Organisational Change: Using Health Informatics Education as a Change Agent

Graham WRIGHT[a,1]
[a] *Rhodes University, Grahamstown, South Africa*

Abstract. This paper highlights some of the challenges, achievements and collaborations using health informatics education and research as a change agent in which I have been involved over the last 40 years. The Open Software Library (OSL) was a specialist publisher of Computer-Based Training materials (CBT) mainly authored by nurses and medics. The "Rainbow" series of distance learning materials, "Using Information in Managing the Nursing Resource" sold over 55,000 copies. It was utilized as the basis for seven Universities' Certificate and Diploma programmes and in-house training by the NHS to encourage organisational change. Workshops at Manchester University's HSMU focusing on evaluation studies highlighted that most NHS IT projects failed because of human and organisational issues rather than IT. This led to the development of a master's degree in Health Informatics shared between four European Universities. IMIA conferences, Working Groups and the development of the IMIA approved Education Recommendations and the IMIA Knowledge Base are effectively used worldwide.

Keywords. Strategy, Change Management, Evaluation, Education, Health Informatics

1. Introduction

Mine has not been a solo journey; it was only possible because of the involvement of many collaborators who supported my journey.

My employment since 1980 has been in management and organisational change within the UK National Health Service (NHS), Consultancies, and Universities. In parallel, I have had an academic interest and voluntary involvement in Health Informatics through the Centre for Health Informatics Research and Development (CHIRAD) and the British Computer Society (BCS). Much of my consultancy work has been "Business in Confidence" and thus cannot be published, in particular, my MBA thesis "A Review of the NHS IT Strategy". However, in this paper, I will attempt to give a flavour of the impact of some of the other projects with which I have been involved.

2. The Open Software Library and Computer Based Training

I started my Certificate in Education (Cert. Ed.) in 1980 at Huddersfield Polytechnic and had the opportunity to take an advanced computer programming course. The assessment

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[1] Corresponding Author, Graham Wright, Rhodes University, Grahamstown, South Africa; E-mail: Profwright@gmail.com.

of which was to produce a teaching program and a paper explaining the overall functions and purpose. On my return to Warrington General Hospital, I was asked to provide some sessions about computers, which were enthusiastically received, and inaugurated the Warrington Hospitals Computer Club and the Open Software Library (OSL) with David McKendrick [1].

The obstacles we faced included over 20 models of computers with incompatible operating systems and a lack of understanding of the uses and limitations of Computer Based Training (CBT) by healthcare teachers. Some of the solutions we tried to overcome these hurdles are listed below:

1. Using authoring tools. Microtext was available for several operating systems and soon enabled a catalogue of software to be created; the authors received 70% of the sale price.
2. Partnering with the Nation Health Service Training Authority (NHSTA) to undertake several functions including assessing, cataloguing, and publishing their materials via OSL including a simulation of a major disaster in Microtext and using a Laser Disk Drive.
3. OSL ran workshops and demonstrations at IT conferences including the BCS annual Health Informatics Conference, which had over 4000 daily attendees.
4. Publishing papers at conferences including Medical Informatics Europe (MIE) 1985 and the 1st International Conference on Human Resources in Health Care [2] and in journals [3].
5. The journal Nurse Education Today commissioned OSL to write a series of six articles explaining computers and their potential use in nurse education.
6. In partnership with NHSTA, OSL organised two Computer Based Training Conferences at Keele University in 1986 [4] and 1988 [5].
7. In 1985 the first International Conference paper about OSL was presented at MIE 85 in Helsinki [6] to a "who's who" of the BCS and EFMI and AMIA nursing informatics colleagues.

The first national conference on the "Use of Computers in Health Care and Training" was organized in partnership with the NHSTA and is widely believed to have been the first UK Conference to have its proceedings edited, published and printed before the start of the conference, so participants were presented with a printed copy of all the papers on arrival. In 1988 a second conference was organised at Keele University and featured many leading edge developments including CBT packages linked to the Phillips Laser disc and a demonstration and paper about the Fidonet emailing system [7].

In 1986 OSL set up a free-to-access Bulletin Board System (BBS) [8] on Fidonet that ran continually for 21 years on the same computer until 2007. Fidonet is still in existence https://www.fidonet.org. Tim Berners-Lee who ran an English Fidonet node just a few nodes down the chain was always complaining about the inefficiency of the system and how perhaps we could use the Post Code or letterbox numbers style number to represent an individual BBS. He went to CERN to develop their communication and developed the World Wide Web (WWW) in 1989. Berners-Lee persuaded CERN to give the copyright to a foundation later named the World Wide Web Consortium (W3C) https://webfoundation.org/about/boards/tim-berners-lee/. He is also a Fellow of the British Computer Society (FBCS). The activities of OSL and its membership had a significant impact on the adoption of Computer Based Training in the UK.

