TEACHING MODULES: AN ACADEMIC REFEREED WEB PUBLICATION

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ABSTRACT

The Module is an electronic teaching document in two parts : the first part is the actual teaching note (the MAIN) and this is stored as a read only Web document; the second part is a COMMENTARY document which is linked to the Main.

Initially commentaries on the Main must be sent to designated referees who will jointly decide whether to include them into the COMMENTARY. The MAIN has links to references and to a site for sending e-mail comments to the referees. There is also provision for sending comments on the nature of the Module itself.

A pilot Teaching Module "e the Exponential – the Magic Number of Growth" has been set up at the Australian Mathematical Society electronic site

http://www.maths.unsw.EDU.AU/amsweb/Modules/

It will be seen that in this form the Module presents a challenge to the mathematical community to submit a self contained note capturing the essence of some topic, in such a way that an intelligent student can follow the central arguments and understand the main results. It is further hoped that the student is given the opportunity to share the author's excitement and interact with him/her as they contemplate the wonder of the patterns revealed.

Every so often a review of the Commentary will be carried out which might result in the Main being edited by incorporating some of the commentaries. Alternatively it might even be decided that a better balance can be obtained if these commentaries are kept in the form of an addendum to the original Main. It is hoped that, used in this way, the commentaries will shape the Module so as to develop a life of its own – continually evolving into something more dynamic and exciting whilst still retaining its solid mathematical core.

The author now makes a confession that he has a hidden agenda – the main motivation for developing these Modules is that he believes that most first year textbooks (especially of the thick omnibus form) should be abolished. To implement this new modular concept it will be necessary to have a paradigm change in our academic culture.

He will also assert that research journals in all honesty should be classified as teaching journals and thus they also would be best presented in this Module form.

The real challenge is to use these modules so as to develop a love of learning; that is to encourage the student to become a philomath and leave mere information transfer and drills to CAL.

KEY WORDS

Academic, publication, refereed, teaching, commentary, module.

1. INTRODUCTION

We have had of course, academic electronic publications for some time and most of them are accessible on the Web. Unfortunately all that appears to have been done for many of these publications is to convert a printed document to an electronic document. Everything else remains much the same and, in particular, the interactive potential of the internet has been largely ignored.

In contrast,the Teaching Module described below attempts to exploit this INTERACTIVE potential and through a dependence on referees of high standing attempts to ensure that the content is of reputable academic quality. Apparently this Module, in which the comments are refereed, is the first of its kind in any discipline in Australia.

Although mainly concerned with mathematics it is suggested that the strategies discussed here are quite general for designing a reliable electronic academic system for any discipline. The paper is also concerned with the emergence of a hierarchy of electronic academic publications.

In what follows 'Society' refers to the Australian Mathematical Society which has recently accepted the Modules as an official publication. Also 'site' as used below refers to the Australian Mathematical Society Electronic Site specified in the Appendix.

As a preliminary the reader might like to browse through the associated Web links detailed in the Appendix. Firstly there is the general philosophy of a hierarchical suite of publications as outlined by Tognetti (1995) then the Launch document for the Teaching Modules by Tognetti and Doust (1998) which describes the concept and links to Tognetti (1998) which is the first Module (on the exponential) in this format.

Dr Doust (Pure Mathematics, University of NSW) is in charge of the Australian Mathematical Society Electronic Site. He is responsible for the design and the setting up of the web site and loading documents into the system. We collaborate in editing the commentaries.

Odlyzko (1994, 1996) should be read for a very valuable assessment of the broad issues involved with electronic publications and futuristic scenarios.

2. THE TEACHING MODULE

By a Teaching Module is meant a refereed paper linked to a set of refereed commentaries. Quoting from the Launch it is hoped that the Module is,

> " . . . a lively self contained entry to some mathematical topic that excites the author, written in such a way that the reader is infected with this excitement. The author challenges the reader to make mostly constructive comments to further reveal the beauty of the underlying structures and uncover interconnections with allied structures. It is hoped that it is this 'becoming' aspect which will give the publication its unique character.
>
> Furthermore it is asked that, during this early formative stage, the community offers comments in a spirit of cooperation rather than competition.
>
> Eventually the Module will be set up in two parts: the MAIN (the original article) and the COMMENTARIES. The Main part will store the original paper in the form of read only. The other part will be a record of Commentaries on the paper which will be included only after being refereed and this will be interactive.

