

SELECTION OF DESCRIPTIVE GEOMETRY TEXTBOOKS

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Abstract: The concept of analyses of descriptive geometry textbooks presented in the paper is based on the communication theory and enables varied approach to construction and evaluation of textbooks. Due to the fact that descriptive geometry is the field of knowledge, meta- linguistic function of the textbooks seems especially interesting. The development of the presented concept by the appropriate techniques of measurement may master methods of evaluation of the didactic materials.

Keywords: descriptive geometry, academic textbook, communication theory

1. Introduction

Transformation of descriptive geometry as university subject is the consequence of the decreasing number of didactic hours during the past decade. On the other hand, application of CAD software influences methods of teaching descriptive geometry. Advantages of electronic educational teaching materials are among others: easy access to Internet and freeing from editing limitations. Colorful and esthetic drawings placed in chronological order show the stages of the construction and are supported by additional visualization models. In such an educational environment the role of traditional 'paper' textbooks changes. They become complement to electronic teaching materials and are mainly used for self-education.

For a long time relatively stable literature for descriptive geometry consisted of several textbooks written by great authorities. Generations of Polish engineers learned from them and copies of mainly those books are accessible at the university library in Gdansk University of Technology. However, the content of those textbooks covers a much wider range of educational objectives and teaching material than needed at present. Understandably, such textbooks are frequently regarded as too difficult in perception. The changes in the curriculum greatly influenced the course-content and the textbooks for students. Lately the number of new textbooks has rapidly increased, reflecting the present educational needs.

The subject of the paper originated as the reflection on the practical choice of textbooks for students and their role in the course-content for Faculty of Civil and Environmental Engineering in Gdansk University of Technology. The analysis applies to literature which is the element of a three-dimensional model of course-content. The model combines three components, i.e. educational objectives, teaching material and curriculum requirements. Attributes of those components require that the educational objectives subordinate the relevant teaching material. Teaching material contains lectures, tasks for classes, tasks for self-education, ready-made examples and a list of literature. The curriculum requirements enable differentiating scores according to the expected students' achievements.

2. The survey

The initial comparative analysis of the course-content for descriptive geometry at Polish technical universities carried out by means of Internet reveals some convergent and differentiating features. The similarities cover general teaching objectives and application of computer assisted teaching methods in different forms. What differentiates the courses are some specific objectives, teaching materials such as drawing tasks and recommended literature.

Students of Faculty of Civil and Environmental Engineering in Gdansk University of Technology use educational materials for descriptive geometry adjusted to the educational objectives and placed on the Internet page of the subject. One of the aims of evaluation was to find out how many students use recommended literature of traditional textbooks. Students could choose one or the combination of sources of knowledge or they could also add their own comments. The results of the survey show that most students (92%) use tailored-made lectures for revision before classes and tests. Half the number of students use traditional textbooks, among them 17% also use other Internet materials.

The results of the survey show that even though students commonly use tailor-made complete teaching materials in electronic version and other additional Internet sources, they emphasize the need for printed textbooks. The presented analyses refer to the educational objectives set for the course of descriptive geometry in 2006/7. In the survey ten descriptive geometry textbooks enlisted in the references of the paper were taken into consideration.

3. Definition and the functions of the textbook

In own research the textbook is defined as the collection of the messages constructed in different languages (e.g. visual language, logic, mathematics) and placed on different kind of a carrier [12]. The concept originally comes from the psycho-linguistic communication theory initiated by Roman Jakobson. Such approach enables the analysis of textbooks at six different levels, which apply to formative components of communication process (sender, message, receiver, context, cod and channel). In theory of communication the sender should control the message at six levels while creating it, whereas the receiver evaluates the message according to the same criteria. The functions are adapted to the survey needs (Fig. 1).

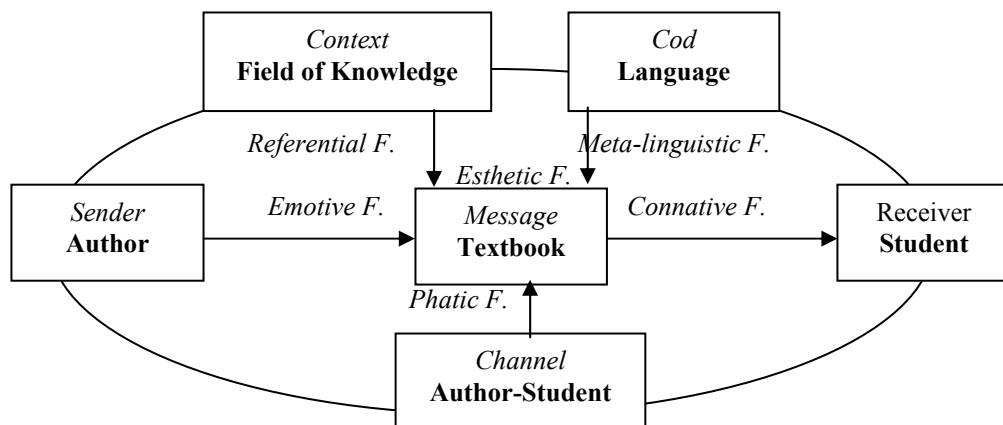


Fig. 1: Functions of descriptive geometry textbook based on communication theory

To each component, the dimension and the research question was specified. (Table 1)