3. Free and Libre Open Source Software (FLOSS) and Value Systems

Several thoughts occur in mankind's behaviour that puzzle, particularly regarding the value of software and services. OSL was asked to submit a proposal for an online database to house the NHS Surplus Equipment database. We had access to the SQL database used by the NHS and so installed it on the Fidonet BBS and gave a demonstration of it completely operational online. As we had done the work to put it online the only real cost was the expense of continuing to run a BBS. We saw the news sometime later that a national telecom company had been given a three-year contract to develop it, but nothing more was heard of it. It seems that mankind is wary of FLOSS software solutions but happy to pay large amounts of money to a large nationally known company. There is no doubt that this risk avoidance behaviour is present in many government departments and national corporations. Bill Gates showed that putting a new frontend on MSDOS to make it easier for ordinary people to use and look good could be the basis of charging for software. He persuaded the manufacturers of micro-computers of its added value and so many machines came complete with Windows.

Peter Murray and I had these and similar conversations when we were helping to facilitate members of the European Commission Expert panel. He helped with the English grammar, and I gave financial input regarding what was permitted and what wouldn't be funded. We aimed to help projects find the right balance to achieve acceptance for funding. We established that some Health Informatics organisations needed help to understand the notion of FLOSS and put together a structure to support open source via the IMIA working group systems, the IMIA OS WG was formed in October 2002 https://imia-medinfo.org/wp/open-source-health-informatics , followed by the European Federation of Medical Informatics (EFMI) Libra and Free Open Source Software (LIFOSS) in 2006. In 2003 people in Washington smiled at us as we pinned up information about a meeting to start a FLOSS group, saying we wouldn't get the required 50 AMIA members. They were right we had over 200 people in the room and so the AMIA Open Source Working Group was formed.

An EMFI Special Topic Conference at the BCS HQ in London [9] was organised by CHIRAD, EFMI OSWG, and the BCS chairman. Thomas Karopka later said "The ideas and theses in this paper were stimulated by discussions with various participants at the EFMI special topic conference "Open Source in European Health Care" which took place in September 2008 in London. My special thanks go to all participants of this conference" [10]. Thomas became Chair of the IMIA group when I emigrated to South Africa. He was foremost in the development of the online repository of FLOSS in Health and the results of the IMIA OSWG thinking [11].

During Covid-19 the world moved to online seminars and I was invited as Chair of the HELINA and SAHIA Education Groups, to facilitate several seminars including a series of eight sessions by the open source GNU Health team which are available on the GNU site. So my passion for FLOSS continues.

4. System Failures

Victor Peel opened the Centre for Health Informatics in the Health Service Management Unit (HSMU), Manchester University and invited a number of us to be Honorary Fellows, Sir Duncan Nichol, Denis Protti, David Colin-Tome and myself in 1989. We organised several three-day courses on nursing information and had an unexpectedly

high number of applications, so the course was repeated quarterly. The team undertook multiple reviews of hospital systems, and I took the lead on the nursing systems. Thus, we had people attending the courses and people from the reviews talking about the current situation, but we needed to look to the future and try to change the number of failures.

