

Relationship and dependency between linguistic and non-linguistic forms of concept representation:

A study of texts addressed to experts and students

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1. Introduction

Concept representation has always been an intriguing subject, and in the last few years it has gained even more importance (Thornton, 1996: 152). As Picht states (1994: 932), since long ago, terminology has been concerned with the description of the concept with special focus on the definition, and, in recent years, terminologists have reevaluated how the concept can be represented.

Despite this interest, little has been written in the field of terminology about the relationships and dependencies between linguistic and non-linguistic forms of concept representation. Picht (2002: forthcoming), Kalverkämper (1993: 218), and Laurén (1998: 186) maintain that large holes remain to be filled in this matter in scientific and technical contexts.

In order to help fill these gaps, we have carried out a study on documents addressed to aircraft mechanics specialized in fighter jets and to students of this discipline. This research is part of a greater work conducted in the field of terminology¹. With this investigation we aim to contribute to a better understanding of the communication at high and medium levels of specialization, and, in this way, to draw conclusions useful for theoretical and practical users of terminology.

Before beginning with the analysis of the relationships and dependencies between linguistic and non-linguistic forms of concept representation in the area of fighter

¹ The work is a thesis entitled *Interrelaciones e interdependencias entre distintas formas de representación conceptual: Estudio en tres niveles de especialización en textos sobre instalaciones de combustible de aviones*, directed by Dr. Picht and defended at the University of Las Palmas de Gran Canaria (Spain) on January 31, 2002.

jets, we must delimit our corpus to a manageable size. From this abridged sample we will determine which forms of concept representation exist as well as the parameters used to establish relationships between those forms.

2. The corpus

Considering that the area of fighter jets is largely inaccessible by the general public, to our knowledge no one has studied its different forms of conceptual representation with the exception of this paper's author who investigated it in her minor thesis (Monterde, 1999). As the area of fighter aircraft is very broad, we chose the sub-area of fuel systems, because we could count on the assistance of a first sergeant fighter mechanic of the Spanish Air Force² specialized in this matter and with the restricted documents (Marcel Dassault, 1974a, 1974b: 002, 1-509, 1974c; Maestranza aérea de Albacete, 1989)³ he uses in maintaining the Mirage F1 fighter.

At the student level, we assert that in order to follow a parallelism with the expert level, we should analyze texts on fuel systems studied by the mechanics of the Spanish Air Force while they were students. For this reason, our sample for this level comes from the books studied by the aforementioned mechanic (De la Malla, 1972: 195-218; Escuela de Mecánicos de Aviones, 1971: 110-119) and by current students (Lombardo, 1994: 97-106; Sáinz, 1998: 139-151).

After analyzing the fuel system documents, we isolated 119 and 100 concepts on the expert and student level, respectively⁴.

3. Forms of concept representation

The various definitions given for concept representation are vague (Stockinger, 1993: 5). We will apply Greco's (1995: 119) and Montes' definition (1992: 12-13): the representation of a concept is a linguistic or non-linguistic expression, or combination of both, through which a concept is determined; that is, a "unit of knowledge created by a unique combination of characteristics" (ISO 1087-1, 2000: 2).

3.1. Non-linguistic forms of concept representation

² His help was based on the condition of anonymity.

³ From now on, we will use abbreviations of these and student documents. Refer to the bibliography to see these abbreviations.

⁴ To isolate this sample we designed systems of concepts of the fuel-feeding phases and parts of aircraft fuel systems by following norms ISO 704 (2000: 6-11), ISO 1087-1 (2000: 4-5, 16-23) and DIN 2331 (1980: 810). Due to space limits, we do not include these systems of concepts or the texts and illustrations that we have analyzed with the exception of two examples shown in Appendix 2. Excluding the restricted documents, supplementary information can be provided by request to amonterde@sinf.ulpgc.es.

We consider non-linguistic forms of concept representation to be all those in which the human written or oral language do not participate. In this sense, in our corpus we found only illustrations⁵ as non-linguistic forms; that is, pictorial representations of concepts. Despite their interest, we will not give details about the different types of illustrations found, nor about their characteristics, since this is the aim of another part of our research.

3.2. Linguistic forms of concept representation

By linguistic forms of concept representation we understand those that represent a concept by means of human written or oral language. In our sample, the linguistic forms we found are terms, definitions, and explanations⁶.

A term is a "verbal designation of a general concept in a specific subject field" (*Ibid*: 6). A definition is a "representation of a concept by a descriptive statement which serves to differentiate it from related concepts" (*Ibid*). Finally, an explanation is defined (ÖNORM A 2704, 1990: 3) as "Inhaltsbeschreibung ohne hinreichende Bezugnahme auf ein Begriffssystem" ("A content's description without sufficient reference to a system of concepts").

Moreover, we take into account any linguistic form included in an illustration of our corpus, specifically:

- terms in the legends⁷;
- any other term on an illustration;
- captions;
- any other text printed on illustrations.

