

Comparing Principle-oriented and Information-oriented Educational Approach towards Human Genetics: A Profile of Selected Textbooks

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Abstract

Back ground: Genetics is the study of inherited traits and their variations. It directly affects our lives, as well as those of our relatives, including our descendants. To diagnose a disease of inheritance the knowledge of Genetics is essential for a physician today. When the problem is within the gene of a patient then the goal of the treatment should obviously be the correction of the mutated gene. But the subject 'Genetics' being a very complex one, it is often difficult for the medical students to develop a proper understanding of it. So it requires developing an acceptable way for the students to get the subject easily by heart. It is assumed that learning process may be facilitated by structuring it around general stable rules or 'principles' of the subject rather than trying to memorise plenty of apparently disconnected information both at the 'knowledge' and the 'skills' levels. For achieving this goal, an appropriate analysis is in warrant. **Objectives:** To Identify the approaches taken regarding the use of 'principle' and 'information' in presenting Genetics through texts and illustrations in the textbooks. **Method:** The present study was a cross-sectional type of descriptive study with qualitative and quantitative component was done in the Department of Anatomy, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. **Analytical materials:** Two selected textbooks on Genetics. **Main Outcome Measures:** Textbooks on Genetics were analysed to estimate the relative proportions of 'sentences and illustrations presenting primarily Principle-oriented text and aspect' and 'sentences and illustrations presenting primarily Information-oriented text and aspect'. **Results:** In the Genetics textbooks those were analysed, the mean percentage (\pm SD) of the 'sentences presenting primarily Principle-oriented text' and the mean percentage (\pm SD) of 'Illustrations are having Principle-oriented aspect' were within 38-46%. **Conclusion:** This study has produced a basic profile of the 'Principle-Information' issue in the teaching-learning and assessment of Genetics in terms of the presentation patterns of textbooks. Analyses through this thesis work noticed the reflections of 'Principle oriented approaches' in Genetics textbooks. This result will provide baseline understanding on which further studies can be designed and preliminary decisions can be made in developing and implementing a 'Principle-oriented curriculum for postgraduate Genetics.

Key Words: Principle, Information, Text, Illustration

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Introduction:

Genetics is the branch of science concerned with genes, heredity, and variation in living organisms. Genetic disorders differ from other areas of medicine in that it so often involves families, rather than only individuals. The patients are often healthy, but concerned about the risk of developing or transmitting a disorder. According to Skirton et al.¹ as an understanding of the effect of gene variation on the complex or common diseases increases, knowledge of Genetics is needed by health professionals to practice. The specific genes that seem to contribute to specific disorders, the practitioner must understand and be able to explain to patients—which of these reports have clinical significance and which are merely unsubstantiated claims. To achieve the goal of gaining

adequate knowledge on Genetics the field of education has to be focused. We know that it is quite difficult to understand Genetics properly being a complex subject. Erickson² pointed out, 'At times, teachers express a concern over the tension between a heavy curriculum load and the time to teach for deeper conceptual understanding and the transfer of knowledge'. We must have to go through an acceptable and easy way to make it understandable because students are more likely to enjoy learning when they are able to be successful; they are more likely to be successful if they are learning in a way that is natural to them. Brady³ stated 'what students need is a "master" organizer— a mental filing system or map they understand— that displays the general layout of the mind and its system for integrating knowledge'. Today's challenge for medical educators is to provide continuing education that supports excellence in clinical

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practice while finding new approaches to make learning more stimulating, motivating, and entertaining⁴. Here, a way that can be helpful for learning Genetics is “generalisation” which means taking one or a few facts and making a broader, more universal statement. Here the concept considered for generalisation is termed as “principle” and the fields to which it is applicable are termed as “information”. When student learns to analyse information they are able to gain a deeper understanding of ideas. Brain research has shown that information in our brain is organised in schematic structures. These structures are made up of interconnected bits of information and serve as a framework for the knowledge we require. When a learner's knowledge is connected it is much more likely that they will apply the prior knowledge to a wide variety of new situations. They will acquire new information in a way that is more accessible and will be better able to relate it to previously acquired knowledge.

Materials and Methods

This was a cross-sectional type of descriptive study with qualitative and quantitative component carried out on two Genetics textbooks where all chapters with its relevant parts were considered by excluding specific parts using defined exclusion criteria. Then the total number of sentences and illustrations of each textbook were counted. Then the 'sentences presenting primarily Principle-oriented text' and 'sentences presenting only Information-oriented text' and 'illustrations having Principle-oriented aspect' and 'illustrations having only Information-oriented aspect' in each textbook were identified and counted separately. Then the percentages of the above types of sentences among all the sentences and illustrations among all the illustrations in each textbook were estimated. Then the means of the percentages in the two textbooks were calculated. The textbooks on Genetics were selected are:

1. Emery's Elements of Medical Genetics: Text and Atlas edited by Peter Turnpenny and Sian Ellard, 14th edition, 2012, Elsevier Churchill Livingstone, Philadelphia.
2. Human Genetics: Concepts and Applications by Ricki Lewis, 9th edition, 2009, McGraw-Hill Primis, United States of America.