In the majority of sites under review, technology usually did what it was supposed to do. Then the opportunity came to look at an implementation in Winchester and Eindhoven both using the same system. The Royal Hampshire County Hospital had a "full-blown" Electronic Health Record (EHR) that eventually ran for 25 years, while the same system in Eindhoven never became operational before it was decommissioned. Jos Aarts, Victor Peel, and I, together with input from Denis Protti discussed all the causation issues for these failures. We developed a model to address them and in 1997 presented our initial thoughts at a conference (12) and the paper was published in the conference proceedings "Health Telematics Education" edited by John Mantas. Whilst sitting in a Copenhagen café the three of us worked most of the day drafting the full model paper as evidenced by our reviews of implementation failures, which are shown below.
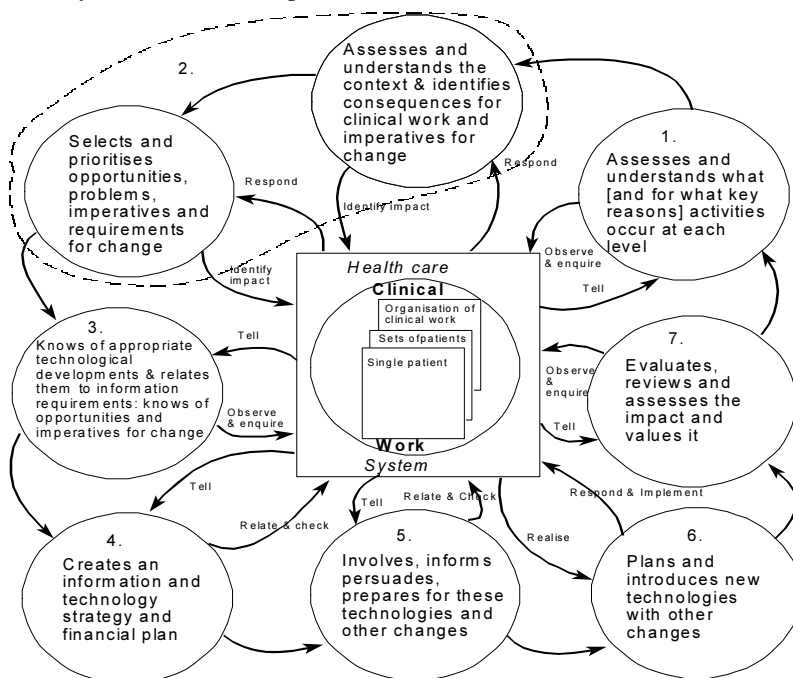

Figure 1. Showing the Aarts, Peel and Wright model [13]

Using the issues identified during reviews and looking at the areas absent from the many health informatics programmes we designed a master's degree. Looking at the expertise required to provide the different modules it was decided that we should offer the MSc Health Informatics programme at Surrey University's European Institute of Health and Medical Sciences (EIHMS), where I was Director of Education. Manchester University and Erasmus University would be partners. I recruited John Bryant (BCS Treasurer, IMIA and EFMI board member) to manage the programme at Surrey University. The first cohort was oversubscribed and most of the group were known practitioners in Health Informatics, who wanted to have a post-graduate qualification.

The full paper describing to degree design was published in the "International Journal of Medical Informatics" as "Organisational issues in health informatics: a model approach" in 1998 [13]. It is the highest cited of my papers after the IMIA Education Recommendations article [14]. Human and Organisation modules then started to appear in other HI master programmes.

5. How do you Train a Total Population of a Nation's Nursing Staff to Understand the Use of Information when Managing Resources?

Christine Greenhalgh, Director of Greenhalgh and Company Limited (GCL) had answers to the question. One was having the staff who could work together with the talent of being able to deliver the vision. In 1990 she persuaded NHS senior nurses that the model of large population training needed to be based on the experience of senior nurses working in learning sets to produce the training needs and then write learning material that could be used as in-service training supervised by a trainer, self-learning or as part of a formal education programme. The overall programme decided by the Chief Nurses would be called "Using Information to Manage the Nursing Resource", having five main headings, Quality, Workload, Skill Mix Management, Financial Management and Human Resource Management and two modules developed by GCL Consultants, Setting the Context and Analysis and Presentation [15].

Each of the five main module workshops was hosted by the Chief Nurse of the region together with a GCL consultant who produced a draft outline following all the day-long meetings. Hence feedback to the teams producing the materials for each chapter and the Steering Committee of Regional Nurses allowed rapid development. When the final collection of books was ready for testing and production, the following points were noted:

- Each book contained a standalone learning module
- Topics could be studied in any order according to the needs of the individual or organisation
- Two modules Setting the Context and Analysis and Presentation could be used as reference texts
- The Health Service Management Unit and GCL would produce a formal Certificate and Diploma programme using the materials
- The initial press run would be 35,000 sets, 27,000 of which went to the NHS training schools. A second run of 17,000 was produced and sold for 70 pounds a set

During cover design, it was agreed not to show a reading order and so it was printed in the seven colours of the Rainbow to the delight of Jean Roberts who was responsible for marketing. From that day on the materials were known as the Rainbow course [16]. It was the first of a series of training materials (Rainbow Series) produced for and used by the NHS that was accompanied by supportive training from GCL. A report from the NHS in England identified it as "an excellent development programme for nurses, which was relevant in the NHS agenda, providing a flexible approach to learning" [17]. The following year an evaluation of Rainbow in Scotland found that over half of their colleges used the material and that there were demonstrable changes as a result of this training [18].