4. Parameters of study

Our objective is to relate every linguistic form with the non-linguistic form (illustration) found in our sample of the two selected levels of knowledge. We propose to accomplish it by answering the following questions.

4.1. Questions relating terms to illustrations

Terms inside definitions and explanations:

- Can we find in the texts the names of all the illustrations and of all the elements inside these illustrations⁸?

⁵ We will use the names "illustration" and "figure" indistinctively to avoid the repetition of the word "illustration".

⁶ To analyze the linguistic and non-linguistic forms of our sample, we created a terminological database with conceptual entries in the computer program *MultiTerm*. Each entry includes all terms, definitions, explanations and illustrations which represent a concept in our corpus. (See the previous footnote).

⁷ According to Dr. Rafael Moreno, Senior Professor of Aeronautical Engineering at the Universidad Politécnica de Madrid, a legend is (oral communication) the concise explanation attached to an illustration to complement it. It normally consists of graphic symbols (see footnote 13) followed by the terms which represent them.

Terms inside illustrations:

- Which illustrations are accompanied by terms in the legend and which by terms that indicate the name of the different parts depicted in the illustrations?
- How are these latter terms associated with the illustrations; i.e., are they written next to the part that they name⁹ or do they appear in a list next to the number of the corresponding part in the illustration?

4.2. Questions relating definitions and explanations to illustrations

- What percentage of illustrations possesses a definition or explanation of the concept that they represent?
- What percentage of concepts depicted in the illustrations has a definition or explanation?
- Are illustrations identified by means of the name of the illustration (figure, diagram, picture, etc.) followed by a number¹⁰?
- Are figure references strong or weak forms¹¹?
- Are the illustrations situated on the same page as the text that refers to them, or on the pages before or after the text?
- Are the elements of illustrations situated on the same page as the text that refers to them, or on the pages before or after the text?
- Are the elements inside illustrations referred to by means of a term, a term followed by a number that corresponds to these elements, or only by such a number?
- Is the preceding reference a strong or a weak form?

4.3. Question relating captions to illustrations

- What is the caption's function: to explain the illustration, to add new information to the descriptive text, or to offer redundant information?¹²

5. Expert level

⁸ We have to remember that a figure as a whole represents a concept (e.g., an electronic circuit), but in detail it contains many concepts (e.g., parts of an electronic circuit). See, as an example, the illustration in Appendix 2.1. This illustration depicts an electronic fuel-feeding circuit . Inside it, we can see graphic symbols that represent parts of the aforementioned circuit: diodes, relays, switches, circuit breakers, etc. This figure has been slightly altered, without any prejudice to our research, because it is restricted material of the Spanish Air Force.

⁹ The term normally points to the part that it names by means of an arrow.

¹⁰ This parameter and the following two have been analyzed by Darian (2001: 10-36) at the University student level in the fields of biology and chemistry.

¹¹ We define these concepts in 5.2.1.

¹² Darian (*Ibid*) studied this parameter and determined its functions.

At a minimum all concepts are depicted by one figure at the expert level. We find 67 illustrations that represent circuits, systems, etc., inside which we can see 112 illustrations of parts of the studied fuel system. Therefore, there are in total 179 illustrations for the 119 isolated concepts.

We discover no definitions for linguistic forms, but there are 111 explanations, 67 captions, 157 different terms inside explanations, and terms in the legends. Our discussion continues with the analysis of the relationship between these linguistic forms and the illustrations.

5.1. Relationship between terms and illustrations

As we have already pointed out in 4.1, we distinguish between terms within explanations and terms contained inside illustrations.

5.1.1. Terms within explanations

At this level, 100% of the illustrations and of the parts represented inside them are named by at least one term in their corresponding explanations. Of these, 100% of the terms represent a concept also depicted by an illustration.

5.1.2. Terms contained inside illustrations

Inside illustrations we discover that only legends contain terms. Specifically, legends accompany only 5 of the 67 illustrations (7.46%). In each legend, we can see all of the graphic symbols¹³ shown in the illustration together along with the terms that name them. Part of the legend of an illustration (MARman/ 163) that represents an engine feeding system is shown below.

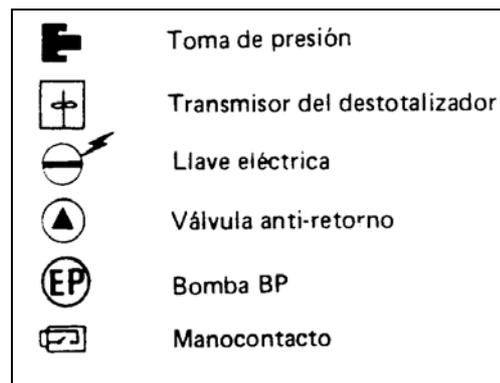


Figure Fejl! Ukendt argument for parameter.. Example of part of a legend

Graphic symbols used in aeronautics are often not standardized, hence the need for legends. However, our mechanic specialized in fighters ensures that, even without

¹³ According to Dr. Rafael Moreno (oral communications), a graphic symbol is a symbolic drawing that depicts a component inside an illustration.

the legend, a mechanic would be able to interpret the illustration due to the location of the different elements within it and the similarity of the graphic symbols used in different publications.

