The Nature of Research in Biological Education

Old and New Perspectives on Theoretical and Methodological Issues

A selection of papers presented at the VIIth Conference of European Researchers in Didactics of Biology (ERIDOB)

ERIDOB

CONFERENCE 2008

Edited by
Marcus Hammann
Arend Jan Waarlo
Kerst Boersma

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Freudenthal Institute for Science and Mathematics Education at Utrecht University

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Section 4: Student reasoning, scientific thinking and argumentation

Section 5: Teaching: teaching strategies, teaching environments and educational technology

Preface

This volume consists of 29 original papers presented at the 7th Conference of European Researchers in Didactics of Biology (ERIDOB) organized by the Freudenthal Institute for Science and Mathematics Education (FIsme) and held in September 2008. Previous ERIDOB conferences have taken place in Kiel (1996), Göteborg (1998), Santiago de Compostela (2000), Toulouse (2002), Patras (2004) and London (2006). The conference fortunately has become firmly established in the field of research on biology education and at the 7th ERIDOB Conference, there were 45 paper presentations and 43 poster presentations with 95 people attending from 14 countries. The conference was held at Woudschoten Conference Center, Zeist, The Netherlands, a place that is well known for a seminar on relating macroscopic phenomena to microscopic particles held in 1989 [Lijnse, P.L., Licht, P., de Vos, W. & Waarlo, A.J. (eds) (1990). *Relating Macroscopic Phenomena to Microscopic Particles: a Central Problem in Secondary Science Education*. Utrecht: CD-β Press].

When the first ERIDOB conference was held in Kiel, research in biology education was still a relatively young discipline and the founders of the conference – among them Horst Bayrhuber and Fred Brinkman – wanted to create a forum for encouraging European researchers to discuss their research and the standards of their scholarship. The major characteristics of the conference stem from this time and cannot be understood without keeping in mind that the conference is intended to provide a forum for an intense exchange of ideas: single-strand presentations guarantee that every participant is able to attend and discuss all presentations; attendance at the conference is bound to actively presenting one's work (there are a few exceptions to this policy, for example for young researchers from work groups whose members are presenting) and it is possible to submit only one first-authored paper per person. These policies still exist today – although when the conference grew, poster presentations had to be organized in parallel sessions – and they make sure that researchers have the chance to give and receive feedback that allows an intense exchange of ideas. This makes the ERIDOB conference different from other international conferences in the field in which up to 18 parallel strands are common and it is impossible to attend all paper presentations.

All papers presented at the conference and published in the proceedings have been double reviewed by two members of the academic committee. The 29 papers presented in this volume address a range of topics in the areas of 'student conceptions and conceptual

change', 'student interest and motivation', 'student values, attitudes and decision-making', 'student reasoning, scientific thinking and argumentation', 'teaching: teaching strategies, teaching environments and educational technology', 'health education and biology education', 'social, cultural and gender issues in biology education', 'practical work and field work in biology education' and 'research methods and theoretical issues concerning research in biology education'. The theme of the ERIDOB Conference 2008 was 'The Nature of Research in Biological Education: Old and New Perspectives on Theoretical and Methodological Issues'. We chose this topic in order to underline the importance of research that is securely founded in theory – often educational and psychological models of teaching and learning biology. The quest for the theoretical foundations of our discipline continues and we would like to encourage further efforts in this respect because advances in biology education research depend upon a critical reflection of its theoretical foundations.

The papers in this volume reveal that biology education research – combining approaches from many disciplines – is a fascinating and challenging endeavour. Biology education research is faced with the challenges of transdisciplinary research, as Prof. Dr Hub Zwart from Radboud University, Nijmegen, argues and his inspiring keynote address serves as the frame through which readers who are about to read the proceedings must pass in order to gain an overview of the present state of research presented at the ERIDOB Conference 2008.

Our special thanks go to Lynn du Plessis, Jenny Byrne and Jenny Lewis who contributed to improving the English of the papers in this volume. We would also like to thank Jane Hoyle for her excellent work copy-editing this book.

