

# Towards a new epistemology in university mathematics education (type your title here, the style is called Title)

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*in the memory of Felix Klein and Hans Freudenthal* (write your dedication here in italic, should you wish to add one, use the style called “Author(s)”)

Please read this first. If you are not familiar with using styles, you may prefer to type directly into the formatted sections above and below (which will incorporate the relevant styles) and then delete the guidance afterwards. Do not add or import any additional styles to the document you submit. This can happen inadvertently if you copy and paste from another file. Avoid this by first pasting into a text editor, such as Notepad. If you don’t normally use styles in WORD, you would benefit from finding out about styles before you use this template.

**Abstract.** Type your abstract here. An English abstract of 150 to 250 words is required and should be descriptive enough by itself. The abstract should not contain any undefined abbreviations or unspecified references.

**Keywords.** Theory of Didactic Situations, Anthropological Theory of the Didactic, Fundamental Theorem of Algebra.

**Résumé.** Le résumé doit également être donné en français. The style automatically provides a 12pt space after the English abstract and keywords, which mean that you don’t need double returns between paragraphs.

**Mots-clés.** Théorie des Situations Didactiques, Théorie Anthropologique du Didactique, Théorème fondamental de l’algèbre.

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## 1. Introduction (the main section Heading style is called Heading 1)

This is the style Normal. The style automatically provides a 6pt space after paragraphs, which means that you don't need double returns between paragraphs.

The present text serves as an example to show the characteristics of the ÉpiDEMES Épijournal's template. The mains features of the template will be used and described throughout the document.

References must be in the APA style. As far as mathematics education is concerned, our main references for this sample paper are (Brousseau, 2011) and (Chevallard, 2006). Readers may also benefit from reading the books (Brousseau, 1997) and (Chevallard, 1985).

We suggest to put the list of author addresses at the end of the paper (i.e., usually, after the references).

## 2. Typical structure of an article

Broadly speaking, two main types of articles could be published in the Épijournal ÉpiDEMES:

- articles in which researchers in mathematics education aim to disseminate results of their research to a wider audience (type 1) ;
- articles that report on a pedagogical and/or didactic innovation (type 2).

The typical structure of an article differs slightly depending on whether it belongs to type 1 or type 2. See 2.A. (resp. 2.B.) for an example of such a structure for type 1 (resp. type 2).

Please, note that the Épijournal ÉpiDEMES covers the mathematics taught at all level of the tertiary education curricula, from the secondary-tertiary transition to doctoral modules. ÉpiDEMES aims at providing a database for the initial and in-service training of higher education teachers.

## **2.A. Type 1 (the subsection Heading style is called Heading 2)**

The description of the focus and scope of ÉpiDEMES on the webpage <https://epidemmes.episciences.org/page/a-propos> underlines that the Épijournal ÉpiDEMES publishes articles written in English or French and dedicated to the dissemination of the results of university mathematics education research (didactics and epistemology of mathematics with a focus on higher education) towards higher education teachers (mathematicians and other members of academic staff). Special care should be given to making theoretical frameworks and theoretical constructs used in the papers accessible to a readership of non-specialists.

### **2.A.a. Introduction (the subsection Heading style is called Heading 3)**

This structure is pretty standard. It is indicative and may need to be adapted to better serve the purpose of the paper. It shall of course not hinder the authors' creativity.

### **2.A.b. Theoretical framework**

We emphasize that special care should be taken to make theoretical frameworks and constructs used in the papers accessible to a readership beyond the community of mathematics education researchers.

### **2.A.c. Methodology**

Let us underline that the epistemology of the Didactics of mathematics as a research field is that of an experimental science. As such, hypothesis are tested by means of experiments with a view to establishing didactic facts. A standard methodology consists in comparing a priori and a posteriori analyses.

### **2.A.d. Results**

This is where the collected data is presented and analyzed. In the case of a purely theoretical paper, the discourse is more speculative and the global structure of the paper may also be adapted.

### **2.A.e. Discussion**

Results are discussed here. Theoretical constructs are expected to show their strength in shedding light on the teaching-learning phenomena.

### **2.A.f. Conclusion and perspectives**

## **2.B. Type 2**

The description of the focus and scope of ÉpiDEMES on the webpage <https://epidemmes.episciences.org/page/a-propos> underlines that manuscripts either written by practitioners (tertiary education teachers) or co-written by practitioners and researchers in mathematics education, to report on innovative teaching-learning activities and methods, are also welcome. In this case, a theoretical framework is not compulsory, but reflexive analyses are expected in the form of a discussion of the teaching methods and learning goals, the pedagogical scenario and

didactic choices, the observed educational effects in relation to what was expected a priori. Editors may provide assistance to the authors in order to facilitate this reflexivity.