> Every so often a review of the Commentaries will be carried out which might result in editing the original and incorporating some of the commentaries. Alternatively it might even be decided that those Commentaries, which offer new ways of looking at the topic, should be kept in the form of an addendum to the original.
>
> It is hoped that in this way the Module will then develop a life of its own and will continually evolve into something more exciting and dynamic. What is more, by incorporating links to other allied areas, it should become a very good starter for entering some area for the first time as well as being of use to those who are trying to refresh themselves in a long forgotten area."

So the distinctive features of the Module are: it has an 'emergent' character through the provision of the commentaries; it attempts to ensure genuine quality control through refereeing as both the paper and the commentaries are formally refereed; it is accessible and quite transparent to an intelligent student (which includes professionals visiting a long forgotten area); it has the potential to have rich interconnections to allied areas.

One of the greatest defects of the Web is of course the fact that there is very little genuine discrimination, with very little regard for quality in most browsers; that is quantity is emphasised at the expense of quality.

The other problem area concerns BUNDLING by which we do not necessarily mean the Welsh use of the term that had young unmarrieds so swathed in bundles of clothes that they couldn't get into any mischief. On the Web this term is used in a similar way as with newspapers where for example the sport and business sections are bundled together even though different readers might want only one of these sections.

Odlyzko (1996) discusses the implications of bundling at length and gives some rather nice costing examples. The topic is of vital interest to internet users at the moment with the massive court case underway to force Gates to unbundle his Web browser from Windows and charge a realistic price so as not to crush competitors such as Netscape. The implications of just one individual having complete control of the internet are horrendous, especially if that individual has been observed reading widely on Napoleon (as the court proceedings could go on for 10 or more years this could be a case of closing the gates after the horse has bolted).

The unbundling associated with the Teaching Modules is rather less dramatic but it does involve deeper issues than just cost. For example consider a typical fat first year omnibus of a text book of the 'Calculus' variety. Although these Leviathans claim to encompass the whole range of some topic, many of them are merely offerings of isolated tit bits with only poor linkages to allied areas and practically none to emerging areas.

Almost every year a new edition is brought out which makes mostly cosmetic changes to all except a small section, thus forcing old editions to be discarded. Worse still, although certain parts of this great omnibus might be preferred by a lecturer, other sections are better treated in other sources again usually buried within other voluminous pandects. But the lecturer is denied making his/her preferred selections because of the costs involved.

As for quality, the Module offers the imprimatur of a professional society which has an established reputation for being jealous of its standards. In contrast a preprint has only the reputation of an isolated individual.

Unbundling is of course basic to the Module as, in contrast to the above bundled tomes, it is an attempt to produce a self sufficient, stand alone treatment which can best express the essential ideas behind some fundamental topic. However it is not set up to be insulated from other sources, quite the opposite, and this is where the inter-connectivity of the Web is exploited. Even so these links to other sources and associated topics are not necessary for an intelligent student to comprehend the basic concepts within the Module.

The Module offers a rather gentler alternative to actually burning the great fat tomes mentioned earlier – instead of such frozen monoliths we now have the potential to work towards revealing the seamless web that we know underlies all structures in knowledge. (Actually this author believes that a better image is that of the brain with discrete modules and massive inter-connectivity.)

2.1 A NOTE ON THE TERM COMMENTARY

If we write down some of the synonyms for the term commentary we begin to form the following list: exegesis, interpretation, guide, scholian, explanation, hierophant, expounding, revealing, guide, exercitation, discourse, disquisition, discursive, roving, perhaps even jobation.

The point is that these words rove over a wide range of meanings and unless it is decided which of them is to set the style beforehand, the computer medium will not be at all helpful ; in fact it could exacerbate the problem and, as we have seen in many areas already, simply proliferate the banal. Now Wittgenstein believed that if only a clear, accurate, concise language could be created then the whole of philosophy would become trivial ; perhaps such a language is the genuine philosopher's stone. It is in this spirit that we use the term commentary which spirit can be used to help us to at least try to reform the present inaccessible priestly language of mathematics. We do see some of this happening in parts of what is called first year maths where a simple language construct has allowed such an area as matrix theory, which was accessible only to specialists but a few decades ago, to be now understood at a very elementary level.

