Commentaries on the IMIA Award of Excellence Lecture by Reinhold Haux

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Summary
The IMIA Yearbook editorial team asked five internationally renowned biomedical informaticians to respond to Prof. Haux's editorial. This paper summarizes their thoughts and responses. Contributions are ordered alphabetically by the contributor's last name. All authors provided an equal contribution to this manuscript.

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Feasibility Considerations

by Arie Hasman, PhD, FACMI

Introduction

The editors of the IMIA Yearbook asked me to write a commentary on the lecture of Prof Reinhold Haux, presented on the occasion of his receiving the IMIA Award of Excellence. In this lecture entitled "On determining factors for good research in Biomedical and Health informatics, some lessons learnt" Reinhold Haux reflects on factors elicited from situations that influenced his career. In his opinion, these factors have a positive influence on the quality of research in biomedical informatics.

Characteristics of Medical Informatics as a Field

Reinhold Haux first describes the characteristics of medical informatics as a field. He starts with a conventional definition of medical informatics and adds another one motivated by a description of statistics given by Senn (http://www.senns.demon.co.uk/DICE.html). He acknowledges that medical informatics is not the only discipline that deals with organizing, representing, and analyzing data, information and knowledge in biomedicine and health care. Also medical statistics and epidemiology fall under this thematic umbrella. But biomedical informatics has both an analytic and an engineering side and this distinguishes biomedical informatics from epidemiology and medical statistics.

According to Haux, biomedical informatics is interdisciplinary rather than mono-disciplinary: its body of knowledge derives from a number of disciplines. This has also consequences for the education of biomedical informatics.

Reinhold Haux is concerned about the future of medical informatics. Jan van Bemmel earlier stated that medical informatics could become fully integrated with the specialties and branches of basic and clinical medicine and healthcare. Reinhold Haux is not convinced. Because of its interdisciplinary character, biomedical informatics can survive and take over (parts of) other fields instead of being taken over. Both opinions may be correct. Biomedical informatics, as all sciences, is concerned with generalization. In biomedical informatics we ask for example whether informatics solutions that work in one medical specialty also work in other medical specialties. This type of question will typically remain the playground of biomedical informatics researchers. Biomedical informatics will also continue to study the way data, information, and knowledge can be analyzed and translated into each other. Knowledge management and decision support systems will continue to be developed by biomedical informaticians.

Increasingly software and hardware are used for carrying out research within a medical specialty, among others also software developed by biomedical informaticians. This software will be used to solve problems or to simulate processes that are studied by the specialty, as it is done, for example, in databases, simulation software, and decision support systems - the specialists do not have to enter data or knowledge into the system to carry out the research. The software will be considered a type of productivity tool. This type of research will increasingly be carried out within the confines of these specialties. And it may be that one or more biomedical informaticians are involved to work efficiently with the available systems. But it is unlikely that 'real' biomedical informatics research will be carried out by medical specialists themselves. They are focused on their own discipline and will gladly use software for answering research questions belonging to their discipline. They will have neither the time nor the background to carry out research in biomedical informatics, unless they become biomedical informaticians themselves and loose their status of medical specialist. Thus, biomedical informatics will not cease to exist, because the study of the systematic organization, representation, and analysis of data, information, and knowledge, requires another body of knowledge than the knowledge of medical specialties.

Factors for Creating Good Research

I agree with the factors important for creating good researchers proposed by Reinhold Haux. But there is a need to comment on the feasibility of implementing some of them. Today's global attitude towards productivity, and the time allowed for carrying out research and writing a thesis does not admit many research detours.

Indeed promising students should be encouraged to pursue a scientific career. Much depends on the ability of teachers to identify these students. In the Netherlands, there are educational possibilities for bright young students. The Amsterdam University College, for example, offers a bachelor (honours) degree programme in liberal arts and science, taught in English, and open to both Dutch and international students. Characteristics of the study are:

- Small international classes with personal attention and interaction with lecturers
- Substantial freedom in designing a study programme
- Support and advice from a personal tutor on planning the study programme
- Focus on far-reaching themes and real-world problems in science and society
- Learning about the relationships between fields of knowledge, as well as building specialist knowledge in the subjects that interest the student most.

Such a bachelor offers what Reinhold Haux intended to promote with factors 3 and 10. Students with such a background are very well suited for a discipline like medical informatics.