We locate another 12 illustrations (17.91%) that include graphic symbols but do not have legends. Nevertheless, each manual provides at the beginning a list of all graphic symbols used in all of the illustrations followed by their names. Consequently, in case of doubt, the expert could consult this list.

5.2. Relationship between explanations and illustrations

Every single one of the explanations represents a concept, which is in turn depicted by an illustration. As for the parts inside the illustrations, all but two (97.06%) are explained.

These explanations do not thoroughly describe the figures, but they delimit the concept represented and explain it by referring to the numbers of the different elements depicted in the illustrations. Due to the detail, it would be very difficult to articulate all the information provided by the illustrations. Furthermore, because of the high specialization of the language utilized in the explanations, only a specialist in the field of aeronautics would likely be able to understand the complex illustrations of this level.

5.2.1. References to illustrations

We have investigated whether an illustration is referred to by a strong or weak form. A figure reference is strong if it is part of a sentence (e.g., “In figure 1.6, a steel rod has been placed next to a ruler.”), and, it is weak if it is subordinated in parentheses (e.g., “Balances measure mass...the quantity of matter in a material (Figure 1.2).”) (Darian, 2001: 27).

In the explanations of our sample, we did not find any strong references. However, all titles of the epigraphs contained weak forms of reference¹⁴.

Regarding location, illustrations are found one or more pages after their explicative text.

5.2.2. References to elements in the illustration

Without regard to their type, all parts of fuel systems inside the illustrations are identified by a number or by a combination of a number and a letter that indicates their position in the mentioned system¹⁵. All explanations make reference to these parts through the use of their names followed by their corresponding number and letter in the illustration. These figure references are made without a verb or

¹⁴ See an example of this kind of reference in the text of Appendix 2.1.

¹⁵ For example, "bomba de arranque 15Q" ("starting pump 15Q"), "nodriza derecha 2" ("right feed tank 2"), etc.

parenthesis, i.e., with a strong form, and they are situated in any part of the sentence -beginning, middle, or end.

Therefore, we deduce that illustrations are needed in order to completely understand the explanations, since without them we would not know where the parts of the fuel system are located.

The combinations of numbers and letters are very important. Not only do they refer to the parts represented inside the illustrations, but also to lists of terms. In the case of the repair manuals, there is a so-called "índice de órganos," ("parts cross-reference"), containing the following information: a part number that indicates its location in the fuel system, name of the part followed by a description of its main characteristics and functions, and data to obtain physical access to the part. Consider the following example¹⁶ (MARman/ 113):

Posición	Designación de características y funciones	Situación – Acceso por el registro Núm.
97	AUTO-OBTURADOR - Cierra la tubería de presurización en caso de ausencia del depósito pendular derecho 14.	Mástil derecho
98	COMPUERTA ANTI-RETORNO - Evitan las intercomunicaciones entre las nodrizas posteriores izquierda 1 y derecha 2 permitiendo la admisión del aire exterior en caso de avería de presurización.	27.11/3 27.01/3

Table Fejl! Ukendt argument for parameter.. Extract of a parts cross-reference of a fighter maintenance manual

In particular, the text in the second column is the explanation of many of the concepts in our corpus, and in it we can find a part reference by the use of its position number.

In the same way, lists of terms are found in the "catálogos ilustrados de partes," ("illustrated part catalogues"). In this case the lists provide the following data: part number, manufacturer reference, and part name or description followed by other reference numbers. In these manuals, we can even find the smallest parts such as screws and washers. Curiously, the text of these lists is in French¹⁷. This demonstrates that the illustration is what is actually important for the mechanic since most of them do not speak French and thus do not know the meaning of the

¹⁶ This example and the following are printed with their original typography.

¹⁷ The Mirage F1 is a fighter aircraft that the Spanish government purchased from France together with its manuals.

terms, although they are familiar with the reference numbers. Here we provide an example (MARcar/ 21-03P 1).

PLANCHE REPERE	REFERENCE FABRICANT	DESCRIPTION
+001	FC1E521 – 01F1LAA	RESERVOIR CENTRAL 1 (PARTIE 2)..... (NRU) (EIS 06-21-01F020)
010	SA32D02	. ROBINET A FLOTTEUR (ADP).....F0553
020	F521-01-28 OU	. VIS.....
020A	FJ1C521-01-29	. VIS.....
030	23320CA080	FIL ACIER INOXYDABLE.....F0111

Table Fejl! Ukendt argument for parameter.. Example of a parts list in an illustrated parts catalogue

Finally, the illustrations with graphic symbols and drawings that represent the different parts appear one or more pages after the explicative text.