Marcus Hammann, Arend Jan Waarlo and Kerst Th. Boersma

27. Content analysis of the ERIDOB proceedings and comparison with the *International Journal of Science Education*

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Abstract

The aim of the study was to summarize, categorize and present a coherent overview of the ERIDOB research activities over the last 10 years and compare them with research in biology education published in the *International Journal of Science Education* (IJSE). A total of 130 papers published in the first five ERIDOB conference proceedings were classified into nine categories. In order to gain a more precise view of the state of European research into the didactics of biology, we chose one of the leading science education journals, IJSE, classified the articles with biological content from the years 1996, 1998, 2000, 2002 and 2004 according to different categories, and compared them with the ERIDOB proceedings. This cross-check between the papers from the ERIDOB proceedings and the research articles from IJSE allowed us to present data on the research focus in these two publication venues. Our findings showed that the ERIDOB publications focused on the category 'Learning', whereas publications in IJSE were more balanced across the nine categories. As expected, English-speaking countries contributed most articles to IJSE, and contributions from Europe (apart from the UK) were marginal. It is hoped that this paper will encourage researchers to cover a broad range of topics and to publish them internationally.

1. Introduction

The aim of this study was to summarize, categorize and present a coherent overview of the ERIDOB research activities over the last 10 years and to compare them with research studies in biology education published in the *International Journal of Science Education* (IJSE). This systematic analysis of articles published in the ERIDOB proceedings of the first

five ERIDOB conferences (Kiel, 1996; Göteborg, 1998; Santiago de Compostela, 2000; Toulouse, 2002; Patras, 2004) will help researchers and educators reflect on past trends in the highly diverse field of biological education research. On the basis of this study, it is possible to discuss future trends in biological education. To gain a deeper insight into the actual state of ERIDOB research activity and to place ERIDOB research activities in an international arena, we chose one of the leading science education journals, IJSE, and categorized the articles from volumes 1996, 1998, 2000, 2002 and 2004 to compare them with ERIDOB research activities. We chose these volumes because the years in which they were published are identical to the years of the biannual ERIDOB conference. The IJSE was considered to be a reference point for this study as it is widely distributed and recognized in science education. Moreover, IJSE articles are indexed in the Social Sciences Citation Index.

2. Research questions

We wanted to answer the following questions:

- *Do both publications – the ERIDOB conference proceedings and IJSE – focus on similar research topics (categories)?* Here, we assumed that an international journal can serve as a reference point in order to describe current research issues, which could be compared with the ERIDOB research topics.
- *Which countries contribute to what degree to the ERIDOB conference proceedings and to IJSE?* We supposed that the ERIDOB proceedings and IJSE attract authors from different nations, with ERIDOB reflecting European research activities and IJSE a more international spectrum of research activities.
- *Are there differences between ERIDOB conference proceedings and IJSE in the category of research on student conceptions?* Research on students' conceptions is one of the most important fields and is among the most popular topics in the research community. Again, IJSE served as a reference point to determine the status quo of the ERIDOB proceedings.

3. Methods

One of the reference points of this study was a paper by Tsai & Wen (2005), in which the authors conducted a series of content analyses of articles published in four different

journals, including IJSE, from 1998 to 2002. The authors categorized the articles into the following nine categories: (1) Teacher education; (2) Teaching; (3) Learning – students' conceptions; (4) Learning – classroom contexts; (5) Goals, policy and curriculum; (6)

Table 27.1. Description of the different categories for classifying research (after Tsai & Wen 2005).

Category	Research topic	Content
1	Teacher education	Pre-service and continuing professional development of teacher and teaching material; teacher education programmes; teacher education reform, action research
2	Teaching	Teacher cognition; pedagogical knowledge; forms of knowledge representation; teacher thinking; teachers' knowledge; teaching strategies
3	Learning – students' conceptions and conceptual change	Methods for investigating students' knowledge and understanding; students' alternative conceptions, instructional approaches for conceptual change; conceptual development
4	Learning – classroom contexts and learner characteristics	Student motivation; learning environment; individual differences; learning approaches; teacher–student interaction; laboratory environment; affective dimensions of science learning; social, political, and economic factors; argumentation
5	Goals and policy, curriculum, evaluation and assessment	Curriculum development, implementation, dissemination and evaluation; social analysis of curriculum; assessment; teacher evaluation; educational measurements; curriculum policy and reform
6	Culture, social and gender issues	Multicultural and bilingual issues; ethnic issues; gender issues; comparative studies; issues of diversity related to science teaching and learning
7	History, philosophy, epistemology and the nature of science	Historical issues; philosophical issues; epistemological issues; ethical and moral issues; nature of science; research methods
8	Educational technology	Computers; interactive multimedia; video; integration of technology into teaching
9	Informal learning	Science learning in informal contexts (e.g. museums, outdoor settings); public awareness of science

Culture, social and gender issues; (7) History, philosophy, epistemology and the nature of science; (8) Educational technology; and (9) Informal learning. We adopted these

categories for our study; however, we applied minimal changes to the more detailed descriptions of the categories as shown in Table 27.1.