Appropriate Education

At the time I selected medical informatics to pursue a career, I had a PhD in physics and had worked three years in a Radiotherapy and Nuclear Medicine department. In 1974, I joined the new Medical Informatics group, chaired by Jan van Bemmel. It was not too difficult for me with my background to obtain a good overview and knowledge of biomedical informatics. The field had just started and my knowledge of physics and mathematics and my familiarity with what was going on in hospitals were an adequate basis. But biomedical informatics in the mean time has developed a large body of knowledge. Reinhold Haux received his education as a student of the Heidelberg/Heilbronn medical informatics programme. So he was directly confronted with the field of biomedical informatics. Is it still possible today to start a PhD track without being introduced to the field via a master programme in biomedical informatics, given the allowed period of four years (at least in the Netherlands but also in other countries) for producing a PhD thesis? Of course PhD students coming from outside the field of biomedical informatics can become good scientists when carrying out research that usually covers only a very small part of the field of biomedical informatics, but whether after their PhD defense they will be good biomedical informaticians is another question. Reinhold Haux suggested the same concern with his remarks about factor 6. To be a good biomedical informatician means that you must master the increasing body of knowledge of biomedical informatics and I am not sure whether PhD students in general are able to acquire all this knowledge in four years.

Many Are Called, but Few Are Chosen

When inviting candidates for PhD positions, we should not only put forward the challenges of working in our discipline. Many students are also interested in the possibilities of pursuing a career in the field they are going to work in. They therefore should also be told that the number of full professors, associate professors, and assistant professors or positions in research institutes is usually rather limited. Also they should realize that they work in a competitive field. And some of these competitors may spend much more time on their research (and therefore may be more productive) than others are able or willing to spend because of social, financial, or other reasons. This touches upon factor 16. Life for some is more than the pursuit of research or a job. Time should also be spent with husband or wife, children, family, and friends. Of course we need quite a number of PhD students to be able to select the best of them.

Therefore candidate PhD students should also be made aware of the positive fact that with a good research background they will become good practitioners and will easily find challenging jobs. So following a PhD research track always has benefits, independent of the fact whether one continues as a researcher or as a practitioner.

Sufficient Time and Backtracking Opportunities

Whether PhD candidates have enough time to also explore less successful research paths or even dead ends, I doubt. Of course, we all learn from our mistakes, and after having done a certain investigation we usually know better what we should have done in the first place. But PhD candidates are only given four years for their research. Biomedical informatics is a broad field and, in my opinion, students freshly graduated from the university do not yet have a good understanding of the discipline, especially when they did not do a master in biomedical informatics. Also increasingly available positions are based on grants. A grant usually is obtained when an excellent research proposal has been written and such a research proposal dictates what will be investigated. It would be desirable that the PhD candidate could write an outstanding proposal him or herself, but usually a more senior researcher will be involved. Of course, even such a research proposal does not determine in minute detail how the research has to be carried out. That is left to the creativity of the PhD candidate. But as long as society does not allow more time for carrying out a research project, we as teachers should take our responsibility and protect our PhD candidates from too long detours. When Reinhold Haux states that one should not expect productivity too early, I agree. The PhD candidate should get time to study the literature and to further specify research questions and study design. But although Reinhold Haux is right when he says that one should not combine this (productivity) too much and too early with the setting of career targets, it is also clear that PhD students do see a link between productivity and career targets. Career tracks are important for them and they will take into account the conditions for success.

Summary

I congratulate Reinhold on his IMIA Award of Excellence. He has earned it! As it is clear from my comments, I agree with the factors he proposed. But in my opinion some of these factors are difficult to implement in today's world. Productivity counts, whether we like it or not. And success is among other drivers determined by the impact factors of the journals that we publish in and by how many times our work has been cited. Of course, these bibliometric indicators are used because they can be calculated relatively easy, but they show only part of the picture. An IMIA Award of Excellence or a similar prize takes more aspects, also qualitative ones, into account to identify a successful person. We therefore should work into two directions: one is to try to convince administrators that bibliometric indicators only tell part of the story and should therefore be used with caution. On the other hand, we should take these bibliometric indicators into account as long as they are accepted. Otherwise we put our PhD students at a disadvantage.