"Using Information" was the resource used in formal programmes at Manchester University; a Certificate level for users and a Diploma level for future facilitators that

also included marking and setting credit-rated assignments, and facilitation skills so the diploma graduates could run the program in their health workplace or in conjunction with a university. Manchester University subsequently franchised to all six institutions in the University of Wales.

6. Cognitive Mapping and the IMIA Knowledge Base

One of the BSC and CHIRAD's joint projects was a cognitive mapping exercise called "Open Steps" using several interesting methods to identify concepts employing Bloom's Taxonomy as the indicative level of intellectual thinking to undertake health informatics activities at certificate, diploma, graduate, or postgraduate level. BCS funded a 24-hour workshop at an Otley conference venue near Harrogate, England so attendees could also attend HC2005. A grid was used to map the range of experiences and functions that would identify potential attendees, and an outline paper regarding the workshop and reading materials were sent to them. There was an excellent response rate and individuals invited replied positively, including overseas participants from South Africa, the USA, and Europe. Presentations of the exercises and a timetable of activities were followed by group exercises to identify the main headings of Health Informatics. Small groups, led by a researcher had a rapporteur to record the discussions. Each group developed learning objectives on Post-it notes which were then photographed so they could be projected.

Figure 2. One of the brainstorming outputs, each group had a different colour Post-it notes: this is one of the group's outputs, projected for all to see and vote on.

Overnight the next exercise was prepared using the identified 13 headings, each one on a separate large sheet of paper prepared with Bloom's six levels of Taxonomy. A grand dinner including the after-dinner speaker, the BCS Health Chair Glyn Hayes relaxed the participants who continued to discuss the next stage of the exercise. In

brainstorming sessions participants produced learning outcomes on Post-it notes that were placed in the appropriate space on the Bloom's taxonomy grid.

Figure 3. One of the paper sheets indicating Bloom's Taxonomy levels

Participants had to place one of the 13 subject tables at the level of Bloom's Taxonomy. Where people thought they could exist underneath different subjects then duplicates were allowed and if somebody disagreed, they could put an X on the statement.

Figure 4. showing multicoloured Post-it notes being placed on the Hierarchy of Bloom's Taxonomy by participants.

The resulting Bloom's Taxonomy mapping was describing learning outcomes in health informatics use at the time and place as perceived by the participants. It was tested out by the team using an electronic voting system during presentations and workshops at several IMIA, EFMI and BCS events [19].

7. The IMIA Knowledge Base

Nancy Lorenzi, President of IMIA recruited a task force [20] that included some of the team involved in the BCS Cognitive Mapping project to update the IMIA strategy. It was agreed to use the cognitive mapping outcomes to develop a Knowledge Base using the keywords in published papers. Reference Manager could generate keywords for documents than had not listed them as such. Some 10,000 different words were produced. These were given to teams of informatics experts at a workshop in London in January 2007 who reduced this list to 444 words, by voting out spurious words to remove firstly common language words. The next stage had "voting in" the remaining words that were applicable to the informatics labels. This was undertaken by emailing all members of all the IMIA working groups and countries to use a spreadsheet to vote for sections of the spreadsheet which had all the letters of the alphabet as column headers. They were asked to focus only on the columns that used the first letter of their surname. XYZ was combined with W to even out the occurrence of surnames.

The results were collated by teams of experts over several weeks and placed under the Cogitative map 14 final headings [21] and the report was submitted to the IMIA General Assembly [22].

Computer Science for Health	Health & Social Care processes	Health (care) records	Health and Social care Industry	Health informatics standards
1	2	3	4	5
Biomedical equipment interfaces	Advantages and disadvantages of existing systems for primary clinical uses	Audit trails	Assess Health Informatics readiness of an organisation	Clinical coding systems
Collaborative Internet architectures	Application of telehealth solutions to the elderly population	Case note tracking	Financial management	Clinical interface protocol

Figure 5. an extract from the 245 units The IMIA Knowledge Base

8. Using the IMIA Knowledge Base and the Education Recommendations to Create an MSc Content

I have perceived the IMIA Education Recommendations as the overarching curriculum structure and the IMIA Knowledge Base as the detailed content. The former was overtly so with its relationship to degree structures and implied weighting. The Knowledge-Base started as learning outcomes using Bloom's Taxonomy's six stages but emerged as content heading within the format of the Knowledge Base. Thus they could describe the content within each of the Recommendations [23].