5.3. Relationship between caption and illustration

All illustrations contain a caption in the lower part. Each caption consists of the label *figure* accompanied by order numbering followed by terms that represent the same concept depicted by the illustration. Let us consider, for example, the following two captions (MARman/ 17, 20).

FIGURA 12 –LLENADO DE LA INSTALACIÓN– Circuito de combustible
 FIGURA 13 –LLENADO DE LA INSTALACIÓN– Circuito electrónico

This caption reminds the expert, although he already knows, the concept represented by the illustration. However, as we have seen, the information provided in these captions is redundant, since the epigraph titles of the manuals refer to the illustrations and these titles already indicate the concepts depicted by the illustrations.

6. Student level

In our student texts, the linguistic forms of concept representation for the 100 concepts isolated at this level are 16 definitions, 98 explanations; 15 captions, 148 terms (contained in definitions, explanations, and illustrations), and any text printed within or below illustrations.

At this level, illustrations, or non-linguistic forms, are less important than at the expert level where 100% of the concepts include at least one illustration. Specifically, in the student texts we find 30 illustrations that represent only 28 of

the 100 concepts isolated. Fifteen of these illustrations depict general concepts (circuits, systems, etc.), and, the other 15, parts of these general concepts (valves, relays, access doors, etc.). We note, however, there are 200 parts in the 15 general illustrations, which means that 185 parts have not a corresponding linguistic form in our texts.

6.1. Relationship between terms and illustrations

In the following sections we investigate the relationship between illustrations and terms inside definitions, explanations and illustrations.

6.1.1. Terms inside definitions

Of the 16 definitions found in this level, 6 (37.5%) define a concept that is also depicted by an illustration. These definitions include terms that identify illustrations. In total, 8 (53.33%) of the 15 figures and only 4 (2%) of the 200 parts represent inside the illustrations are named by a term inside definitions. Finally, the definitions contain 9 non-repeated terms, 7 (77.77%) of which also represent an illustrated concept.

6.1.2. Terms inside explanations

Only 28% of the terms in our corpus correspond with an illustration that depicts the same concept. With respect to the illustrations, 100% of them are distinguished by a term inside an explanation. Nevertheless, no explanation cites all the parts of a figure through the use of terms. In total, 45 of the 200 (22.5%) parts are named by terms inside explanations.

6.1.3. Terms inside illustrations

At this level, inside illustrations we find terms in the legends and terms next to the parts depicted in the figures or in a numeric list.

As we have already seen, the legend is useful to interpret graphic symbols in the illustrations. At this level, these symbols appear only in one type of illustration (schemes). More precisely, a legend appears in 5 illustrations (LOMcom/ 98, 99, 100; ESCfun/ 117; MALsis/ 207-208), comprising 33.33% of the figures. However, not all the symbols are found in these legends, but only those that represent pipes or tubes.

Nevertheless, it is doubtful that the student would have any problem in identifying which elements are depicted by the graphic symbols since nearly all illustrations include terms written next to the part that they represent. Exceptions consist of 3 illustrations (ESCfun/ 111; MALsis/ 200, 207-208) (20% of the illustrations) that contain a list with the terms preceded by the number assigned to the part in the illustration. This list provides the name of all numbered parts and it is situated inside the illustration, with the exception of one case (MALsis/ 200) whose list trailed the caption and mentioned only 4 out of its 10 numbered parts.

6.2. Relationship between definition and illustration

As we have previously acknowledged, 6 (37.5%) out of the 16 definitions found at this level define a concept that is also represented by an illustration.

With respect to the 15 existing illustrations, 7 of them (46.66%) (ESCfun/ 111, 117; LOMcom/ 98, 99, 100; MALsis/ 205, 207-208) are provided with definitions, and, 8 (4%) of the 200 parts depicted inside these figures are also defined.

6.3. Relationship between explanation and illustration

All of the illustrations are accompanied by explanations, but of which only 4 (26.66%) describe its corresponding illustration (ESCfun/ 111, MALsis/ 199, MALsis/ 207 and SAIsis/ 145) making reference to its parts, though they do not mention every part. The other explanations seem to be independent of their illustrations and scarcely provide data about them¹⁸.

As for the parts inside the illustrations, 84 out of the 200 (42%) isolated are explained.

Finally, at this level we detect 98 explanations, but only 14 of them¹⁹ (14.28%) represent a concept that had an illustration.

6.3.1. References to illustrations

Unlike the expert level, all explanations at the student level which described an illustration make reference to it by means of sentences such as "véase fig. x" ("see fig. x"), "en la fig. x" ("in fig. x"), or simply "fig. x". Two out of the 14 explanations (14.28%) make strong references to illustrations (ESCfun/ 111; SAIsis/ 145). This type of form is situated at the beginning of a sentence, which as stated above, more strongly binds the text to its illustration. In contrast, nearly all (85.72%) weak forms are localized at the end of sentences. We find one exception (8.33%) (LOMcom/ 99) which is in the middle.