### **2.B.a. Introduction**

Again, this structure is indicative, it may be freely adapted to better serve the purpose of the paper and shall not hinder the authors' creativity.

### **2.B.b. Background**

### **2.B.c. Description of the innovation**

### **2.B.d. Observed educational effects**

It is useful here to present excerpts of students' work or other data that may be useful to ground the claims and comments that will be given in the next section.

### **2.B.e. Discussion**

The data is interpreted in this section in order to reflect on the impact of the choices that were made.

### **2.B.f. Conclusion and perspectives**

## **3. Comments on the style**

### **3.A. Text and headings**

Please use no more than three levels of displayed headings (section, subsection, subsubsection). The first paragraph in a section, subsection or subsubsection is normally not indented (the first paragraph style is called “first paragraph”). However, if you start a new paragraph in the course of a continued exposition, be aware that the paragraph is in the style “before: 0 cm First line: 1cm” (the corresponding style is called “Indented Paragraph”).

In the case abbreviations are used, they should be defined at the first mention and be used in a consistent way afterwards. Footnotes may be used to give additional information<sup>1</sup>. They will be automatically numbered.

### **3.B. Mathematical Statements**

In case you use mathematical statements in your paper, please be careful that you are using the same counter for theorems, propositions, lemmas, to avoid the possibly confusing situation where different types of statements get the same numbering. Please, note that the number before the dot corresponds to the first level of title (here, the third section of the paper). You need to use the paragraph style called “Normal”. The words “Theorem”, “Propositions” and “Lemmas”, as well as “Example” and “Remark”, should be in **Bold**, the “Proof” word in *Italic*, as in the example below.

In his book, Klein (1932, pp. 101-104) discusses the following:

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<sup>1</sup> Additional Information

**Theorem 3.1. (Fundamental theorem of algebra)** *Every algebraic equation of degree  $n$  in the field of complex numbers has, in general,  $n$  roots. More accurately, every polynomial  $f(z)$ , of degree  $n$ , can be separated into  $n$  linear factors.*

*Proof.* Given the polynomial

$$f(z) = z^n + a_1 z^{n-1} + \dots + a_n$$

We may write

$$f(x + iy) = u(x; y) + i \cdot v(x, y)$$

where  $u, v$  are real polynomials in the two real variables  $x, y$ . The leading thought of Gauss' proof lies now in considering the two curves  $u(x, y) = 0$  and  $v(x, y) = 0$  in the  $x y$  plane, and in showing that they must have one point, at least, in common. [...]

**Example 3.2.** In the case  $f(z) = z^3 - 1 = 0$ , we obviously have  $u = r^3 \cos 3\varphi$ ,  $v = r^3 \sin 3\varphi$ , so that  $v = 0$  consists simply of three straight lines, while  $u = 0$  has three hyperbola-like branches. The Figure 1 shows the three intersections of the two curves, which give the three roots of our equation.

**Remark 3.3.** One can refer to the mathematical result 3.1. by creating – in Word (“Insert” tab then “links”) – “bookmark” and “cross-reference” tools. We recommend Theorems, Propositions and Lemmas to be typeset in italics, Remarks and Examples in normal characters.

We ask to use the “Equation” editor for any formula or mathematics expression, for instance  $f(z)$  in the statement of the **Theorem 3.1.**, and the equations in the *Proof* and the **Example 3.2.**

### 3.C. Citations and quotations

Cite references in the text using APA style, by name and year in parentheses.

The short quotation style is called “Citation,Quote”. It can be used for short quotations. The short quotations are indented in either margin (1.2 cm before and after), and you may be surrounded them yourself with quotation marks, if you wish. See, as examples, the quotation below.

“What happens is a reconstruction process that I called – years ago – a process of transposition. The original praxeology, let me call it  $[\Pi/\Lambda]$ , is transposed into a new praxeology,  $[P = L] = [\Pi^*/\Lambda^*]$ , supposed to be better at surviving the constraints imposed on both its “praxis” part  $\Pi^*$  and its “logos” part  $\Lambda^*$  by its new habitat, I.” (Chevallard, 2006, p. 27)

The long quotation style is called “Citation Quotation”. It should be used for quotations made up of several paragraphs. The long quotations are indented in either margin (1.2 cm before and after), the first line of each paragraph has an additional indentation (1 cm before). The long quotations may be surrounded by quotation marks, if you wish. See, as example, the quotation below.

