The analysis of science textbooks: science-chemistry teachers’ book and students’ book of junior high school

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Abstract. This study aims to analyse the science textbooks for teachers and students of junior high school students. The method used in this research is a qualitative method that used text analysis as a content analysis. The issue of school science textbooks has been a major research topic within the science education research tradition. The analysis of textbooks is divided into three formality values, namely: terminology and notation, nominalisations, and the use of passive voice. The categories of terminology and notation for teachers’ book and students’ book showed the result of high (H) value, the nominalisations for teachers’ book and students’ book also showed the result of high (H) value. Meanwhile, the use of passive voice for teachers’ book and students’ book showed the result of a low (L) value. By nominalising verbs in writing, more information can be packed into each clause so that the noun phrases can extend and carry more content. On the other hand, the analysis showed the result of low value in the use of passive voice while the verbs in passive voice appeared less than the verbs in the active voice. The result also showed weak power relationship and weak involvement in both textbooks. The weak power (hierarchical) relationship was shown by more occurrences of interrogatives and declarative rather than imperatives in both textbooks. Meanwhile, the weak involvement was shown by the frequency of the use of personal pronouns (more use of plural personal pronouns than singular ones). In conclusion, the analysis in both Chemistry textbooks (teachers’ book and students’ book) in the content of acid and base was high value in the formality markers of both terminologies, notation, and the nominalisations.

1. Introduction
The curriculum as a set of educational plans should be developed dynamically by the demands and changes that occur in society. All Indonesia’s national curricula were designed based on the same foundation, namely Pancasila (Philosophical foundation of the Indonesian Republic) and the 1945 Constitution of the Republic of Indonesia; the principal differences among those curriculums were only on emphasising educational goals and approaches to realise it. The national curriculum of Indonesia had changed several times, more than ten times in precisely, such as curriculum before colonial until after independence. Those alterations are logical consequences of a political issue, government system, social culture, economic, and science technology in the community [1], [2]. Furthermore, the last version was the curriculum 2013 with several revisions on basic competencies and the evaluation instructions until 2018. In curriculum 2013, the government developed the textbook as the resources in teaching and learning in the school.

Textbooks are one of the essential factors to the shaping of teachers, students, and families to a view of the school subject [3], [4]. Moreover, the science and mathematics textbook have a significant effect on classroom practice and has a correlation with curriculum [4]. Consequently, the content and
the feature of the textbook become a specific vision of the curriculum. Based on the curriculum 2013, the government of Indonesia released two kinds of the textbook, namely teachers’ textbooks and students’ textbook. Students’ textbook is the main resource to achieve the basic competencies and core competencies; meanwhile, the teachers’ textbook is the guideline which includes the teaching and learning strategy, a model of teaching and learning, the technique of learning, and the evaluation for every courses or theme of learning. The textbook is a part of the tools of teaching, which has the closest material for students to achieve the knowledge. 

Moreover, it is almost impossible for a student to obtain a high level of education without textbooks [5]. The essential factors for a student to achieve knowledge is the capability for reading, writing, and speaking, especially in the science area [6]. However, the understanding of reading, writing, and speaking of the content of the textbook is not easy, especially for a science textbook. Because science textbooks have several differences in technical and unique vocabularies. It also in technical science terms, abbreviations, alphabetical, notational signs, and graphical signs with other textbooks [7], [8]. Furthermore, the language of science and the language of school science is different. The language of science is textured and structured; meanwhile, the language of school science resembles the language of science textbooks [6]. This research is slightly very few in the science field, especially in the science education department, even though the lectures and government are often used this textbook as references for teaching in the classroom. It should have a good analysis which the content was proper with the students’ knowledge. Therefore, it can construct new ways for making the content of the science-chemistry textbook.

This article aims to analyse the formality value of science textbooks for teachers and students in junior high school, especially for chemistry textbooks with the basic competency of acid and base. The formality value forms the terminology and notation; nominalisations; and use of the passive voice.

2. Method
The qualitative method is utilised in this research with teachers and student's science textbook analysis as a content analysis. Qualitative content analysis is one of the various qualitative methods available for analysing and interpreting the data [9]. This analysis has proper to analysis the science-chemistry textbook because, by several questions, the researcher can conduct a more in-depth analysis of textbooks, such as the terminology and notation, nominalisations, and the use of passive voice. There are six questions must be addressed in every content analysis, such as which data are analysed, how are the data defined, from what population is data drawn, what is the relevant context, hat are the boundaries of the analysis, and what is to be measured [10]. In this research, there are two types of the science-chemistry textbook, namely teachers’ science-chemistry textbook and students’ science-chemistry textbook.