In line with Tsai & Wen (2005), we categorized each published article in the ERIDOB proceedings and in IJSE into one of these nine categories. We adopted the categories used by Tsai & Wen (2005) because we considered them to be a meaningful and precise tool for categorization. In contrast, ERIDOB research strands – as published in the call for papers – were not used as they have changed over the years, with one new strand in 2004 for example, and another new one in 2006 (see section 7). Also, the proceedings at times list the papers under slightly different headings, for example 'The impact on teachers of new approaches in biology education' (see Proceedings of ERIDOB 2004, Table 27.2). The research strand 'Social, cultural and gender issues' appeared for the first time in the ERIDOB proceedings in 2006 (see Table 27.2), but has been used as a research strand in the call for papers since 2002 (see section 7). The category 'Health education and biology education' forms its own category in the ERIDOB proceedings, but does not exist in the categories of Tsai & Wen (2005), whereas the category 'Student conceptions and conceptual change' is used by both. The category 'History, philosophy, epistemology and the nature of science' is not explicitly mentioned in the ERIDOB research strands, neither is 'Informal learning' (category 9; Tables 27.1 and 27.2).

A total of 130 articles published in the ERIDOB conference proceedings and 155 articles of IJSE were categorized according to the categories listed in Table 27.1. As a general science journal, IJSE encompasses different subjects. To assure an adequate comparison, we only chose articles addressing biological topics (about 30% of the total number of articles published in these years) and excluded articles dealing purely with physics, chemistry, etc. However, certain articles that did not have an entirely biological background but referred marginally to a biological theme were included, such as the paper by Gopal *et al.* (2004) focussing on evaporation, condensation and vapour pressure, because the topics are also relevant to ecological processes. Another example was the study of Martin *et al.* (2000), investigating restructuring processes of students using concept maps and scoring for their structural complexity. This paper was included in our study because the concept maps dealt with the biological topic of 'Life in the ocean' and it was thus included in category 3 (Learning – students' conceptions).

Table 27.2. The research strands as they appear in the proceedings of the ERIDOB conferences (1998–2006).

No strands were explicitly mentioned for the first conference in Kiel. Similar categories are written on the same line. The ERIDOB research strands are not completely represented in this table as the proceedings present a selection of papers presented at the conference. All research strands for ERIDOB 2000–2006 are listed in section 7 of this paper.

Category[a]	2006[b] (London)	2004 (Patras)	2002 (Toulouse)	2000 (Santiago de Compostela)	1998 (Göteborg)
1, 2	Teaching: teaching strategies, teaching environments and educational technology	Teaching biology in technology-supported educational environments	Teaching biology	Teaching biology	Teaching and learning
3	Student conceptions and conceptual change	Learning biology: Students' conceptions and conceptual change	Learning biology	Learning biology	Students conception
4	Student reasoning, scientific thinking and argumentation	Reasoning: scientific thinking and argumentation	Reasoning	Reasoning	
4	Student interest and motivation	Developing attitudes and opinions: interest and motivation for biology			Research on attitudes and interests
6	Social, cultural and gender issues in biology education				
–	Health education and biology education	Environmental and health education	Environmental education	Environmental education	Environmental education
–		The impact on teachers of new approaches to biology education			
–	Practical work and field work in biology education				
–	Student values, attitudes and decision-making				

[a] According to Tsai & Wen (2005); see Table 27.1.
[b] This year is not included in the study.

Categorization was done by the first author of this paper by reading the title and the abstract of the articles. Subsequently, the content of the paper was examined more thoroughly. A paper was categorized in one category only. In the case of uncertainty, the two authors discussed controversial points and subsequently decided on the category. For example, a classification was rendered difficult when a study described a teaching approach (category 2, Teaching) based on a prior study of students' conceptions (category 3, Learning – students' conceptions), or when conceptual understanding was tested before and after a teaching sequence (e.g. Wallin *et al.,* 2001). In most of these cases, we consistently assigned the article to category 3, because the teaching sequence was based on findings about students' conceptions.