Beyond Good Research: Biomedical and Health Informatics Requires Competent Professional Practice to Optimize Its Value

By William Hersh, MD, FACMI

It is an honor to be asked to write a commentary to appear alongside the published keynote address of Prof. Reinhold Haux, which I also had the opportunity to attend at the MEDINFO 2013 conference in Copenhagen, Denmark. Prof. Haux asks what are the best factors for research in biomedical and health informatics (hereafter called informatics, with the application in biomedicine and health implicit)? I believe Prof. Haux describes well the factors that are required for the best research to emerge from our inter-disciplinary, sociotechnical science. I also agree with his noting what separates informatics from other information-oriented disciplines is that it is also an engineering science.

From his excellent paper, I would extend the discussion to advocate that good informatics research also requires competent professional practice so that the optimal research can be disseminated and implemented, i.e., not bound up in journals and academic settings. The real value of informatics, like all biomedical research, is the extent to which it can be used to improve human health through its application. This improvement will come from dissemination of that research to achieve the most impact and benefit for society. One of the many ways to disseminate that science best is to understand the most important factors for the professional practice of informatics.

We may first ask, why be concerned with the professional practice of informatics? I would reply that one of the critical values for the success of research, and the science underlying it, is providing useful value to society. Even purely theoretical research must manifest in a way that helps humanity. For example, the mathematics and physics that underlie computing and other technologies demonstrate the value of fundamental research in those basic disciplines.

By the same token, the fruits of research in informatics must provide value to justify society investing in it. There are, of course, many ways that informatics research can benefit humanity. When implemented properly, electronic health records (EHRs) can improve safety and quality while reducing costs [1]. Likewise, clinical research informatics systems can extend the ability of clinical and translational researchers to advance health and medicine [2]. In addition, advances in bioinformatics improve our understanding of the human genome that can lead to new and improved tests and treatments for disease [3]. These may all come together in a patient-centric world that prioritizes health, driven by personal health records (PHRs) [4].

Informatics is now at a critical juncture in being able to provide value in ways that were impossible in the past. Computing power has become inexpensive and widespread. The Internet is ubiquitous across most of the planet (I marvel when, in my opportunities to teach students from low-resource countries, I see them using their smartphones, tablets, and laptop computers. This is not to mean that there is not still a large digital divide in the world, but that knowledge workers from just about all countries now have access to computing resources and network connections). In middle-income and high-income countries (and low-income ones in some instances), we are also observing the widespread adoption of EHRs, patient engagement through PHRs, the development of telemedicine networks, and other advances.

Prof. Haux and I (a half-decade his junior) came about in an earlier era of informatics. The focus of work in informatics when we began our careers in the last quarter of the 20th century was very different. Much of the emphasis was on research systems, with medical informatics programs housed in academic departments and applications used in operational settings being mostly homegrown (locally developed).

Around the beginning of the new century, informatics began to change. Leaders from healthcare outside of informatics began to understand the potential of our systems, particularly their potential to improve quality and safety while reducing costs. Probably the most influential documents were the reports of the US Institute of Medicine (IOM) [5-7]. These reports set in motion a process that culminated with the HITECH Act in the US [8, 9].

Evolution of technology in medical environments is changing the nature of informatics research. There are concerns whether homegrown systems are generalizable to the larger world. We are also seeing a shift in the emphasis of informatics work from implementing EHRs and other systems to optimizing them. This has brought new areas within informatics to the fore, such as data analytics [10].

Also changing is the nature of informatics work. We still certainly need the good research and researchers with the attributes outlined by Prof. Haux. But we also need a much larger cadre of professionals who know how to properly interpret the research and apply it in hospitals, clinics, and other healthcare settings around the world, not to mention in patient homes and other places [11]. This makes it critical that we pay attention to developing these professionals, not just as people who can be trained to deploy technology, but who understand the underlying science, apply it, measure its impact, and adapt as it changes.

A critical component in building a competent workforce is, of course, education and training. Prof. Haux correctly notes that appropriate education is a critical factor for good research. By the same token, proper education and training are also essential for competent professionals to implement and optimize the results of informatics research. There are some aspects to education that are appropriate for both researchers and professionals. There must first and foremost be bright and motivated students to attract. There must also be faculty committed to teaching and mentoring those students. The interaction of students and faculty must be synergized by an academic infrastructure that nurtures and maintains both. Finally, there must be a process of professional development so that researchers and practitioners alike can maintain and advance their careers.