The first way to analyse the textbooks is Unitization. This step is looking for any images, cover, which level the textbook is used, the narrative text. The second step is data selection. The step is classifying the elements, which related to formality value. Operationalised is the next step which explaining the images or statements. Next step is coding. The coding is the symbol to emphasise the keyword from the explanation. For instance, H is the symbol for high and have explained that the nominalisation has three or more noun. The last step is data analysis and reporting [10].

3. Result and Discussion
The issue of school science textbooks has been a major research topic within the science education research tradition. The analysis of science textbooks can be seen in table 1.

| Acid and Base | Teachers’ Book | Students’ Book |
|--------------|---------------|---------------|
| Formality value | Code | Code |
| a. Terminology and notation | High | High |
| b. Nominalisations | High | High |
| c. Use of passive voice | Low | Low |
According to the table, the content analysed was chemistry subject in the science textbook for the seventh grade of junior high school in Indonesia. The content was about acid and base. The sociolinguistic aspects of formality value were analysed in both teachers’ book and students’ book [11]. Some arrangements categorised the division of formality and can be seen in table 2.

**Table 2.** Formality markers of the linguistics code

| Arrangement of Formality Value (combinations of marker) |
|--------------------------------------------------------|
| High: High- High- High                                 |
| High- High- High-Moderate                              |
| High- High- High-Low                                   |
| High- High-Moderate-Moderate                           |
| Moderate: Moderate- Moderate-Moderate-High              |
| Moderate- Moderate- Moderate- Moderate- Moderate        |
| Moderate- Moderate- Moderate- Moderate-Low              |
| High- High-Low-Moderate                                |
| High- High-Low-Low                                     |
| Low-Low- High-Moderate                                 |
| Low-Low- Low-Moderate                                  |
| Low-Low- Low-Low                                       |
| Low- Moderate-Moderate-Low-Low                         |

Formality corresponds to the degree of abstraction, elaboration, and specialisation of the linguistic code employed. Low formality corresponds to a linguistic code resembling very much the vernacular. On the contrary, high formality corresponds to the specialised linguistic code that follows the conventions that scientific experts use when communicating through this code. Science uses a specialised linguistic code. This kind of code is not an external feature of science but constitutes an intrinsic characteristic for the construction of the scientific discourse [7].

**Table 3.** The three-domain of formality markers analysis

| Formality Markers of the Linguistic Code |
|-----------------------------------------|
| Terminology and notation                |
| High = appearance of terms, symbols, and equations |
| Moderate = appearance of two elements (e.g., symbols and equations) |
| Low = appearance of only one element (e.g., only terms) |
| Nominalisations                         |
| High = existence of nominal groups of three or more nouns |
| Moderate = existence of nominal groups of two nouns |
| Low = no nominal groups |
| Use of passive voice                    |
| High = prevalence of verbs in the passive voice |
| Moderate = verbs in a passive voice almost equal with verbs in an active voice |
| Low = verbs in a passive voice less than the verbs inactive |

Fundamental realisations of the specialised character of the scientific linguistic code (formality) are: (1) the specialised terminology and notation which can be classified into the categories of 'terms,' 'symbols' and 'equations,' (2) the use of nominalisations which are very frequently used in scientific language because they: (a) facilitate reference to the taxonomy of various entities, (b) enhance the compressive expression of complex information, (c) allow the smooth development of arguments and (d) allow the formation of novel conceptual entities [12], [13], (3) the heavy use of the passive voice which represents the objective and non-personal character of scientific knowledge.
Table 4. The example of formality markers in science textbooks

| Formality Markers of the Linguistic Code | The teachers’ Science-chemistry textbook | The students’ science-chemistry textbook |
|-----------------------------------------|------------------------------------------|------------------------------------------|
| **Terminology and notation**            | Symbol: SO₂                             | Symbol: NO                               |
|                                         | Term: the gas of Nitrogen dioxide       | Term: Aluminium hydroxide               |
|                                         | Equations:                               | Equations:                               |
|                                         | HCl + NaOH                               | Asam + basa                             |
|                                         |   $\text{NaCl + H}_2\text{O}$           |   $\text{garam + air}$                   |
| **Nominalisations**                     | Burn become burning                      | Different become difference             |
|                                         | Investigate become investigation         | Observe become observation               |
| **Use of passive voice**                | The reaction of neutralisation can be    | A lot of kinds of a plant can be used    |
|                                         | implemented in many fields               | as a natural indicator                   |