The research contribution by each country was analysed quantitatively (Table 27.3). Each paper was given one point. If a paper was published by more than one author who came from different countries, the point was divided in certain proportions (see Tsai & Wen, 2005, and Howard *et al.*, 1987, for a detailed explanation). This cross-check between articles from the ERIDOB proceedings and from IJSE allowed us to present data on the degree to which individual countries contribute to research activities.

4. Results

4.1. Comparison of ERIDOB and IJSE articles across the different categories

A χ^2 test revealed significant differences between the sum of published papers in the ERIDOB proceedings and IJSE among the different categories (Table 27.3). A significant effect was shown for categories 3 (Learning – students' conceptions) and 7 (History, philosophy, epistemology and the nature of science). If these categories were excluded from the analysis, no significant differences were found ($\chi^2 = 8.0$, $p = 0.24$) among these categories. The χ^2 test is a statistical method used to examine differences between different category variables. Here, the category variables were the number of articles published in each category in the ERIDOB proceedings and in IJSE.

The comparison of observed and expected values was particularly revealing. There was a clear focus on the category 'Learning' in articles published in the ERIDOB proceedings, especially on students' conceptions, compared with the articles in IJSE (Table 27.1,

Table 27.3. Contingency table of the absolute number of articles published in each category, expected values and standardized residuals ($\chi^2 = 20.1$, $p < 0.01$).

Categories contributing to the significant effect are highlighted in a darker shade of grey (categories 3 and 7).

Source	Value	Category 1: Teacher education	Category 2: Teaching	Category 3: Learning – students' conceptions	Category 4: Learning – classroom contexts	Category 5: Goals, policy and curriculum	Category 6: Culture, social, and gender issues	Category 7: History, philosophy, epistemology and the nature of science	Category 8: Educational technology	Category 9: Informal learning
ERIDOB (n = 130)	Observed	11	18	39	32	6	9	2	7	6
	Expected	(15.1)	(19.2)	(30.1)	(26.5)	(7.8)	(13.2)	(7.3)	(5.9)	(5.0)
	Standardized residuals	–1.0	–0.3	1.6	1.1	–0.6	–1.2	–2.0	0.4	0.4
	%	8.5	13.8	30.0	24.6	4.6	6.9	1.5	5.4	4.6
IJSE (n = 155)	Observed	22	24	27	26	11	20	14	6	5
	Expected	(17.9)	(22.8)	(35.9)	(31.5)	(9.2)	(15.8)	(8.7)	(7.1)	(6.0)
	Standardized residuals	1.0	0.2	–1.5	–1.0	0.6	1.1	1.8	0.4	0.4
	%	15.2	15.5	17.4	16.8	7.1	12.9	9.0	3.9	3.2

categories 3 and 4). In contrast, articles in IJSE put somewhat more emphasis on the category 'Teaching', especially on the professional development of pre-service and in-service teacher training (Table 27.1, categories 1 and 2). Moreover, a larger number of articles dealing with the curriculum (category 5), cultural studies (category 6) and history (category 7) were published in IJSE compared with the ERIDOB proceedings. These results can be partially explained by the fact that categories 5 and 7 are not genuine ERIDOB categories. None of the ERIDOB conferences explicitly featured the research strands: 'Goals, policy and curriculum' and 'History, philosophy, epistemology and the nature of science.' The ERIDOB research strand that comes closest to this is strand 10 'Research methods and theoretical issues concerning research in biology education.' However, in the five ERIDOB proceedings analysed, no paper was published in this category, which is an interesting finding in the context of the fact that the present study was presented in a symposium on theoretical issues in ERIDOB 2008.

We also examined the degree to which different countries contributed to the ERIDOB proceedings and to IJSE. English-speaking countries contributed the most articles to IJSE, whereas contributions from most European countries were minimal (Table 27.4). For example, the four countries that ranked as the most productive contributors to IJSE in the field of biology education research were the UK, USA, Australia and Spain, with the latter as the only European, non-English-speaking country. In contrast, the four countries publishing most frequently in the ERIDOB proceedings were Germany, France, the UK and Sweden. With the exception of the UK, none of these countries was in the list of the eight countries that published most frequently in IJSE. Clearly, the only two countries represented in both lists (Table 27.4) were Spain and the UK, so is possible to argue that different countries contribute to the ERIDOB proceedings and to IJSE.