Results

In the present study, the analysed portions of the textbook Lewis (2009) have 7550 sentences and those of Turnpenny and Ellard (2012) have 6250 sentences. Table III shows the

percentages of the 'sentences presenting primarily Principle-oriented text' and 'sentences presenting primarily Information-oriented text' of the two Genetics textbooks analysed. The mean percentage of 'sentences presenting primarily Principle-oriented text' of the two textbooks is 38%. Figures 3 and 4 present the percentages of 'sentences presenting primarily Principle-oriented text' and 'sentences presenting only Information-oriented text' in specific portions under different headings/ sub-headings of the Genetics textbooks analysed. It revealed that under all the headings/ subheadings of the two Genetics textbooks, the 'sentences presenting primarily Principle-oriented text' out proportion the 'sentences presenting primarily Information-oriented text' most noticeably for the chromosome, cells and cell divisions and genetic counseling topics. On the other hand, the sentences presenting primarily Information-oriented text' out proportioned by the 'sentences presenting primarily Principle-oriented text' most noticeably for the genetic disorders, testing and treatment topics. A total number of 336 illustrations were analysed from the textbook, Lewis (2009) and 315 illustrations were analysed from the textbook, Turnpenny and Ellard (2012). The relative proportions of the 'illustrations having Principle-oriented aspect' and 'illustrations having only Information-oriented aspect' of the two selected Genetics textbooks as shown in Table IV and Figure 5 and Figure 6 shows relative Proportions of 'illustrations having Principle-oriented aspect' and 'illustrations having only Information-oriented aspect' in specific portions of different headings/ sub-headings of the Genetics textbooks. The mean percentage of 'illustrations having primarily Principle-oriented aspect' of the two

Table I: Showing examples of 'sentences presenting primarily Principle-oriented text'

Chapter	Example
The History and Impact of Genetics in Medicine	The law of segregation refers to the observation that each person possesses two genes for a particular characteristic, only one of which can be transmitted at any one time.
The Cellular and Molecular Basis of Inheritance	Within each cell of the body, visible with the light microscope, is the cytoplasm and a darkly staining body, the nucleus, the latter containing the hereditary material in the form of chromosomes.
Chromosomes and Cell Division	The tip of each chromosome arm is known as the telomere.

Table II: Showing examples of 'sentences presenting primarily Information-oriented text'

Chapter	Example
The History and Impact of Genetics in Medicine	The history of genetics in relation to medicine is one of breathtaking discovery from which patients and families already benefit hugely, but in the future success will be measured by ongoing progress in translating discoveries into both treatment and prevention of disease.
The Cellular and Molecular Basis of Inheritance	In 1953, Watson and Crick, based on x-ray diffraction studies by themselves and others, proposed a structure for the DNA molecule that fulfilled all the essential requirements.
Chromosomes and Cell Division	The word <i>chromosome</i> is derived from the Greek <i>chroma</i> (= color) and <i>soma</i> (= body).

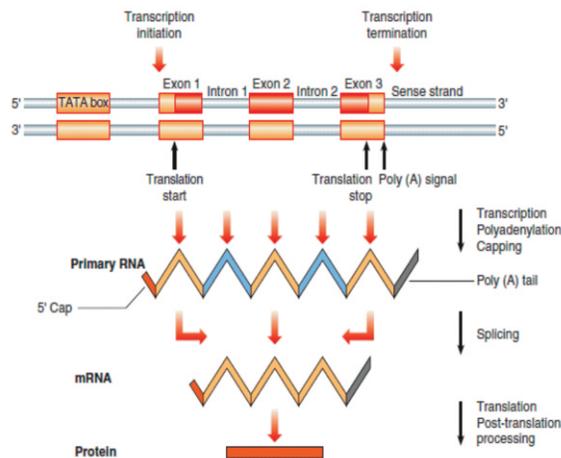


FIGURE 2.8 Transcription, post-transcriptional processing, translation, and post-translational processing.