Another major change resulting from new computing and Internet technologies is the breaking down of the walls of the classroom. My own experience has taught me that virtually any educational experience can be replicated in an online environment. Furthermore, there is no reason to segregate "in-person" from "distance" education, as we have found that the best from both methods can benefits students locally and remotely. Students can be taught, mentored, and immersed in real-world experiences "from a distance." There is no question that students who pursue research training need closer and more sustained contact with faculty than those in professional pathways, but technology is no longer a barrier to these interactions being across distances.

Those of us in the informatics field for any significant period of time have seen substantial changes in technology, research, and implementation. The role of informatics in the health ecosystem is not completely settled, yet there is no question that it belongs among other sciences and professional disciplines. With an aging world population and a need to tame healthcare's insatiable appetite for technology and the money to pay for it, the role of good informatics research and practice will become even more critical. One component for realizing its value will be the proper education and training of people who provide that research and practice.

A Comprehensive View of the Informatics Research Process

By Nancy M. Lorenzi, PhD, MA, MS

Professions move forward based on the results of research, whether quantitative or qualitative. The question of what makes a research project more successful than another is a long standing challenge to researchers.

During the 2013 MEDINFO meeting in Copenhagen Prof. Reinhold Haux received the IMIA Award of Excellence. The award recipient has the opportunity to make a presentation on the topic of his/her choice. Prof. Haux presented an overview of what constitutes good research. His presentation "On Determining Factors for Good Research in Biomedical and Health Informatics: Some Lessons Learned" was an immediate success with the audience. He succinctly captured the total essence of research from the content and research methodology knowledge to the surrounding ethos factors needed for success.

I have had the privilege of working with Reinhold Haux for more than twenty years. Reinhold receiving the IMIA Award of Excellence was outstanding. Listening to his presentation in Copenhagen and subsequently reading the copy that is included in this issue of the journal was also outstanding. I dedicate my comments and thanks to Reinhold for his commitment to health informatics and for all of his accomplishments and contributions.

In the health informatics discipline, my education and background are on the people process side rather than on the technological side. While I did learn programing/documentation etc. my heart was more with the people side of the discipline. In his presentation for determining the good factors of research Prof. Haux stresses the core need for basic, solid, research methodology. This solid research methodology is the foundation for the type of research that is needed in our discipline. However, having the best methods and methodology knowledge is not sufficient to have the research successfully completed. Being in the audience in Denmark and listening to Prof. Haux talk about other factors was exciting to me from the people-process side of the equation.

Of the sixteen research success factors presented by Prof. Haux, about a third are in the core foundation of research factors. Examples of these include: appropriate education, medical informatics competencies, necessary preconditions for good informatics research, access to high quality knowledge, and appropriate conditions for sustainable research.

To me the most exciting concepts portrayed in this talk reflected the factors that are usually considered intangible for success. Ten factors fit into the intangible category and that to me this is as important for overall success of the researcher. The idea that we can more easily identify and think about what would be good research is an important area. Sometimes people want to do research in areas that have either been over researched or may not be as significant as the idea that we can think thorough what is important is critical.

Working with stimulating people and environments allows the researcher to grow in both knowledge as well as level comfort with doing research. The synergy of working with other people who support the researcher will have a tremendous impact on the future. The ability to communicate is critical to solve problems in an inter and multidiscipline environment. If you have the most brilliant research but you cannot adequately explain it or share it with others, your research will not be accepted or used until communication becomes a core skill that is necessary for long term success. How we convey the research results, how we write, how we speak and how we share are all important components of being successful.

There are times in our lives when we are the leader of a research team and other times when we are members of the team. Knowing when it is the most acceptable to be the leader or to be a member and let others lead also leads to success. Staying unbiased is a success factor. If we know the outcome before we start the research is it truly research? Thinking things through and saying what if or how this might work will be a key to research success.

Research and informatics are crucially important but they are not our entire focus. We need a work-life balance. The family balance, the ability to learn, to listen to music, to tell jokes are all important balancing components. Prof. Haux added this balance to his list as a reminder to all of us of our humanness.

I recommend that every informatics student read Prof. Haux's speech as it contains holistic ways that we need to view the total concept of research. It is our guidepost to the future of our discipline!