In the analysis of Tsai & Wen (2005), authors from the UK, USA and Australia had the most publications in IJSE from 1998 to 2002. This fact was confirmed by our results (Table 27.4), although Tsai & Wen (2005) looked at 1998–2002, while we focused on articles published in 1996, 1998, 2000, 2002 and 2004.

Table 27.4. Country rankings and percentages of publication in the respective journals.

ERIDOB (n = 130 papers)			IJSE (n = 155 papers)	
Rank	Country	%	Country	%
1	Germany	28.9	UK	32.7
2	France	10.3	USA	18.0
3	United Kingdom	8.7	Australia	14.3
4	Sweden	8.3	Spain	5.2
5	Spain	7.9	Canada	3.3
6	Netherlands	6.4	Taiwan	3.0
7	Israel	4.8	Brazil	2.0
8	Greece	4.4	South Africa	1.8
	+ 20.3 % from 13 other nations		+ 19.6 % from 23 other nations, each of which contributed less than 1.8%	

Tsai & Wen (2005) observed a declining trend between the years 1998 and 2000 in category 3 (Learning – students' conceptions), despite its popularity among science educators. A reverse trend was found in category 6 (Culture, social and gender issues), which apparently became more attractive for science educators. Probably, cultural, social and gender studies received much attention because they bridge the gap between science and the real lives of people. Thus, it is not surprising that it was added as a new research strand for ERIDOB 2006 (Table 27.2). Tsai & Wen (2005) were also surprised by the small number of articles published in categories 1 and 2 (Teaching and Teacher education), especially as continuing professional development of the teacher is indispensable, in particular the education of students and pre-service teachers. In general, these results were in line with our analysis of the ERIDOB proceedings, where the main focus of articles published lies in category 3, whereas categories 1 and 2 are underrepresented in comparison with IJSE. This can be seen by the standardized residuals in Table 27.3.

Finally, we investigated whether the subset of IJSE papers analysed by us for this study was representative of the larger set of IJSE papers analysed by Tsai & Wen (2005). Our results concerning the categorization of articles differed somewhat from the results of Tsai & Wen (2005) (Table 27.5). We assigned more articles to categories 1 and 2 and fewer articles to categories 3 and 5 than Tsai & Wen (2005). This was due to the fact that both studies analysed different sets of papers. In addition, we selected articles dealing with biological topics only, whereas Tsai & Wen (2005) included all articles in their analysis.

Table 27.5. Results from the study of Tsai & Wen (2005) and our results for each category Values are given as percentages. JRST, Journal of Research in Science Teaching; SE, Science Education.

	Category 1: Teacher education	Category 2: Teaching	Category 3: Learning –students' conceptions	Category 4: Learning – classroom contexts	Category 5: Goals, policy and curriculum	Category 6: Culture, social, and gender issues	Category 7: History, philosophy, epistem-ology and the nature of science	Category 8: Educational technology	Category 9: Informal learning
ERIDOB (n = 130)	8.5	13.8	30.0	24.6	4.6	6.9	1.5	5.4	4.6
IJSE (n = 155)	15.2	15.5	17.4	16.8	7.1	12.9	9.0	3.9	3.2
IJSE (n = 364)[a]	6.0	3.6	33.0	17.6	14.3	8.8	6.3	4.7	5.7
IJSE, JRST, SE (n = 802)[a]	7.0	6.9	24.7	17.9	13.6	14.3	8.5	3.4	3.7

[a] Articles published from 1998 to 2000.

4.2. Comparison of ERIDOB and IJSE articles in category 3 (Learning – students' conceptions)

A total of 29 article in IJSE and 39 articles in the ERIDOB proceedings were used for a more detailed classification into thematic categories (Figure 27.1). The following categories were defined: students' conception of evolution (Evo), ecology (Eco), genetics/cytology (Gen), human biology (Hum), immunology (Imm), zoology (Zoo), the nature of science (NOS) and others (Oth). ERIDOB proceedings contained more articles in the field of students' conceptions of genetics and evolution compared with IJSE. In contrast, more articles dealing with students' conceptions of ecological topics were published in IJSE, compared with the ERIDOB proceedings. Interestingly, we did not find any article in the ERIDOB proceedings dealing with student conceptions of the nature of science,

whereas four articles from IJSE were assigned to this category. Specifically, Lubben & Millar (1996) published an article on children's ideas about the reliability about experimental data, and Newton & Newton (1998) and Reis & Galvão (2004) investigated students' conceptions about scientists. The fourth study dealt with students' understanding of the role of scientific models in learning (Treagust *et al.*, 2002). Thus, it seems fair to argue that both ERIDOB proceedings and IJSE covered students' conceptions over a wide range of biological topics, but research published in the first five ERIDOB proceedings fell short of addressing topics related to the nature of science. Discussion of the nature of science began historically in English-speaking countries, but researchers contributing to ERIDOB have not given this subject much attention.