With respect to their references, all but one illustration (92.86%) (SAIsis/ 145) is inserted after the explicative text, either in the same page or in the following one.

6.3.2. References to elements in the illustration

In contrast to the expert level where all parts in illustrations are numbered, only 3 illustrations (ESCfun/ 111; MALsis/ 200, 207-208) at the student level designate their different elements with numbers. The explanations accompanying these 3 illustrations talk only about some of their parts, but they do not mention the numbers. Therefore, explanations and parts of illustrations are not directly related.

6.4. Relationship between caption and illustration

¹⁸ See an example in Appendix 2.2.

¹⁹ There exist 15 illustrations, but 2 have the same explanation.

All illustrations are accompanied by a caption. This is logical since it has been proven empirically that the existence of a caption in an illustration helps to improve knowledge acquisition (Bernard, 1990; Schnotz, 1994, Weidenmann, 1994) and this is one of the objectives of documents addressed to students.

In the same way as the expert level, captions appear at the foot of the illustration and it is composed of the word "Figura" or "Fig." followed by order numbering and a term corresponding to the concept depicted by the illustration. We offer an example below (MALsis/ 199):

Fig. 99 Localización y capacidades de los tanques del sistema de combustible del avión BOEING-747

Six (42.85%) out of the 14 captions found in our sample indicate the type of illustration shown²⁰ which helps the student to understand which kind of illustration he is observing. If we compare these captions with the ones in the previous level, they are more explicative and specific of the concept that they represent.

Moreover, two captions are followed by a short explicative text (LOMcom/ 98; MALsis/ 200):

Figura 8.1. *Sistema de combustible del avión Cessna 152 (standard y largo alcance). Por la alimentación cruzada entre tanques, éstos deben taparse tras repostar para asegurar la máxima cabida.*

Fig. 100 Esquema del avión de combate MIRAGE III-E, en el que pueden observarse los depósitos principales de combustible (8), el depósito suplementario (5), los depósitos auxiliares (en góndolas exteriores, lanzables) (9) y el depósito especial para vuelo en invertido (3).

In short, the function of the captions is to explain the illustrations or to add new information that has not been provided by definitions or explanations.

7. Summary of results

At the expert level a close relationship exists between linguistic and non-linguistic forms of concept representation²¹. Explanations contain terms that name all illustrations and the parts inside them. We can find terms that represent all the concepts depicted by illustrations, not only inside illustrations (terms in the caption and the legend), but outside as well (terms in explanations, lists of pieces and numbers of references, headings of epigraphs and parts cross-references). On the other hand, all explanations represent a concept that is also depicted by an

²⁰ For example, the caption may say: "Esquema de x" ("Scheme of x").

²¹ See a table with a summary of the results in Appendix 1. The symbol $\bar{}$ in this table means that *this set does not exist*.

illustration and vice versa. Explanations make reference to the parts in illustrations by means of a strong form. We also find weak forms after epigraph headings, which, in reality, serve the same function as the captions of illustrations. Of the parts depicted in the illustrations, 97.06% are explained in the parts cross-reference. On the contrary, at the student level the relationship between text and illustration is not so close. In general we may say that illustrations do not depict all of the concepts represented by the linguistic forms and vice versa. The student is capable of understanding definitions and explanations without the help of illustrations. Figures are not described in detail and the text could be completely independent of them. In fact, no reference to the parts in the illustrations exists, although the reader is encouraged to observe the illustrations by the use of weak references. Nevertheless, despite the text's assistance, illustrations are easier to interpret than in the expert level, since they include terms that name their parts. Moreover, they have explicative and specific captions.

8. Conclusions and justification of results

Reviewing the results (see Appendix 1), we conclude that the more specialized in a field a text is, the greater the relationship between text and illustration. This result is logical if we recognize that illustrations combine with terms to supply information. Hence, the type of illustration depends on the objective of the text whose meaningful purpose is in relation with the communicative function at each level of knowledge.

At the expert level, illustrations have characteristics derived from the fact that the text in which it is inserted has a practical function, i.e., for the mechanic to apply the theory. The illustration is the most important form of concept representation, and therefore, it is logical that the text is at the service of this form.

At the student level, the text has another function, as do the illustrations. At this level the aim is to ensure that a student acquires knowledge. Hence, illustrations are less abstract than in the expert level and they are accompanied by terminology that helps the reader to better understand illustrations. These figures, by their part, lend assistance to the explanations in the text.

Our conclusions can be explained by Sperber and Wilson's theory of relevance (1995). These authors propose a general strategy of discourse interpretation. The form of a text depends on its reader. It then follows that the grade of the reader's familiarity with a topic will influence the way in which the author treats the subject matter. He will have to adapt his text to its reader's knowledge, and as a consequence, all forms of concept representation as well.

As we have proved, this is what happens in our sample: each text, although treating the same subject, adapts to the level of knowledge of the reader to whom it is addressed.