The concept of using a dynamic commentary associated with a text is of course an ancient one especially, in the Jewish tradition. As detailed in Manguel (1996) it is seen that this tradition begins with commentaries on the Torah (the Mosaic Law), and culminates with the Ashkenazi scholars who used it to investigate every possible level of meaning in both the text and its full history of commentaries. The Talmud is the Jewish Canon which consists of a collection of oral laws and the Gemara an elaboration in the form of a debate which was "developed to preserve the diverse layers of reading over many hundreds of years, from the sixth century to modern times." Beginning in the sixteenth century the Ashkenazi school refined a form of the commentary which "analysed every line and every word, searching for every possible sense".

Since the purpose of the Scholar was to explore and elucidate the text on every conceivable level of meaning, and to comment of the commentaries all the way back to the original text, Talmudic literature developed into self-regenerative texts that unfolded under progressive readings, not superseding but rather including all previous ones. Thus reading was an activity that could never be completed.

Kafka interpreted this approach to mean that "One Reads to ask questions". It is hoped that the Module shares the same spirit as these commentaries and that they can be used to help the student to read maths to, not just ask questions that lead to answers, but to stumble across questions that lead to deeper questions – thus deepening the mystery.

3. THE FIRST MODULE – "e – THE MAGIC NUMBER OF GROWTH"

This topic was deliberately selected to be a safe non-controversial topic for introducing the concept but one that was widely known to the community. Hence as detailed in Tognetti(1998) this first topic was concerned with the exponential as it is indeed the magic number of growth and the basis of all population studies whether in economics, biology or engineering. The presentation has a core of solid mathematics but attempts to bring the topic alive by detailing the history and also emphasising the beauty of the mathematical structures.

The Module is written as a self contained introduction to exponential, bringing together the main theorems and important properties of this fundamental constant of natural growth processes. It assumes only an elementary understanding of integration and is intended for the serious student in maths who wished to begin a deeper understanding and also perhaps colleagues who are returning to this area after a long break. Some history and anecdotage are also included – in particular Nobel Prize winning physicist Richard Feynman showing how he can use his feel for numbers to outdo a calculator.

Euler's gamma constant also comes into the main theorem and this highlights the intimate interconnection between exponential, the area under the curve 1/x, and the truncated Harmonic series. Although exponential is the base of Natural logarithms it is not, as commonly supposed, the base of Naperian logarithms – in fact, as is shown, the Naperian approach led to one of the few dead ends in mathematics. And yes the absurdity of expecting sustainable interest rates is highlighted through an example based on the Dutch buying Manhattan Island form the Indians.

The layout of the Module is as follows :

An Introduction based on a simple example to demonstrate how exponential becomes the limit as we increase the number of periods of compound interest in a year. Growth Models – is a simplified treatment of intrinsic rate of increase and "Malthusian" growth – it develops the formula for doubling time which is approximately 70 divided by the % interest rate. A short history of e is coupled with an appendix outlining Naperian logarithms.

A collection of proofs is then given which are selected only on the basis of their elegance that is their unexpected simplicity. Whereas to the visual artist beauty is a surface thing and lies in the eye of the beholder, to the mathematician beauty lies deep down within the very enfoldments of the mind. To demonstrate this one simply has to look at the myriad of pretty chaos pictures and realise that they can all be generated by the one simple recurrance relationship.

4. THE GENERAL PHILOSOPHY

This is detailed in Tognetti (1995) where it is explained that the Teaching Module fits into a hierarchy of proposed publications with preprints at the bottom ranging up to research papers of international standing at the top. It is proposed that eventually only abstracts will be published by the Society; initially as a hard copy and finally even these will be only on the Web. The actual location of the associated paper is not important as long as there is some certified copy kept at a safe and secure location. However it is envisaged that there must be a hard copy stored initially in case of 'burn out'. This will be the case until the system proves itself. Although there are claims that there are now cheap reliable discs with long lifetimes there is still the long term problem of physically cataloguing and secure storage of such discs (consider how difficult it is to access some long archived magnetic tape).