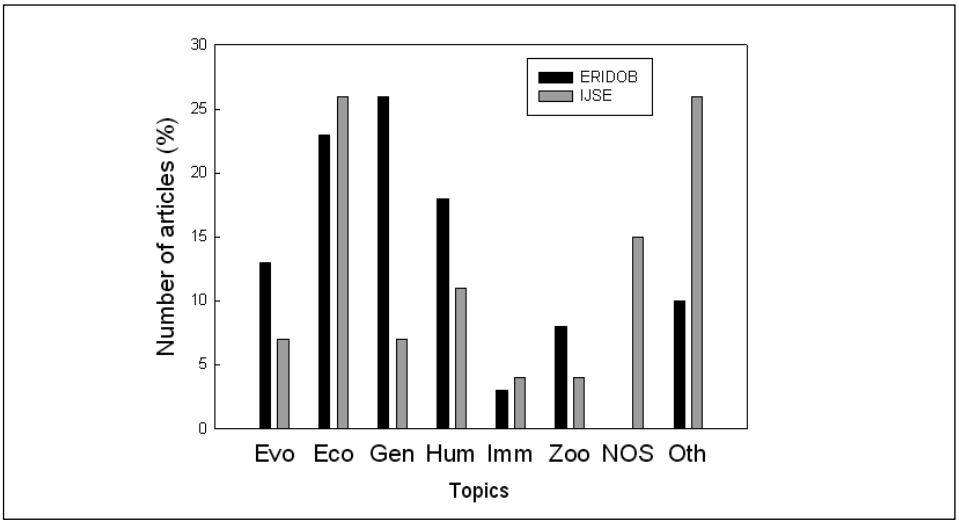

Figure 27.1. Number of articles published in category 3 (Learning – students' conceptions) in the ERIDOB proceedings (39 articles in total) and IJSE (27 articles in total). Evo, evolution (e.g. natural selection, geological time); Eco, ecology (e.g. cycling matter, interactions between organisms, environmental education, food webs, physiological aspects, photosynthesis, the carbon cycle, plant growth, environmental disturbances); Gen, genetics (e.g. misconceptions in molecular genetics); Hum, human biology (e.g. digestion, nutrition, food in contaminated areas, birth, sexual development); Imm, immunology (e.g. antigens and antibodies); Zoo, zoology (e.g. insects, animal skeletons, systematics); NOS, nature of science (e.g. conceptions of science and scientists); Oth, other (e.g. understanding of textbook images).

5. Discussion

This comparative analysis of papers published in the first five ERIDOB proceedings and in five years of IJSE publications was limited in a number of ways. For example, ERIDOB proceedings do not reflect all research presented at ERIDOB conferences – only a selection of papers published after the conference – and we did not check whether the selection was representative. This was rendered difficult, if not impossible, by the fact that we did not have access to the many oral presentations and posters delivered at the first five ERIDOB conferences. Also, we chose to compare ERIDOB research activities with one representative scholarly journal in the field, IJSE, which was due to fact that it is impossible to cover all relevant international journals in the field. This also created a bias, as individual countries may have a traditions of publishing in some scholarly journals and not in others.

Nevertheless, a few interesting insights were gained, which we will discuss here. One of the main findings concerned the fact that the categorization by Tsai & Wen (2005) contained three categories that did not appear in the ERIDOB research strands of the first five conferences, namely category 5 (Goals, policy and curriculum), category 7 (History, philosophy, epistemology and the nature of science) and category 9 (Informal learning). Although the ERIDOB research strand 'Social, cultural and gender issues in biology education' became a new research strand for ERIDOB in 2002, it did not appear in the proceedings until 2006, and it may be worthwhile considering whether the present research activities of the ERIDOB conference are sufficiently devoted to this category. As for the nature of science, our research showed that there have been no ERIDOB proceedings papers on students' conceptions of the nature of science, which is in contrast to the recognition this topic finds in IJSE and beyond, and lends further strength to the argument for adding these and other neglected aspects to the ERIDOB research strands, to encourage research in this area.