Good Research in Biomedical Informatics: Getting the Word Out

By Edward H. Shortliffe, MD, PhD, MACP, FACMI

Reinhold Haux's analysis of the factors that determine the quality of research in informatics [12] is a wonderful summary of important issues. He draws conclusions with which I largely agree. The 16 identified factors cross cultural and geographic boundaries and help us to understand not only what is important for assuring and nurturing the next generation of informatics researchers, but also the challenges that exist in assuring that such supportive environments are built, sustained, funded, and appreciated. Rather than addressing the entire set of factors, I would like to discuss three that I find to be particularly compelling.

The Role of Stimulating Persons and Environments (df3)

I believe that the importance of Haux's df3 cannot be overstated. When a well-primed individual enters an environment that is characterized by intellectual curiosity, rigor, esprit, passion, shared commitment, and avoidance of petty rivalries, the impact can be remarkable. I have often reflected on the serendipity that brought me to my introductory informatics environments at just the right time – surrounded by exciting ideas, an expectation of research productivity, and wonderfully supportive people who were as interested in my own success and ideas as their own. As Haux stresses in his article, the core competencies in informatics involve more than technical know-how. Our field exists in a milieu where social and organizational structures are crucial determinants of our success and impact. Thus the field has a cultural element that needs to be experienced and absorbed; it cannot be learned in the classroom and requires an immersion in discussions, and debates, implies shared understandings, and team-based interactions that are in many ways unique to informatics. Excellent research training programs engage students in such environments from the outset and, as Haux emphasizes, encourage their gradual evolution from team members to independently motivated investigators who identify their own research problems. Some students find these expectations very difficult with which to deal, and this often means they are not meant to be independent researchers. It is when the right kind of student is exposed to such environments that great, creative investigators are born.

My discussions with researchers in other fields reaffirm that the issues discussed here are very important for nurturing good science in many disciplines, although I believe the notions are unusually complex and important in a field such as informatics that has a remarkable emphasis on its interdisciplinary components. After all, our field is more than computer science in medicine [13]. It also includes medical and biological sciences; decision sciences; psychology, cognitive science, and other behavioral/social components; statistics and information science; healthcare economics; organizational theory; management science; and many others. It is obvious that a series of focused courses in all these topics would not produce a top informatics researcher; it is the coexistence of these topics and themes in a dynamic and stimulating environment that allows budding scientists to absorb not only the knowledge but the rich interconnections that are involved.

These observations lead to my strong rejection of the notion that high quality and innovative informatics researchers can be produced through online education. Advocates of online courses stress the importance of offering degrees to individuals in ways that are more cost-effective, suitable for part-time study, and sensitive to geographic realities that complicate an effort to disrupt one's life and travel to a university for several years. These arguments may hold for vocational or certificate training, and possibly for applied masters' programs, but not for developing the kind of inspired researchers that are the subject of Prof. Haux's analysis. Doctoral (and research masters') training is aimed at producing researchers, individuals who will often be teachers and academicians as well. For reasons outlined above, a series of online courses simply cannot accomplish this goal, even if there is a required doctoral dissertation in addition to the coursework.

The Necessary Preconditions for Good Medical Informatics Research (df6)

The Ability to Convey Research Results in a Highly Inter- and multi-disciplinary Environment (df11)

I have found that these two factors are highly interrelated and would like to discuss them together, since I believe they are extremely important to the growth and appreciation of our field as a science (or as a collection of component sciences drawn from other fields). When discussing df6, Haux points out that good informatics research is dependent on two basic qualities: (1) relevance to the objectives of the field (which he also discusses), and (2) originality with respect to new methodology and/or technology in the field. Whereas these two considerations may seem self-evident, I fear that both informatics professionals (including academic faculty) and students sometimes lose sight of them. It is revealed in the papers that they write and the talks that they deliver, and I believe editors, reviewers, readers, and audiences need to be much clearer in specifying what needs to be presented in a good research talk or paper.

Let me explain the basis for my concern. There are actually several issues to discuss. The first is the persistent tendency of some informatics authors to focus their work and communication on the application of informatics technology or methods rather than the underlying innovative science or lessons that may exist. There is no doubt that the good science in informatics is intended eventually to be applied, and the field is assessed by others in large part by how those applications function and contribute to enhanced patient care, public health, or biomedical science. But a wonderful application does not contribute to the science of informatics unless its innovative, generalizable, and evaluated methods or contributions are explicitly revealed and discussed. Good science informs the work of other scientists; tomorrow's work builds on the results of today's.