Finally, we would like to stress that our conclusions are broadly applicable to the area of fuel systems in jet aircraft²². However, they could be applied, *mutatis mutandi*, to other fields of specialty, although we cannot prove it here.

9. Bibliography

9.1. Cited works

- Bernard, R. M. (1990). "Using extended captions to improve learning from instructional illustrations". *British Journal of Educational Technology*. Blackwell Publishers. vol. 21, nº 3, pp. 215-225.
- Darian, S. (2001). "More than Meets the Eye: The Role of Visuals in Science Textbooks". *LSP & Professional Communication*. Copenhagen: Dansk Selskab for Fagsprog og Fagkommunikation. vol. 1, nº 1, pp. 10-36.
- DIN 2331 (1980). *Begriffssysteme und ihre Darstellung*. Berlin, Köln: Beuth.
- Greco, A. (ed.) (1995). "General Aspects of the Concept of Representation". *Cognitive Systems*. Génova. pp. 119-129
- ISO 1087-1 (2000). *Terminology work – Vocabulary – Part 1: Theory and application. Partial revision of ISO 1987: 1990*. Genève: ISO.
- 704 (2000). *Terminology work-Principles and methods*. Genève: ISO.
- Kalverkämper, H. (1993). "Das fachliche Bild: Zeichenprozesse in der Darstellung wissenschaftlicher Ergebnisse". Schröder, H. (eds.) *Fachtextpragmatik. (FFF 19)*. Tübingen: Gunter Narr Verlag. pp. 215-238.
- Laurén, Ch. (1998). "Repräsentationsformen für Begriffe und Phänomene". Laurén, Ch.; Myking, J.; Picht, H. *IITF Series 9: Terminologie unter der Lupe: Vom Grenzgebiet zum Wissenschaftszweig*. Wien: TermNet. pp. 186-209.
- Monterde Rey, A. M. (1999). *Las distintas formas de representación conceptual: Estudio en documentos dirigidos a mecánicos de aviones sobre la instalación de combustible de los aviones de combate Marcel Dassault*. Las Palmas de G. C.: Universidad de Las Palmas de G. C. [Unpublished].
- Montes Serrano, C. (1992). *Representación y Análisis Formal: Lecciones de Análisis de Formas*. Valladolid: Universidad de Valladolid, Secretariado de Publicaciones.
- ÖNORM A 2704 (1990). *Terminologie. Allgemeine Grundsätze für Begriffe und Bezeichnungen*. Wien.
- Picht, H. (1994). "Die Anwendung graphisch-figurativer Mittel bei der Begriffsrepräsentation". Brekke, M.; Andersen, Ø.; Dahl, T.; Myking, J. (eds.) (1994) *Proceedings of the 9th European Symposium on Language for Special Purposes: Applications and Implications of Current LSP Research*. Bergen: Universitetet i Bergen, Norges Handelshøyskole, 1993. vol. II, pp. 932-941.
- (2002). "La representación de objetos y conceptos". Guerrero Ramos, G.; Pérez Lagos, M. F. (eds.) *Panorama actual de la Terminología*. Granada: Comares. [Forthcoming].
- Schnotz, W. (1994). "Wissenserwerb mit logischen Bildern". Weidenmann, B. (ed.) *Wissenserwerb mit Bildern*. Bern: Verlag Hans-Huber. pp.95-148.
- Sperber, D.; Wilson, D. (1995). *Relevance: Communication and cognition*. 2nd. ed. Oxford: Basil Blackwell.
- Stockinger, P. (1993). "Conceptual analysis, knowledge management, and conceptual graph theory". *Lenguas Modernas*. Chile: Universidad de Chile. nº 20, pp. 5-53.

²² Due to space constraints the statistical calculations to support this assertion are not presented in this paper.

Thornton, C. (1996). "Re-presenting representation". Peterson, D. (ed.) *Forms of Representation: An interdisciplinary Theme for Cognitive Science*. Wiltshire: Intellect. pp. 152-162.

Weidenmann, B. (1994). "Informierende Bilder". *Wissenserwerb mit Bildern*. Bern: Verlag Hans-Huber. pp. 9-55.

9.1.1. Documents used to isolate the corpus

9.1.1.1. Expert level

MAEpro²³:

Maestranza Aérea de Albacete (1989). *Prontuario para mecánico de línea del avión Mirage FICE, BE, y EE*. Puesta al día nº 14. Editado por el Negociado de Instrucción-Escuadrón de mantenimiento-Ala 14.

MARcar:

Marcel Dassault-Breguet Aviation (1974a). *Cartas de trabajo: Instalación propulsora del avión Mirage FICE*. Válida para las primeras, segundas y terceras tandas. Puesta al día noviembre 1981. Clasificación EA: 2782/MM. [Restricted].

MARman:

-(1974b). *Manual de mantenimiento: Instalación propulsora del avión Mirage FICE*. Clasificación EA: 1812/DIA. [Restricted].