Whilst one-third of the ERIDOB proceedings papers were in category 3 (Learning – students' conceptions) and a quarter in category 4 (Learning – classroom contexts), IJSE achieved a better spread of papers across all categories, with no category standing out as clearly as in the ERIDOB proceedings. For researchers who contribute to ERIDOB, this can be read as an encouragement to cover a more diverse range of research topics. For example, historical and philosophical topics were covered by only two ERIDOB proceedings papers. Thus, we would like to encourage more papers on theoretical issues in particular. This recommendation is also motivated by the fact that we observed that

the ERIDOB research strand 'Research methods and theoretical issues related to research in science education' apparently did not encourage enough ERIDOB proceedings publications in this field. Given the importance of theory-based research, it seems important to address theoretical issues explicitly.

One other recommendation that arises from this study is to ensure international publication of the ERIDOB contributions. From our point of view, it would be worthwhile making ERIDOB papers accessible to a wider readership, by expanding ERIDOB manuscripts and submitting them to journals indexed in the Social Sciences Citation Index. It is surprising that different countries are major contributors to either the ERIDOB proceedings or IJSE, and it would be a desirable development for ERIDOB if more articles were published both in the ERIDOB proceedings and in international science education journals. A good example is Teixeira (2000a) published in the ERIDOB proceedings and Teixeira (2000b) published in IJSE.

6. ERIDOB proceedings analysed

- ERIDOB 1996: Bayrhuber, H. & R. Brinkman (eds), *What – Why – How? Research in Didaktik of Biology. Proceedings of the First Conference on European Researchers in Didaktik of Biology (ERIDOB)*. Kiel: IPN-Materialien (published in 1998).
- ERIDOB 1998: Andersson, B., Harms, U., Helldén, G. & M.-L. Sjöbeck (eds), *Research in Didactics of Biology. Proceedings of the Second Conference on European Researchers in Didactics of Biology.* Göteburg: NA-Spektrum no. 22 (published in 2000).
- ERIDOB 2000: García-Rodeja Gayoso, I., Díaz de Bustamante, J., Harms, U. & M.P. Jiménez Aleixandre, M.P. (eds), *Proceedings of the Third Conference on European Researchers in Didactics of Biology.* Santiago de Compostela: Universidade de Santiago de Compostela no. 130 (published in 2001).
- ERIDOB 2002: Lewis, J., Magro, A. & Simonneaux, L. (eds), *Biology Education for the Real World. Student – Teacher – Citizen. Proceedings of the Fourth ERIDOB conference.* Toulouse: Ecole Nationale de Formation Agronomique. (published in 2003)
- ERIDOB 2004: Ergazaki, M., Lewis, J. & Zogza, V. (eds), *Trends in Biology Education. Research in the New Biology Era. A Selection of Papers Presented at the Fifth Conference of European Researchers in Didactics of Biology (ERIDOB).* Patras: Patras University Press (published in 2005).

7. ERIDOB research strands from 2000 to 2006

No research strands were found for ERIDOB conferences in 1996 and 1998.

ERIDOB 2000 and 2002:

1. Learning about concepts: students' conceptions and conceptual change.
2. Attitudes development: students' values, interest, motivation, attitudes.
3. Reasoning: students' reasoning, scientific thinking.
4. Teaching: teaching strategies, metacognitive strategies, educational technology.
5. Environmental education and biology education.
6. Social, cultural and gender issues.
7. Practical work and field work in biology education.
8. Research methods and theoretical issues.

ERIDOB 2004:

1. Learning about concepts: students' conceptions and conceptual change.
2. Attitudes development: students' values, interest, motivation, attitudes.
3. Reasoning: students' reasoning, scientific thinking.
4. Teaching: teaching strategies, metacognitive strategies, educational technology.
5. Environmental education and biology education.
6. Health education and biology education.
7. Social, cultural and gender issues.
8. Practical work and field work in biology education.
9. Research methods and theoretical issues.

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1. Student conceptions and conceptual change.
2. Student interest and motivation.
3. Student values, attitudes and decision-making.
4. Student reasoning, scientific thinking and argumentation.
5. Teaching: teaching strategies, teaching environments and educational technology.
6. Environmental education and biology education.
7. Health education and biology education.
8. Social, cultural and gender issues in biology education.
9. Practical work and field work in biology education.
10. Research methods and theoretical issues concerning research in biology education.

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