“La théorie des situations mathématiques apparaît en 1970. Elle est née comme simple méthode de description et d'interrogation mathématique des dispositifs psychologiques et didactiques. Depuis, elle n'a pas cessé de se développer sous le double effet des nouvelles questions et des observations empiriques qu'elle a vocation à produire et à mettre en relation.

Une théorie des situations mathématiques modélise les conditions sous lesquelles les êtres humains produisent, communiquent et apprennent les connaissances que nous reconnaissons comme mathématiques.

Ces conditions sont modélisées par des systèmes appelés situations, qui conduisent des agents en interaction avec elles à manifester cette connaissance. Elles sont donc spécifiques de la connaissance en jeu ” (Brousseau, 2011, pp. 1-2)

### 3.D. Tables and figures

All tables should be numbered in consecutive numerical order. For each table, a caption should be provided.

ATD	TDS	Comments

Table 1 – The caption should explain the content of the table

All figures should be numbered in consecutive numerical order. We provide an example of how to include a Figure with a caption.

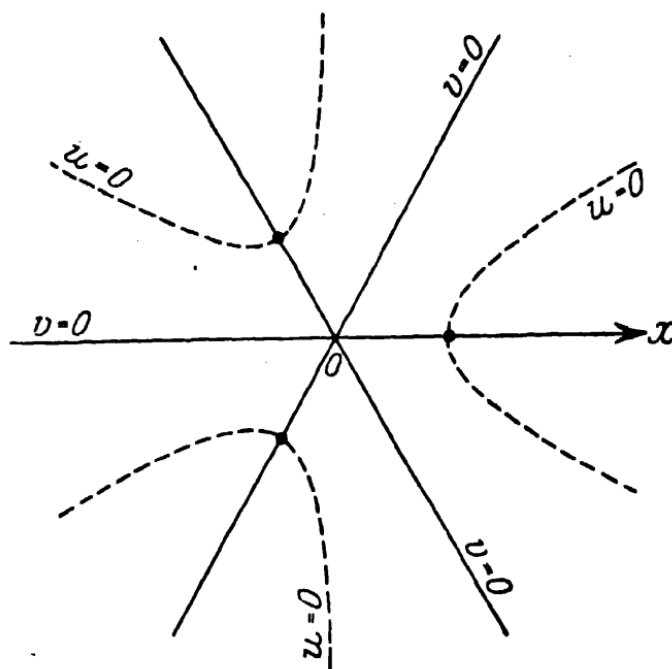


Figure 1 – The case of  $z^3 - 1$ , according to Klein

For both tables and Figures, the caption style is called “FigTitle”.

### 3.E. Transcript

For transcripts, use the style called “Transcript” as follows:

178 Gaston Broussard: Rendre fonctionnelle une notion mathématique c’est lui donner un rôle visible dans une décision critique spécifique.

179 Yves Chevalier: The dialectic of media and milieus is in my view the central problem of our time, at school and elsewhere, in building ademocratic epistemological regime.

If you do not need to number transcript lines, you should proceed as follows

Gaston Broussard: Rendre fonctionnelle une notion mathématique c'est lui donner un rôle visible dans une décision critique spécifique.

Yves Chevalier: The dialectic of media and milieus is in my view the central problem of our time, at school and elsewhere, in building ademocratic epistemological regime.

## Appendix A: First appendix (the style is called Title 4)

For instance, students' worksheet may be included as an appendix, or any other teaching material that is discussed in the paper.

## Appendix B: Second appendix

Excerpts of students' works may be included in a second appendix, or any other relevant data that support the results presented in the paper.

## References

This is in the Style "References". Please make sure you have provided all necessary information, e.g. place of publication, page numbers (where appropriate), all references used in the text (and vice versa). References must be in the APA style ([http://www.tandf.co.uk/journals/authors/style/reference/tf\\_A.pdf](http://www.tandf.co.uk/journals/authors/style/reference/tf_A.pdf)).

Brousseau, G. (1997). *Theory of didactical situations in mathematics – 1970-1990*. Dordrecht: Kluwer Academic Publishers.

Brousseau, G. (2011). La théorie des situations didactiques en mathématiques. *Éducation et didactique*, 5 (1), 101-104.

Chevallard, Y. (1985). *La transposition didactique – Du savoir savant au savoir enseigné*. Grenoble : La Pensée Sauvage.

Chevallard, Y. (2006). Steps towards a new epistemology in mathematics education. In M. Bosch (Ed.), *Proceedings of the 4th Congress of the European Society for Research in Mathematics Education* (pp. 21-30). Barcelona: Universitat Ramon Llull.

Klein, F. (1932). *Elementary mathematics from an advanced standpoint*. London: Macmilan

Appendix A: first appendix

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