MARcat:

-(1974c). *Catálogo ilustrado de partes: Sistema de reabastecimiento en vuelo Mirage FICE*. [Restricted].

9.1.1.2. Student level

ESCfun:

Escuela de Especialistas Mecánicos de Aviones (1971). "Sistema de combustible". *Fundamentos básicos de aviones y equipos auxiliares*. León: Ejército de Aire. Lección 22, pp. 110-119. [Restricted].

LOMcom:

Lombardo, D. A. (1994). "Cómo tratar los problemas del sistema de combustible". *Los sistemas de las aeronaves: Conozca a fondo su avión*. Madrid: Paraninfo. cap. 8, pp. 97-106.

MALsis:

De la Malla, F. (1972). "Sistema funcional de combustible". *Sistemas funcionales de las aeronaves*. Madrid: de la Malla. cap. VII, pp. 195-218.

SAIsis:

Sáinz Díez, V. (1998). "Sistema de combustible". *El motor de reacción y sus sistemas auxiliares*. 6ª ed. revisada. Madrid: Paraninfo. cap. VIII, pp. 139-151.

²³ Before each bibliographic reference, we have written its abbreviation used in our research.

Appendix 1. Table of results

TERMS

EXPLANATIONS

			EXPERT	STUDENT	
TERMS	Inside definitions	Terms with illustration		∫ definitions	77.7%
		Illustration named by a term			53.33%
		Parts of illustrations named by a term			2%
	Inside explanations	Terms with illustration		100%	28%
		Illustrations named by a term		100%	100%
		Parts of illustrations named by a term		100%	22.5%
	Inside illustrations	Comments		∫ comments	∫ comments
		Illustrations with legend		7.46%	33.33%
		Illustrations with terms		∫ illustrations with terms	100%
		Relationship between term and illustration	Term written next to an element of the illustration		80%
List with numbers			20%		
DEFINITIONS		Definitions with illustration		∫ definitions	37.5%
		Illustrations with definition			46.66%
		Parts of illustrations with definition			4%
EXPLANATIONS	Explanations with illustration		100%	14.28%	
	Illustrations with explanation		100%	100%	
	Elements inside illustrations with explanation		97.06%	42%	
	Reference to illustrations	Form	Strong	100%	14.28%
			Weak		85.72%
		Situation of illustration	Before text		7.14%
			After text		92.86%
	Reference to elements of illustrations	Form	Strong	100%	∫ references
			Weak		
		Situation of illustration	Before text		
After text			100%		
CAPTIONS		Function	Explain the illustration	100%	
			Add information	100%	
			Redundant information	100%	

Appendix 2. Examples of illustrations and related texts

Appendix 2.1. Expert level

ALIMENTACIÓN DEL REACTOR

[...]

2 - **CASOS PARTICULARES DE FUNCIONAMIENTO** (Ver Figuras 18-21).

A - En el arranque o en el reencendido en vuelo (ver Figura 18).

En ausencia de corriente alterna (N del reactor <2.800 rpm), la alimentación del reactor está asegurada a partir de la nodriza posterior derecha 2 por la bomba de arranque 15Q que hace fluir el combustible a través de una válvula anti-retorno 152 hasta la tubería de descarga de la bomba BP derecha 12Q.

Mandos(ver Figura 21).

El interruptor de la bomba de arranque 14Q colocado en la posición "Marche".

Estando desexcitado el relé de parada 16Q, se excita el relé de la bomba de arranque 96Q y existe alimentación de la bomba de arranque 15Q.

Desde el momento en que se establece la alimentación de corriente alterna:

- Excitación del relé de parada 16Q por un relé de alimentación de la bomba BP 8Q a través de la caja de células 17Q.

- Desexcitación del relé de la bomba de arranque 96Q y corte de la alimentación de la bomba de arranque 15Q.

(Fuente: MARman/ 161-162)