The result of the analysis in both Chemistry textbooks within the content of acid and base was described as showing high value in the formality markers of terminology and notation (shows the appearance of terms, symbols, and equations) and nominalisations (describes the existence of nominal groups of three or more nouns) in both teachers’ book and students’ book. By nominalising verbs in writing, more information can be packed into each clause so that the noun phrases can extend and carry more content [14], [15]. On the other hand, the analysis shows the result of low value in the use of passive voice while the verbs in passive voice appear less than the verbs in the active voice. The result also showed weak power relationship and weak involvement in both textbooks. The weak power (hierarchical) relationship was shown by the more occurrence of interrogatives and declarative rather than imperatives in both textbooks; meanwhile, the weak involvement was shown by the frequency of the use of the personal pronouns (plural persons are more than a singular person).

4. Conclusion
In terms of textbook analysis for science (chemistry) for both students and teachers in junior high school, there are three formality values such as the terminology and notation, nominalisations, and the use of passive voice. The formality value also has a correlation with linguistic code. The categories of terminology and notation for teachers’ book and students’ book showed the result of high (H) value, the nominalisations for teachers’ book and students’ book also showed the result of high (H) value; meanwhile, the use of passive voice for teachers’ book and students’ book showed the result of low (L) value. The formality markers of the linguistics code were described in the range of High, Moderate, and Low. The high shows that the high formality corresponds to the specialised linguistic code with the existence of nominal groups of three or more nouns; meanwhile the low shows that the formality has many vernaculars with no nominal noun.

References
[1] Brown N and Beswick K 2014 Policy and curriculum research in the context of change. In N. Fitzalen, et al. (Eds.), The future of educational research, perspective for beginning researchers (Rotterdam: Sense Publishers) pp. 3-11
[2] Soekisno R B A 2007 Bagaimanakan perjalanan kurikulum nasional pada pendidikan dasar dan menengah. Retrieved from http://rbaryans.wordpress.com/2007/05/16/bagaimanakajaran-perjalanan-kurikulum-nasional-pada-pendidikan-dasar-dan-menengah/.
[3] Ravitch D 2003 The language police: How pressure groups restrict what students learn. New York: Alfred A. Knopf.
[4] Valverde G, Bianchi L, Wolfe R, Schmidt W, and Houang R (2002 According to the Book: Using TIMSS to Investigate the Translation of Policy into Practice through the World of Textbooks (London: Kluwer Academic Publishers)
[5] Sewall G T 1992 Textbook organisation and writing: today and tomorrow. In J. G. Herlihy (Ed.), The Textbook Controversy: Issues, Aspects and Perspectives (New Jersey: Ablex Publishing Corporation) pp 27-32
[6] Phillips L M and Norris, S P 2009 Res. in Sci. Educ. 39 313
[7] Halliday, M. A. K. (1996). On the language of physical science. In M. A. K. Halliday & J. R. Martin (Eds.), Writing science: Literacy and discursive power (London: The Falmer Press) pp. 54–68
[8] Mulryan, C. (1984). Effective communication of mathematics at primary level: Focus on the textbooks. Irish Educational Studies, 4 (2).
[9] Gray, D.E. (2004). Doing Research in the Real World. SAGE Publications.
[10] Krippendorff, K 1980 Content Analysis: An Introduction to its Methodology (Beverly Hills, CA: Sage)
[11] Dimopoulos K, Koulaidis V, and Sklaveniti S 2005 Res. in Sci. Educ. 35 173
[12] Halliday, M A K 1994 An introduction to functional grammar (London: Edward Arnold)
[13] Pueyo, I G and Val, S 1996 English for Spec. Purposes 15 251
[14] Eggins, S. (2004). An Introduction to systemic functional linguistics. 2nd Edition (London: Printer Publishers, Ltd)
[15] Derewianka, B. (1990). Exploring How Text Work. (Australia: Primary English Teaching Association)