Table 1: The functions of textbooks, dimensions and relevant survey question

Function	Dimension	Research question
Referential	Information about de-scribed field	To what extend is descriptive geometry knowledge presented in a valid and reliable way?
Emotive	Selection of problems	What is the selection of charts and paragraphs in the textbook?
Phatic	Way of narrative, channel author-reader	To what extend is the textbook attractive in reading and encourages the students to continue reading?
Connative	Receiver reaction, aid for learning	To what extend can the textbook help to achieve the general educational objectives?
Meta-linguistic	Cod of the message	To what extend is the language of the textbook comprehensible to the reader?
Esthetic	Graphic layout	Is the textbook appearance attractive for the reader?

The convergent features of most analysed textbooks are the way of coding the messages and page layout with drawing and written text of comments. The paper is limited only to those features and focuses on the meta-linguistic function of the textbooks.

4. Meta-linguistic function of descriptive geometry textbook

Descriptive geometry provides the foundation for creating and understanding 2-D drawings of 3-D objects and was invented as the common language for engineers and workers. Therefore the aspect of communicating about spatial objects between the author and the receiver of the message is the most important. Graphic language of descriptive geometry drawings is clear, univocal and precise. The natural language for geometry is drawing and it is hard to represent the spatial relations without it. Graphic language is used for education and solving practical engineering problems. Written or spoken language provides a very important comment of the picture, but it cannot replace the drawing.

Meta-linguistic function of the textbook refers to the way the message is coded. Meta-language is the language used for describing another language. In case of descriptive geometry textbooks, written meta-language is used for describing drawings - the basic language of geometry. That means that the messages in the textbooks are coded in two languages.

The spoken or written language is definitely the basic way of human communication. Its cognitive apparatus is linear which means that the reader follows the lines of the text. It is the author who controls the sequence of the messages. Visual message (drawing) has got the holistic character. It is the reader who decides where to start and which direction to continue reading the drawing. Both languages encode the messages in different ways and influence the imagination of the reader differently. This may explain why sometimes, regarding the level of detailing and precision of the message, very complex sentences refer to not so complex spatial relations.

As a mean of communication, language is used for transforming message. Geometrical constructions assemble partial stages. Each stage reflects new additional information and requires relevant explanation. Subsequent drawings arranged in logical way direct the reader and transfer the content of the whole message. This is graphic language used for showing the construction step-by-step. Written text completes the graphic message, it works as a comment of the drawing. Numerous opinions of descriptive geometry specialists as well as the description of textbook by Professor Marian Palej [6] confirms that creating graphic messages step-by-step helps learning and understanding the process of creating the construction.

5. Easiness of message perception

Easiness of message perception was traced on the example of two tasks: intersection of level of solids and transformation of polygon. The examples in different textbooks represented similar difficulty. As the base for analysis efficiency postulates of maximum understanding and maximum access to the message by T. Wójcik [12] were adapted.

The message, which was the solved construction of the task, was analyzed by separating the subject, succeeding stages of the construction and final result. Trying to solve the task, the first thing a reader should notice is the subject on the drawing. It is essential for imagination of the 3-D object and the process of finding the solution.

It was observed that most textbooks reveal many convergent features. Written text is used to formulate the subject, to describe the stages of construction and the final result. It is usually accompanied by only one drawing containing all possible graphic information. The subject, direct and oblique constructions as well as final result unite in the drawing and may be hard to distinguish. It seems that it might cause difficulty for the reader to select the proper stage of the whole construction.

Two books from the list reveal separate features. The textbook by T. Bogaczyk, T. Romaszkievicz-Białas *13 wykładów z geometrii wykreślnej* [5] presents the subject of the task, one-to-three stages of the construction and the final result in succeeding accumulative drawings. Additionally, written text is divided into paragraphs corresponding to succeeding drawings. The textbook written by Z. Andrzejowski, W. Pawłowski, S. Przewłocki *Geometria wykreślana* [1] presents the text organized in fragments relevant to the following stages of the solution but there is only one concise picture. In other textbooks the text describing the following stages of the construction continues from six to sixteen lines and it is not organized in clear-cut paragraphs which may negatively influence the understanding of the meaning and reference to the picture.