The **hierarchy** concept is concerned with two broad types of publications

A. Research Publications

B. Teaching Modules

A. Research Publications These should be in the form of a hierarchy as follows:

a) Local Preprint

This gives an opportunity for anybody to get into print and be given an imprimatur by the Society which at least certifies the date of publication of the manuscript together with security on the content at that date. Although these pre-prints are not formally refereed perhaps they could be vetted informally within the Department as a check against obvious plagiarism and for fear of releasing material of too low a standard. These preprints should contain much more connective material than the final paper; that is they should be transparent. Such Preprints should also be accompanied by a comprehensive abstract and perhaps even some attempt at an expository version could be encouraged.

b) Local Abstracts

These are simply user provided abstracts of the pre-prints. The Society should keep a central register of these which can be accessed and copied by Site ftp. The society accepts no responsibility for the quality or accuracy of the associated pre-print; this is entirely the responsibility of the author and perhaps the author's Department.

c) National Abstracts

These and the International publications are in the form of extended abstracts based on fully refereed papers. At this stage the full paper (which is simply a more elegant form of the preprint updated by referees' comments) should be kept on a data base at the Site and at least for the first few years a certified hard copy should also be centrally stored so that hard copies can be sent on request to less fortunate colleagues in third world countries.

d) International Abstracts

These are abstracts of Papers of the highest calibre designed to demonstrate that Australia is capable of truly outstanding work – whether the paper has in fact been published in an existing reputable Journal outside of the Society is incidental. In the case of a paper which has not already been published elsewhere it might be appropriate to consider only those papers that have been accepted in the National Abstracts. Then the referee can take account of subsequent commentaries from the community.

Comments

1. It is claimed that it is quite unnecessary to publish the full paper - the point is that the abstract in the Journal should allow the user to be able to make a decision about asking for the full paper. To get a full copy perhaps the reader should be required to contact the author directly – this could be a condition of acceptance by the Journal and would help to spread the electronic load within the community.

It is emphasised that even if such a recommendation was accepted the Site should store a secure authenticated copy of the entire paper probably at some nominated library which could be accessed if there were any dispute about precedence or if the author slipped off the system.

2. The real-politik now is that we will become more and more under centralised bureaucratic control so it only a matter of time before we will be forced to allocate Brownie points to each publication. Perhaps the Society should take the initiative and address this problem and at the same time the related problem of Salami Science – breaking up into LPU's (Least Publishable Units). After all, our publications do vary considerably in quality and in the effort required for preparation so at least some attempt should be made to address this problem by the referee. Yes, I do realise the dangers of this, as on too many occasions the referee has not realised the significance of the result.

When I start to do research in a new area, my first aim is to submit a draft as soon as possible into the system so as to let the system find a referee who will tell me about the relevant literature. This has been forced upon me as I do not have the time to do a full literature search in an unfamiliar area. However it would be nice at this early stage to make contact with a kind person who is familiar with the area and has the time and patience to give me some early guidance. So this is why I would value the local a≠bstracts as I would be alerted to emerging work not something that was done some years ago. Such a service would also increase the probability of my finding that kind person.

3. Local abstracts should start emerging as soon as possible at the beginning of the study so as to encourage colleagues to interact and work collaboratively. The big question here is whether the author is brave enough to reveal only part of the picture and have some one else come in and finish it off.

4. Finally **Cost**: With the proposed new system no University library will keep copies of post electronic journal publications. Thus the University itself should subsidise the Society for the saving in the cost of the Journal and of course, this should include both the direct cost and the indirect costs (the cost of cataloguing and storing). So it is reasonable to expect that the net contribution to the Society from the University should be substantially more than the former subscription costs. Of course such an arrangement could be implemented only if the AVCC strongly supported the concept. And of course this will happen if and only if the Society is prepared to lobby vigorously with the AVCC on this matter.

5. RESEARCH OR TEACHING ?

We now have a brief look at the terms research and teaching. Firstly Teaching – for what follows and for this audience we will assume that we have an understanding of the term Teacher and that one of the most important roles of the teacher is to disseminate knowledge. Usually this is old knowledge that some researcher has discovered.

Now a dictionary definition (Chambers) tells us that research really means “careful search” and of course the objective of a search is discovery.

So research is concerned with firstly acquiring some knowledge, getting motivated to carry out a search and then carefully searching. Suppose that we are successful and something is actually discovered, what then? Well we write it up and get it published in a Research Journal. Is this still part of the research process? Certainly not! Research has to do with discovery and an article in such a journal is concerned with communicating discovered knowledge. Hence this aspect of preparing an article and publishing should most definitely be regarded as teaching. In other words as soon as a discovery of new knowledge has been made that knowledge is in exactly the same category as old knowledge and its communication should be being carried out by a teacher even though that teacher may have been a researcher a short time before.