The review at The University of Rwanda, College of Medicine and Health Sciences (CMHS) firstly identified the skills required by Master's graduates in Rwanda and then undertook a gap analysis with the existing programme. An SQL 3D database was built by Frank Verbeke having the IMIA Recommendations and IMIA Knowledge Base

within its database. A full explanation can be found in several publications [24] and a new edition of Nursing and Informatics for the 21st Century – Embracing a Digital World, 3rd Edition, Book 2 [25].

The following example is taken from the curriculum document and shows part of one of the modules that was developed using this database to ensure a spread of concepts and equity of module values.

Table 1. Extract of Module from REHCE Curriculum Review

Brief description of aims and content
This module is an introduction to the discipline of Health Informatics and the scope of the program. It covers several basic concepts in Health Informatics and ensures that the students from different backgrounds have the opportunity to share perceptions of Health and Medical Informatics.
Learning outcomes (IMIA competencies)
1.1 Evolution of informatics as a discipline and as a profession
1.4 Use of personal application software for documentation, personal communication including Internet access, for publication and basic statistics
3.1 Basic informatics terminology like data, information, knowledge, hardware, software, computer, networks, information systems, information systems management
3.2 Ability to use personal computers, text processing and spreadsheet software, easy-to-use database management systems
3.3 Ability to communicate electronically, including electronic data exchange, with other health care professionals, internet/intranet use
3.4 Methods of practical informatics/computer science, especially in programming languages, software engineering, data structures, database management systems, information and system modelling tools, information systems theory and practice, knowledge engineering, (concept) representation and acquisition, software architectures
3.5 Methods of technical informatics/computer science, e.g. network architectures and topologies, telecommunications, wireless technology, virtual reality, multimedia
IMIA KB Indicative content (units)
Access to information
Computer literacy (ECDL)
Computer systems
Computing methodologies
Data management and storage
Databases
Demystify IT for users
Explains health informatics
History of methods of gathering information in the clinical workplace
Human-Computer Interaction (HCI) principles Information sources
Information Storage and Retrieval
Internet, intranets, and associative technologies

The learning outcomes are from the IMIA Education Recommendations and the indicative content from the IMIA Knowledge Base. The programme was successfully validated in 2014 with all the modules generated using the same process [24].

9. Reflections: Work that Disappeared or had a Different Impact than Envisaged!

Following the 1986 First National Conference on the Use of Computers in Health Care Education and Training at Keele University, David McKendrick and I received an invitation to present at a 3-day conference in Kielce, Poland for the Deans of Polish Medical Schools, as a result of the attendance at Keele University by a Senior Polish Professor. On arrival at the airport, I was greeted by a senior academic and three UK speakers sponsored by the British Council, including Dr David Ingram who had presented at the Keele conference [26]. I was asked to Chair the day with the UK speakers as they said, "They could understand my English"! Extremely strange as all three had Oxford English accents. The first problem was a lack of computers and no projector, so we spent a day writing acetate folios using coloured pens as they had an Over Head Projector (OHP). We had applause after applause, as they had never seen a coloured acetate pen. We left lots of presents and I secretly carried home a bundle of Scientific papers that eventually were all published under pseudonyms. They had seen lots of OSL logos on the teaching materials that their delegate had taken home and assumed that I was the director of the NHSTA and could donate millions of pounds in funding. They were however extremely happy to receive all the OSL Software Library CDs and a collection of Public Domain software. Whilst I was playing the guitar with a local Polish rock band, David Ingram asked our translator to dance. After a long courtship when Poland became liberated, they married.

An early attempt at populating the BCS/CHIRAD cogitative map with published work was started by assembling as many papers as possible that were available electronically mostly from CD publications. Several online search engines became available for desktops, including Google Desktop, Copernic and ASK. Fourteen months into the analysis of the massive collection housed on two Lacie250 hard drives the results showed no consistency between the search engines. The results were meaningless between the group of search engines and an SQL database search. A rethink and conversation looked with interest at the use of keywords used in many papers. Interestingly Reference Manager would compile keywords from a paper where they were missing. Fortunately, the "Open Steps" workshop produced the 14 key headings and so the process described earlier was followed.