Figure 1: An 'illustration having Principle-oriented aspect'. The diagram shows protein synthesis. Sources: Turnpenny and Ellard (2012), p. 15;



Figure 2: An 'illustrations having only Information-oriented aspect'. The diagram shows features of scleroderma a delayed immune response and is not applicable to any other fields. Sources: Lewis (2009), p. 34

Table III: Percentages of 'sentences presenting primarily Principle-oriented text' and 'sentences presenting primarily Information-oriented text' in the specific portions of two selected Genetics textbooks

Sl no.	Category of sentence	Percentage in individual textbook		Mean percentages in the two textbooks ±SD
		Lewis (2009) n=7550	Turnpenny and Ellard (2012) n=6204	
1	Sentences presenting primarily Principle-oriented text	36%	40%	38.00±2.82
2	Sentences presenting primarily Information-oriented text	64%	60%	62.00±2.82

n: No. of text analysed

Headings/subheadings

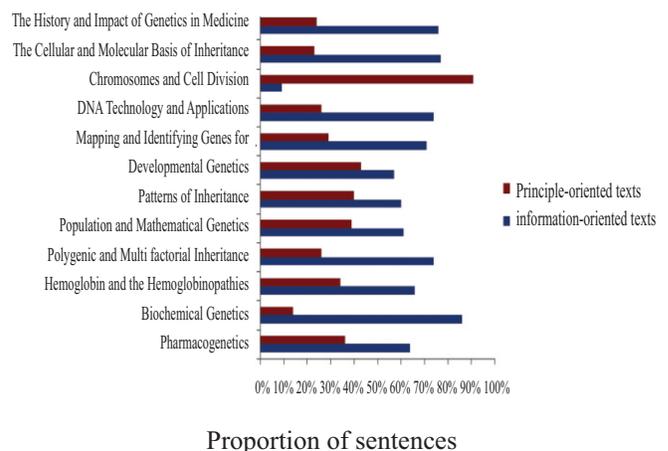


Figure 3 : Percentages of 'sentences presenting primarily Principle-oriented text' and 'sentences presenting primarily Information-oriented text' in specific portions of the Genetics textbook by Turnpenny and Ellard (2012)

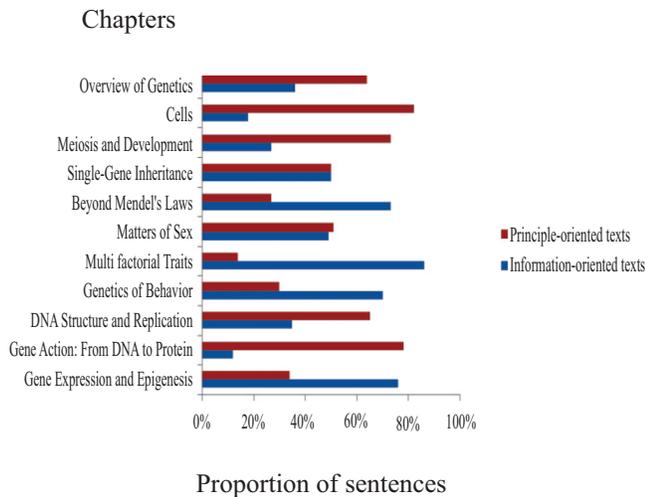


Figure 4: Percentages of 'sentences presenting primarily Principle-oriented text' and 'sentences presenting primarily Information-oriented text' in specific portions of the Genetics textbook by Lewis (2009).

Table IV: Percentages of 'illustrations having Principle-oriented aspect' and 'illustrations having only Information-oriented aspect' in the specific portions of two selected Genetics textbooks

Sl no.	Category of sentence	Percentage in individual textbook		Mean percentages in the two textbooks ±SD
		Lewis (2009)	Turnpenny and Ellard (2012)	
		n=336	n=315	
1	Illustrations having Principle-oriented aspect	56.55%	34.92%	45.73±15.29%
2	Illustrations having only Information-oriented aspect	43.45%	65.08%	54.26±15.29%

n: No. of illustrations analysed

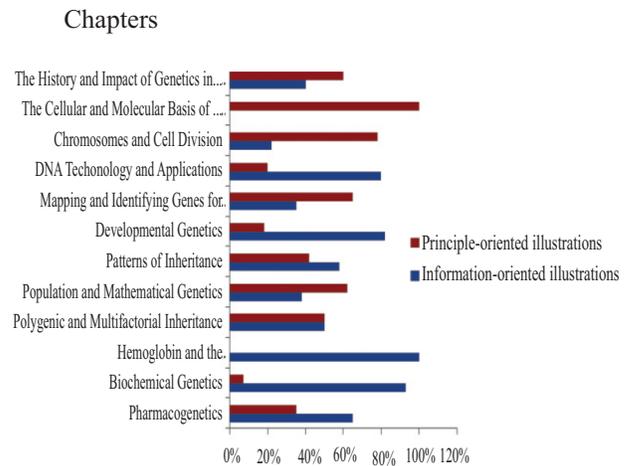


Figure 5: Percentages of 'illustrations having Principle-oriented aspect' and 'illustrations having Information oriented aspect' in specific portions of the Genetics textbook by Turnpenny and Ellard (2012)