Regrettably it is at this stage that the whole academic process almost breaks down. Many productive and creative researchers operate best in a peaceful isolated environment and it is inevitable that they develop a priestly language to keep trespassers away. Additionally, many researchers, and not only the second rate, are as much motivated by pride as they are by curiosity so they tend to be secretive well beyond the discovery stage, and believe that it is not in their best interests to be good teachers. An example of this sometimes occurs in publications in mathematics which include the statement “it is easily shown that”. This often means that the author has suppressed a couple of pages of very difficult development which he/she will be able to use in his/her next paper confident that the reader, denied any real guidance, will be unable to reproduce his/her technique and beat him/her to it. It is not surprising that someone so selfish has difficulties in teaching.

So here is a challenge to change the culture of ‘research publications’ by beginning in a small way to use the Teaching Module described here as a model. It should be admitted at this stage that the only reason we began with a Teaching form was that we thought that would reduce the amount of controversy until we got this project underway.

6. THE FUTURE

Although the first Module has actually been launched there is much to be done before this new publication becomes widely accepted.

Most of this is simply public relations in the form of attending conferences and briefing key officers of various society. Up to this stage it has all been managed without any face to face discussions – so email does sometimes work.

The next stage and one that needs to be handled very carefully is a major project. This is to upgrade from Teaching Modules to interactive Research Publications. Again this has to be associated with a considerable amount of public relations, even more than with the Teaching Modules, as such a publication is a marked departure from the traditional format. Much consultation has to be carried out to determine the complex sequence of events that would enable such a concept to be implemented knowing that most of the most difficult issues are political and that one has to take on some very strong vested interests – what is required is to change the very culture of academic publication.

Genuine scholarship in Australia is reeling from the twin evils of managerialism and massification. Particularly is this so in mathematics and physics, for example Monash University had a mathematics department which was of international distinction. Its high quality staff of over 60 has been brutally cut down to a not too complete skeleton of under 30. Such philistine acts have provided a very hostile climate in which to attempt such a major change. To extend the Modules to include emerging research in this climate would require a new type of professional – one who has very rare skills; being able to carry out high grade research and having a genuine talent for expository writing. With a shrinking population of first class academics, in such traditional areas of scholarship as mathematics and physics, there is just not the time nor manpower to do much more than try to maintain some core activity to keep the disciplines alive.

In contrast the change in the research culture required could be achieved only by doing the opposite, that is by expanding the number of professional mathematicians so as to include a new speciality, that of the expositor. Even if the financial resources were available to undertake such an expansion and reward such expositors it would have to be done with great care as unfortunately this area in the past has tended to attract those who have failed in the mainstream activities. However this could be achieved, avoiding disaster if the enterprise began with small well funded, well monitored pilot schemes. And what is a better way to do this monitoring than through the use of the Modular concept that has been described in this paper. There is too much emphasis being put into flooding the student with even more information. In contrast our hope is that this module concept can be used to create an environment in which students can be encouraged to open themselves up to the joy and beauty of abstract forms and become lovers of learning in the spirit so elegantly captured by Nillsen (1997).

7. APPENDIX

Instructions for accessing the WWW links for Teaching Modules at the electronic site for the Australian Mathematical Society

Main Module web site = http://www.maths.unsw.EDU.AU/amsweb/Modules/

This has a link to BACKGROUND which takes you to
http://www.maths.unsw.EDU.AU/amsweb/Modules/background.html
where you will find the WEB version of the paper launching the Modules by Tognetti and Doust. (printed version, (98)).

Here you will also find e-mail addresses to make comments on the nature and form of the Module as well a link to
http://www.austms.org.au/Gazette/Mar95/letters.html#letter1
which is the original paper by Tognetti (95). The Teaching Module concept is anticipated in this paper together with a hierarchy of other electronic publications.

The Module Home page also has a link to
http://www.maths.unsw.EDU.AU/amsweb/Modules/Exp/
which allows the down loading of the initial Teaching Module. This is a Web document by Tognetti, “e the Exponential – the Magic Number of Growth”. There you will see the beginning of the paper together with options which will enable down loading of the whole paper in three versions PDF, Postscript, DVI. If you do not have Adobe Acrobat to download the PDF version you will also find detailed instructions here which allow you to download a copy of Adobe Acrobat.

You will also see a box labelled “Give your Feedback” which if clicked will give you two email addresses to send your comments together with a direct response for short comments to referees.

The Abstract for this first Module is published in the Gazette see Tognetti(1998).

8. REFERENCES

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