Not all applications involve the development of substantial new methodology, but there are often innovative solutions to problems encountered that can be extracted, articulated, scoped, and made explicitly available to others for their use in similar settings. It is the responsibility of informatics scientists to identify those sharable lessons and to make them the focus and "take-home" message of the articles that they write and the talks that they give. Thus I am not critical of the work that people are actually doing in our field (it is often inspiring and well-conceived), but I am instead disappointed that they have failed to think about and convey the key messages or methods that emerge from their work and that will be of use to others. Too often we encounter papers or talks that include a descriptive series of screen-shots or flowcharts intended to expose the features of a specific system but that leave all interpretation of the associated lessons to be inferred by the reader or the audience member.

The message, then, is not that it is inappropriate to talk or write about applications, but that the main contributions of the work to the informatics field are derived from what has been learned that can also be useful to others. Students should be taught to ask not just "What does my system do?" but "How does it do it? What is novel? What can be generalized? What range of other applications might benefit from the same insights? How does my work potentially contribute to the work of others?"

With the emergence of bioinformatics work within our community over the last two decades, I have noticed a slightly different but related problem: the focus on biological results and a corresponding failure to identify the informatics contribution. The mere use of computers to solve a problem in biology does not assure that the work is a contribution to informatics. The methods may be "off the shelf" and the real innovation biomedical. If so, the work may be a contribution to biology or genetics but not to informatics. Should it be published in an informatics journal? I would argue not. I have noticed that dissertations and papers by informatics grad students who are working on bioinformatics problems often fail to mention informatics innovation (or even the word "informatics") in the title, abstract, or introduction to what they write. Use of the ubiquitous phrase "in silico" seems to be enough reason for an author to submit a paper to an informatics journal. My reaction is to ask grad-student authors of such papers why they are earning their PhD in biomedical informatics rather than in biological science or genetics. It is those fields to which they seem to be excited about making contributions, with informatics viewed largely as a tool rather than a subject of study. They generally deny that is true and, in almost every case, when pressed, are able to identify wonderfully innovative informatics contributions and to revise their paper or thesis document to highlight them. It is important that editors and reviewers of informatics journals require that the informatics contributions of research work in our field be clearly identified. Authors will learn to comply, and the science will benefit.

Also important is the need for our research training environments to take paper writing and oral presentations extremely seriously, since a scientist's success and recognition is highly dependent on the individual's ability to communicate effectively. Most faculty members have learned that incoming students, despite excellent education prior to their graduate programs, know remarkably little about how to write a scientific paper. We accordingly need to require our students to write frequently – in class projects, papers for conferences, dissertations, and journal articles. They also need to learn to write for different audiences, given the multi-disciplinary realities of our field. Students' writing abilities can improve remarkably over the course of their degree program if they are asked to write regularly and are given rigorous, careful feedback and instruction from mentors. Similarly, they need to develop their verbal skills and to learn how to design slides, to avoid excessive complexity in presentations, and to organize their thoughts and delivery style. Again, this requires regular experience preparing and giving talks and defending their ideas orally – always with thoughtful feedback and guidance from mentors. Such skills are important regardless of whether the graduate will remain in academia; informatics experts in industry, government, research institutes, and healthcare settings also excel and advance only if they have excellent writing and speaking skills.

Concluding Remarks

Those of us who have devoted our entire careers to informatics research, education, and practice often wonder why the scientific base of our field is not better understood by observers from outside the discipline. Prof. Haux has demonstrated in his article that there is a scientific core to what we do, and that a variety of factors contribute to what distinguishes good informatics research from bad. Academic informatics is evolving, with challenges related both to industrial relationships and research funding [14], but at its core it remains a remarkable field that has inspired and motivated excellent work by at least two (and arguably now three or four) generations of researchers. At its heart lies the importance of nurturing the development of those next generations of researchers and practitioners – it is they who will bring the promise of informatics increasingly into reality in the decades ahead.

In closing, let me add my own thanks for inspiration and collegial friendship to the informatics leader who is much discussed in Prof. Haux's article, Professor Jan van Bemmel. His influence on many of us has been immeasurable, and although I will not explicitly ascribe to him any of the opinions I have included in this commentary, the ideas emerged in part from observing his example as scientist and editor and by working with him closely on several international efforts over the years. I too would like to honor and thank him.

