, there are also some visual information referred for elaborating and summarizing (6% and 1%, respectively) in the textbooks.

Integration of Verbal and Visual Information

There are three types of verbal information presented in the visual information that are focused in this analysis: captions, labels, and data scales. Table 3 shows the percentages of types of information provided in captions in visual information in the textbooks. There are only three

types of captions provide in the textbooks. The highest percentages of types of information provided in captions are those which present information about data contexts or interpretation.

Table 3. Percentages of types of information provided in captions of visual information

Topics	Captions				
	CA0	CA1	CA2	CA3	CA4
Data Display	0.00	0.33	0.00	0.11	0.00
Measures	0.00	0.28	0.00	0.00	0.28
Total	0.00	0.61	0.00	0.11	0.28

Table 4 shows the percentages of types of information provided in labels of the visual information. All of visual information in the textbooks provide all types of verbal information provided in labels of visual information and most of the types of verbal information provided refer to use name of variable in abbreviations. As for data scales, most of visual information in the textbooks did not provide scales information as can be seen in the Table 5. This result reveals that the textbooks are likely to provide less informative captions and scales but more informative label.

Table 4. Percentages of types of information provided in labels of visual information

Topics	Labels			
	L0	L1	L2	L3
Data Display	0.00	0.00	0.37	0.07
Measures	0.00	0.19	0.33	0.04
Total	0.00	0.19	0.70	0.11

Table 5. Percentages of types of information provided in scales of visual information

Topics	Scales				
	SC0	SC1	SC2	SC3	SC4
Data Display	0.29	0.00	0.00	0.02	0.13
Measures	0.52	0.00	0.00	0.00	0.04
Total	0.81	0.00	0.00	0.02	0.17

CONTRIBUTION

This study may contribute to reveal the strength and the weakness of the textbooks for particular readers to comprehend. It also reveals that the accessibility framework developed by Idris and Yang for analysing college statistics textbooks can also be applied for senior high school statistics contents under data distribution topics. Besides, the result of this study can also contribute on statistic teaching since it can identify the features should be possessed by learning materials or textbooks for learning statistics through reading for particular students. Further discussion about the findings will be presented in oral presentation.

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