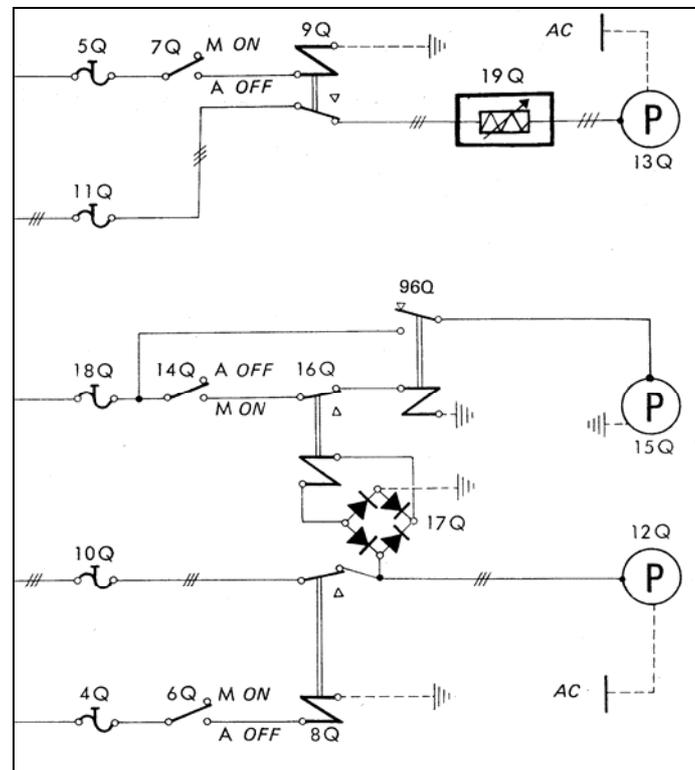


FIGURA 21 -ALIMENTACIÓN DEL REACTOR-Bombas BP
- Circuito eléctrico
(Fuente: MARman/ 165)

Appendix 2.2. Student level

Cuando un piloto pasa de un avión monomotor a otro bimotor, se da cuenta de que su sistema de combustible es mucho más complicado. Este tipo de avión ha sido diseñado para vuelos de largo alcance con uso extensivo de los instrumentos y operación de emergencia con un solo motor. La Beech B55 Baron, por ejemplo, tiene una disposición de depósito y selector combustible/motor más complicados que virtualmente cualquier monomotor construido (Fig. 8.3.). El inconveniente de la mayor complejidad del sistema de combustible es la mayor posibilidad de errores en el control del combustible. Cada avión tiene sus propias peculiaridades, y la buena práctica operativa dicta un conocimiento cabal de los procedimientos del sistema.

(Fuente: LOMcom/ 99-100)

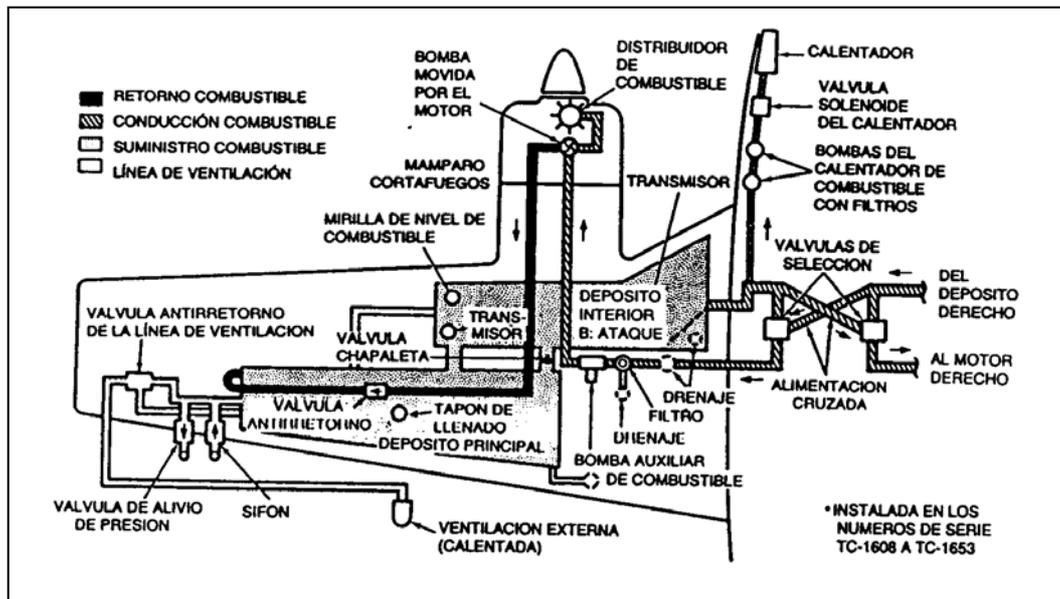


Figura 8.3. Esquema del sistema de combustible de la Beech Baron B55.

(Fuente: LOMcom/ 100)

ABSTRACT

Relationship and dependency between linguistic and non-linguistic forms of concept representation: A study of texts addressed to experts and students

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In this paper we determine the relationships and dependencies between linguistic and non-linguistic forms of concept representation in two levels of knowledge, expert and student, in the field of aeronautics. More specifically, for the specialized level, we select texts on aircraft fuel systems used by Spanish mechanics to repair the jet Mirage F1. In total, by creating systems of concepts, we delimit 119 concepts related to fuel feeding phases and parts of fuel systems. At the student level, we choose books studied by these mechanics during their training period, which has provided us with 100 concepts on the same subject as the expert level.

After isolating these concepts, we determine which of them are the linguistic and non-linguistic forms that represent the concepts of our sample in the selected documents. The only non-linguistic forms found are illustrations. As linguistic forms we discover terms, definitions, explanations, and texts or terms inside illustrations.

Finally, we study how these forms relate and depend on each other leading us to a better understanding of concept relationships in technical writing at the expert and student levels.