Of People, Hypotheses, and Publishing

By Jan H. van Bemmel, PhD

First of all I want to congratulate Reinhold Haux for the very thorough review of factors that are determining successful research in biomedical and health informatics research. I would like to make two remarks in advance: (1) In my opinion, all factors that were listed are just as well applicable to many other domains of scientific research, and (2) in addition to the list, other significant factors might be involved as well. Reinhold is well aware of these points, as he also wrote in his paper. Yes, every researcher has his own reflections, when looking back after some short or lengthy research career. Therefore, in my commentary, I will not primarily discuss, let alone criticize his choice for these factors, because they are, as he wrote in his paper, subjective. In general, I can agree with almost all of them, although perhaps having given some priority in the listing might have been appropriate. All the same, I want to add a few other prioritized elements, being aware that they might just be a different wording of the same factors as Reinhold's.

People

Many years ago already, I borrowed the expression "research is people" from Hubert Pipberger, then researcher in electrocardiology at the VA Hospital in Washington D.C. The first time I met Hubert was at the 1966 Elsinore Conference in Denmark on "Automated Data Processing in Hospitals", the first of that kind in Europe and preceding the first MEDINFO Conference by even 8 years. Hubert conducted research on the analysis of the vectorcardiogram by computer. As a junior researcher I had started a research project in the same area and I was eager to hear from a pioneer like him what guidance he could give me. Anyhow, I visited him one year later in his laboratory and since then we started close collaboration that has lasted many years.

Attending the Elsinore conference was for me a good starting point to learn to know many others that had been present as speakers or participants. As a matter of fact, all pioneers in the domain that was later to be called "medical informatics" were there, such as Gustav Wagner from Heidelberg, Octo Barnett from Boston, Don Lindberg then from Missouri, Homer Warner from Salt Lake City, and François Grémy from Paris, to mention just a few. Later on, I visited all of them as well as many others during a WHO study trip, in their own research environment, and remained in close contact with many of them. In the framework of these visits, I made a couple of observations. For instance: (1) yes, research is people, in all respects, as also mentioned in Reinhold Haux's review. An inspiring research leader is crucial for a research group; (2) there seems to be an inverse relationship between the quality of research and the luxury of the premises in which a research department is housed; if finances are available, invest such resources first of all in individuals and give them the best equipment available; (3) pay utmost attention to the organization of scientific discussions, taking place during weekly presentations by the research staff and the students of a research department. They are pivotal for the training of junior researchers.

Hypotheses

Before starting whatever research project, the best investment to be made in the beginning is a fundamental discussion of the underlying hypotheses and assumptions of the project. Already long ago, when studying philosophy (I know Reinhold has the same interests), I learned that in all research (still better: in all life!) wrong assumptions are penalized in the outcomes. They might be the causes for long delays in a project, financial losses and, sometimes, even failure. During my own career, I have found out that this rule is a 100 percent valid (also for large research institutions: “the larger the budget, the longer it takes to discover the errors!”). That’s why I agree with Reinhold that junior researchers should be given the opportunity to find out for themselves by trial and error the importance of this rule. Taking enough time at the beginning of a research project, to rethink one’s assumptions and prior knowledge pays off, also in financial terms, during and at the end of a research track.

Publish

I do not know whether Reinhold will fully agree with my experience on publishing. I always told my own PhD students that only at the very moment that the pen touches the paper (or the finger presses the keyboard), the time of truth has come. Only when you write down for others what you know and what you do not know, you realize clearly the limitations of your knowledge and whether you know well enough and have paid sufficient credit to the existing literature. That’s why I have (most of the time in a gentle way) urged my students to write down regularly, i.e., at least every three months, a progress report on their research. These periodic reports then serve as the subjects for discussions with their direct coaches. It is at the same time important that as early as possible drafts are written for publication in external progress reports, conference proceedings and - preferably - in refereed journals. I keep telling: the only stuff that will remain and will be visible even after many years are one’s major publications in refereed journals. They also form the main body of a curriculum vitae, of key importance when wanting to follow a career in science.

Perhaps, I am not telling anything new, after having read Reinhold Haux’s extensive review of his determining factors. Anyhow, it was a great pleasure to give my own view as an addition to and a cross-section of his list and I hope that he will be able to continue inspiring many others in Braunschweig, Hannover and elsewhere in the domain that we still briefly call ‘Medical Informatics’.

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