The access to the message was searched by finding the answer to the question if the message is placed within the reader's reach in optimum degree. The drawing and its description form a whole task-message. It was recognized that the message is accessible when both parts of the message are placed in the reader's field of vision in such a way that it is possible to trace the construction on the drawing while reading the description. Only than the translation of the codes is not disturbed.

Among the selected textbooks again the book written by Z. Andrzejowski, W. Pawłowski, S. Przewłocki *Geometria wykreślana* [1] is distinguished. As a rule the drawing and relevant text is placed close to each other on the same page, so it is convenient to follow the text and simultaneously look at the picture. In the text the mathematical symbols are used which distinctly shortens the text. Similar rule organizing the page layout can be observed in the above mentioned textbook by T. Bogaczyk, T. Romaszkievicz-Białas *13 wykładów z geometrii wykreślnej* [5] where the drawing and relevant description is rarely not on the same page. In other textbooks independently from the page format text continues on the next page although it corresponds to the drawing which cannot be seen.

6. Conclusions

Traditional 'paper' textbooks start to function as complement to the extensive computer aided teaching materials. The main employment of the textbooks is shifted to self-education of students; therefore it is important to trace how friendly they are to readers.

Transformation of descriptive geometry as university subject in the past decade caused differentiating in structure and selection of topics of the new textbooks. New formulations of the content were not followed by the changes of the layout of the textbooks though. As a result the layout of the pages and the way of presentation of 3-D problems may be regarded as relatively stable and convergent for most textbooks taken into consideration.

The analysis of the textbooks shows more convergent than differentiating features. Meta-linguistic function of the descriptive geometry textbooks revealed that double graphic-written encoding of the content may influence the perception of the message. Graphic language is generally used to present the final result, whereas written language is used to describe the subject and the process of construction. The reader not only has to use double coding but also constantly swaps between the two languages. Students regard descriptive geometry textbook as very difficult in perception. This difficulty may partly depend on the selection and advancement of the topics, but may partly depend on the difficulty in combining messages received in two different kinds of languages. Additionally, students may find difficult to spot the following steps of construction concentrated in one all-in-all drawing.

The paper presents the concept of analyses of linguistic function of several textbooks. The list of literature contains the books written by great authorities whose contribution to the development of descriptive geometry in Poland awakes great respect of the author of the paper. However, the subject of visual communication especially in contrast with new technolo-

gies appears very important. It seems that presented concept may well help in evaluation of new educational materials.

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WYBÓR PODRĘCZNIKÓW DO GEOMETRII WYKREŚLNEJ

Transformacja geometrii wykreślnej jako przedmiotu kształcenia na wyższych uczelniach technicznych postawiła wymóg przededefiniowania szczegółowych celów nauczania oraz treści kształcenia i stała się bezpośrednią przyczyną powstawania nowych podręczników przedmiotu przystosowanych do zmieniających się potrzeb edukacyjnych. Jednocześnie powszechne stosowanie komputerowych metod wspomagania nauczania zmienia funkcję klasycznych podręczników do geometrii wykreślnej w procesie kształcenia, które zaczynają pełnić rolę uzupełniającą do rozbudowanych multimedialnych materiałów dydaktycznych. W związku z tym zjawiskiem są one stosowane głównie do samokształcenia studentów i dlatego duże znaczenie ma to, na ile są one przyjazne dla użytkowników.

W artykule przedstawiono koncepcję badania podręczników do geometrii wykreślnej bazującą na psycholingwistycznej teorii komunikatu. Zaprezentowane podejście umożliwia analizę podręczników na sześciu poziomach odnoszących się do głównych funkcji komunikacji międzyludzkiej. W artykule skupiono się na postrzeganiu językowej funkcji podręczników geometrii wykreślnej i w tym zakresie stwierdzono wiele cech zbieżnych badanych podręczników. Analiza cech charakterystycznych języka graficznego i słownego, zróżnicowanie kodów zapisu i związany z tym odmienny wpływ na wyobraźnię oraz wzajemny układ obu języków zapisu sprawia, iż czytelnik jest zmuszony do ciągłego odczytywania informacji podwójnie kodowanej. To właśnie wydaje się stanowić jedną z przyczyn trudności w odbiorze zawartości podręczników. Wydaje się także, iż wnioski wypływające z pojętych analiz mogą pozytywnie wpływać na proces konstruowania nowych materiałów edukacyjnych.