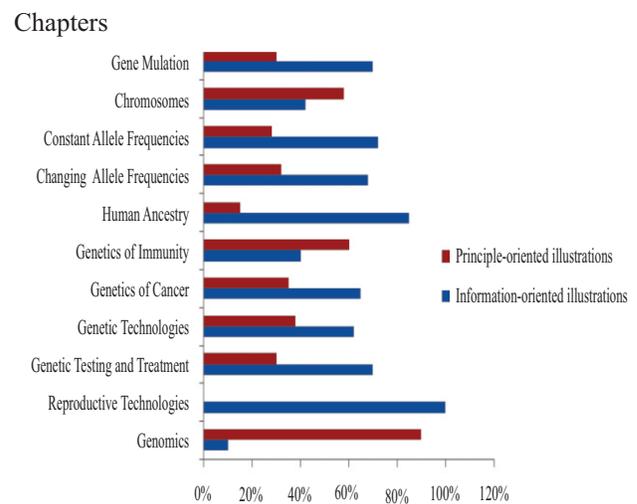


Figure 6: Percentages of 'illustrations having Principle-oriented aspect' and 'illustrations having Information-oriented aspect' in specific portions of the Genetics textbook by Lewis (2009) under different chapters.

Discussion

Textbooks and ancillary materials will remain an instrument of extraordinary power. They may, in fact, be the most effective of educational technologies yet invented, and there is no reason to imagine a modern educational system where textbooks do not play a central role. It is therefore fitting and proper to pay close attention to their role and function and their content⁵.

Textbooks figure into challenge of improving understanding and transfer of knowledge to learners. In a textbook an author can be balanced in different ways depending on the age, ability and experience of the reader and on the importance of topic. The way of presentation of information in a textbook can make all kind of learning effective. To improve memory, have to improve understanding, and to enrich understanding, we must have to increase the utilisation of 'Principle-oriented approach' in textbooks.

The present study revealed that the two Genetics textbooks analysed had an average of around 38% of the sentences 'presenting primarily Principle-oriented text'. Analyses of the illustrations on the two Genetics textbooks showed that a mean of about 46% of them had 'Principle-oriented aspect'.

Through literature search no such study could be detected on Genetics, but in the Department of Anatomy (BSMMU) several similar studies have been done on other subdivisions of Anatomy. These are in Neuroanatomy⁶, in Cell and Histology⁷ and in General and Regional Anatomy⁸. All these researchers worked on two selected textbooks and their studies showed the mean percentages of 'sentences presenting primarily Principle-oriented text' as about 25%, 42% and 81% respectively in the three studies the mean percentages of such illustrations were around 27%, 47% and 84% respectively. These differences between the anatomical subdivisions may be due to differences between the subjects in their nature (including visual nature) and/ or the approaches taken by the textbooks. Besides this another fact that might have influenced the variation of the findings is that Genetics is the subject which is newly approached in Anatomy. So it is taking time to develop 'Principle based approach' in Genetics. In the present study on Genetics textbooks, it is noted that, chapters dealing with chromosomes and cell division had the highest mean percentages of 'sentences presenting primarily Principle-oriented text' while the chapters dealing with genetic technology and genetic disorders carry least amount.

Wikiversity⁹ has mentioned that 'Principles' give us the understanding behind every procedure, and 'there is at least one principle which explains why it works'. Thus, Principle-oriented teaching-learning methods are likely to promote deep understanding. Deep understanding generally refers to

how concepts are represented in the students' mind and most importantly, how these concepts are connected to each other. Genetics is such a subject where there is necessity of plenty of 'Information' as well. Gutterman, Porteous and Melnerly¹⁰ argued that an important goal in educating health-care professionals in genomics is to enable them to understand and utilize genetic-based probability and risk assessment, and to communicate effectively about them. 'Principle' is necessary for understanding and memorisation and 'Information' is the knowledge that is the main target of a lesson. A balance between Principle and Information has to be maintained for proper understanding of the learning process. We need to develop assessment policies in Genetics of medical curriculum in Bangladesh.

Conclusion

Considering the experience gained from the present study, it may be suggested that one can design to compare the impact of 'Principle-oriented teaching' with that of 'Information-oriented teaching' on students learning of Genetics. An exercise-oriented study may be designed on how and how successfully the teachers decide to select 'Principles' from the contents of the Genetics textbooks for using in their teaching.

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