The Learning Set "Caring for the Community" explored the information models required to underpin a strategic funding model. It lasted two years coordinated by me as a member of staff of both organisations, the HSMU, Manchester University and GCL. It had an invited membership of experts from Health and Social Care and was facilitated by Christine Greenhalgh and Victor Peel. When the report was ready for publishing a section of the group requested not to be named as participants. The resulting document seemed to be the health service telling the social service how it should change its strategy. Northern Ireland had an integrated model of Social and Healthcare at the national level at the time. The Prime Minister was questioned about it in Parliament resulting in the opposition party requesting multiple copies from the Manchester University Library [27]. I never expected either of those incidents nor did Christine and Victor, but we suspect our social care colleagues might have done.

Greenhalgh and Company (GCL) were a partner in the follow-on to the successful EU Commission funded Eductra project to be called IT Eductra [28]. With Jean Roberts and I providing input, organising Authors and content. Later I was asked to organise the distribution of the CDs in the UK as we had experience with learning material distribution of 60,000 copies of Rainbow 1. The main outcome was a CD-ROM

containing the teaching materials and tools in 8 European languages. The HELINA Education WG loaded many of the still relevant materials onto the HELINA website in 2020.

The IMIA Knowledge Base was approved together with the IMIA strategy. It is an IMIA approved document, but unlike its fellow IMIA approved "Education Recommendations" document has only a handful of citations. Perhaps I should have published a "How to use" with the IMIA Knowledge Base with the IMIA Education Competencies paper earlier than 2014.

Methods of Information in Medicine publication of "Biomedical informatics: We are what we publish" was completely unexpected in the form it was to emerge in print [29] as part of a "For-Discussion-Section of Methods of Information in Medicine on Biomedical Informatics: We are what we publish". It consisted of an editorial, a paper by P Elkin, S Brown and G Wright followed by a commentary paper with 12 invited experts (30), Hammond, W E, Hasman, A Hussein, R, Koppel, R, Kulikowski, C A, Maojo, V, Martin-Sanchez, F, Moorman, P W, Moura, L A, de Quirós, F G B, Schuemie, M J, Smith, B, Talmon, J. On the day I presented the report on the IMIA Knowledge Base to the IMIA GA, Peter Elkin and I had a long discussion and he spoke about the intended use of SNOMED as a higher archival framework. Three years later he asked me to be a part of this somewhat out of the blue, even though we had met on numerous occasions. If you believe in coincidences or degrees of connectivity; SNOMED CT used Read Codes in its structure which were developed by Dr James Read a GP in England and as a Junior Doctor on the medical team where I was a Charge Nurse in the Intensive Care Unit (ITU). Some years later he was the Head of the NHS Coding Centre and I was Chair of the BCS Nursing Group which had some of his staff as prominent members. He said that I was responsible for him taking the path away from clinical medicine in front of me and most of the eminent Health Informaticians attending the National BCS HC Conference in Harrogate.

Discussion or Closing Remarks

In 1997, Professor Jim Bridges at the European Institute for Health and Medical Sciences, University of Surrey asked me whether I wished to be remembered as a facilitator or a researcher and stated that I needed to choose at this point in my career. I have thought about this in the 24 years since and realise that I am a Facilitator or Change Agent who helps others to rethink their current paradigm. Sometimes I engage them in activities to allow them to rethink and produce different scenarios. In other situations I get them to undertake simple analysis, for example in 1989 I took charge of the Mersey Region amalgamated Mental Health Nurse Training School to prepare the move into higher education at Liverpool Polytechnic. I had all the teaching staff keep a diary and record their main activity in hourly slots during the day for two weeks. At a two-day workshop, they were asked to look at their employment as a Mental Health Tutor and the functions as described by several General Nursing Council and English National Board documents. After agreeing to the list of contracted duties and another list of recorded activities they had made, 93% of the second list was missing from the job specification/role list. In other words, they worked very hard but not for their employer. Unfortunately, although they agreed they were happy doing activities they liked doing for the Hospital like running committees and sitting on interview panels, I failed as a change agent as they all were unemployed a year later because they failed to change. To

be a facilitator one has to be able to undertake research which is used and makes a difference. My reply to Jim was "both".

The jobs titles that I have held include ITU Charge Nurse, Clinical Teacher, Senior Nursing Officer Teaching (SNOT), Senior Managing Consultant, Director of Education and Professional Training, GP Clinical Tutor, Company Director, GP Strategic Manager, Research Professor, Research Champion, Chair of Health Sciences Research, Adjunct Professor, and currently Visiting Professor (Rhodes University) and Professor Extraordinarius (UNISA). As you can see a bit of a Jack of All Trades.

Acknowledgements

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