

# THE NEED OF EDUCATIONAL MATERIALS AND TEXTBOOKS FOR THE PROFESSIONAL GROWTH - A RETROSPECTIVE VIEW AND DISCUSSION

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**Abstract— Educational materials and textbooks are the backbone of all University courses, producing young colleagues for the need of global healthcare. The paper presents a retrospective view of the educational materials and textbooks published in the past 30 years and relates these to the double growth of the profession in this period. In the discussion the paper raises the question of the need to give more prominent place to textbook publishing, alongside research paper citation, in the staff assessment practices. This would encourage the publishing of more books and educational materials, what will further boost education in order to produce the high number of medical physicists needed by 2035.**

## I. INTRODUCTION

The growth of medical physicists in the world is strongly supported by IOMP and its Regional Organisations (RO) - Federations in all continents. This is directly linked with the number of University courses in medical physics. The analysis of the professional growth in the period 1965 – 2015 [1], shows that while the first decades (1965-1975, 1975-1985, 1985-1995) have an almost equal global growth of medical physicists of the order of 2000 new professionals per decade, the next two decades (1995-2005 and 2005-2015) have double growth per decade (approximately 4000 per decade and 8000 per decade, respectively). The analysis relates this to the accent given to medical physics education and the introduction of free materials for the students and young professionals during these decades. The statistics for the current decade (2015-2025) have not been made yet, but it is expected the growth to be of the order of 7-8000 per decade. The maintenance of this professional growth is directly linked with the availability of materials and textbooks, supporting education. This paper aims to show specific activities associated with the development of educational materials and textbooks.

## II. THE NEW EDUCATIONAL E-MATERIALS (E-BOOKS, DATABASES AND WEBSITES)

The use of e-materials and e-learning in the profession was very strong in the period 1995-2015. On one side most specialists in medical physics have very good IT knowledge. On the other side the 1990s were the time when Internet entered human life and steadily established itself as a platform for exchange of information. On this background the pioneer project EMERALD took the aim of developing

new electronic educational materials (e-materials), to be used in medical physics training [2].

These materials were supported by specific educational image databases (IDB). The number of images was initially 1400 and grew to 3000. This was the largest collection of educational images in the profession. The 5 IDBs were engraved on separate CD-ROMs. The first CD-ROM was also one of the first in the world CD-ROMs with ISBN number (as paper books). It is not a coincidence that the first in the world 3 CD-ROMs with ISBN number are in the field of medicine, where images are essential for the education [2]:

-Atlas of Pathology: Urological Pathology CD-ROM, **published on 30 Dec 1997**, Springer-Verlag, ISBN 3540146571

-EMERALD Image Database, Training Courses in Medical Radiation Physics CD-ROM, **published on 19 February 1998**, King's College London, ISBN 1870722035

-Developmental Psychology Image Database CD-ROM, **published on 30 April 1998**, McGraw-Hill, ISBN 0072896914

The rapid development of Internet allowed for placing the content of the CD-ROMs on educational websites and also to be freely available to all in the profession. Thus, the first educational website in the profession was created and launched in November 1999. This was developed by the team of project EMERALD, under the name EMERALD – INTERNET ISSUE (EMERLAD II). This web site (now [www.emerald2.eu](http://www.emerald2.eu)) became rapidly very popular - with thousands of users per month from its first months to now [2, 3]. The 3000+ images (plus text and a Manual) found a stable place in the educational activities in the profession and continued to be used for Power Point presentations. Also, a number of these were used as samples for creating new educational images (in different modern scenarios).

Almost in parallel in 2000 was launched another educational website - The Sprawls Resources, based on the excellent textbooks of Prof. Perry Sprawls, USA. This web site (now [www.sprawls.org](http://www.sprawls.org)) includes full e-books and text with hundreds of diagrams plus other educational images. It also has thousands of users per month [2, 4].

Both websites continue to be used globally, especially by lecturers and students from LMI countries. Several Questionnaires of attendees to the ICTP International College on Medical Physics (ICMP) in Trieste, stated clearly the high importance given to these and other

educational web sites for the educational process in LMI countries [5, 6].

Around the end of 2002 another set of CDs with teaching materials appeared – issued by the International Atomic Energy Agency (IAEA). These included ready lecturing materials (Power Point slides as ready lectures). These three CDs were distributed free and were of great help to the medical physics community. These excellent materials also included a Manual and Multiple-Choice Questions [2].

After a couple of years IAEA developed a special website aimed at the education of medical physicists and medical staff using radiation, but also educating the public - [www.iaea.org/resources/rpop](http://www.iaea.org/resources/rpop). This educational website rapidly grew with constant updates and upgrades. It includes many educational materials on Radiation Protection and quickly established itself as the most visited web site in the profession.

The set of free educational images, discussed so far, is now complemented by free animated images and other visual aids, developed free by many colleagues – e.g. from the University of Colorado, USA.

The Questionnaires at the ICTP-ICMP showed that over 80% of all attendees use the above educational websites and over 50% use e-learning. Many of those colleagues developed new University courses and websites in their own countries. Each attendee of the ICMP after 2002 received a full set of all teaching materials and slides related to Medical Imaging Physics. These, plus the above websites, deliver important information for the educational process in LMI countries.

Around 2006 was launched another excellent educational set of online materials- [www.aapm.org/education/VL](http://www.aapm.org/education/VL) - the Virtual Library of the American Association of Physicists in Medicine (AAPM). This is a very useful educational tool, including videos of many open lectures presented at the AAPM meetings. Soon after the launch the website was opened for free use by all colleagues from LMI countries [7].

The current statistics (2024) of the Medical Physics educational programmes (mainly at MSc-level) show that currently there are 388 such programmes in the world. This is about 10 times more compared with the decade before 1995. What is very important – now many of these programmes are in LMI countries, where such programmes were almost non-existent before 1995 [8]. This exceptional progress is based on several factors, the most important being:

- The accent on medical physics education, supported by IOMP and all its ROs (through various course, seminars, workshops and educational event, satellite to various Conferences and Congresses);

- The support of IAEA (and the ICTP-ICMP) for opening of educational courses in LMI countries and providing them with educational materials;

- The above-mentioned websites with educational materials.

All these materials appeared priceless during the time of the pandemic, supported also by various materials and books explaining the process of including teaching materials in the educational e-learning programmes and building educational modules [9]. Also, at that time rapid progress was made by the IOMP School educational webinars.

Additionally, to the web-based educational materials, the educational process needs textbooks, as these provide not only specific information and images, but also an educational frame, very important for the gradual build-up of knowledge in the students.

### III. THE TEXTBOOKS

Textbooks are essential for education in any profession. One of the most important initial textbooks in medical physics is the classical “The Physics of Radiology” by Harold Johns and John Cunningham. The book, initially published in 1953, continues to be used in its 5<sup>th</sup> edition (updated by a number of eminent colleagues - Eva Bezak, Alun Beddoe, Loredana Marcu, Martin Ebert, Roger Price).

We cannot list all important textbooks used in the profession, but after the World Congress in 1982, IOMP and IFMBE formed a book *Series in Medical Physics and Biomedical Engineering* with the Publisher CRC Press (Taylor and Francis) [10]. This very important Series continues now 40 years with 105 textbooks (+booksets). The first textbook in the Series (from 1985) is: *Fundamentals of Radiation Dosimetry, Second Edition* by J G Greening, 1985. The third book in the Series was published in 1993: *The Physics of Three-Dimensional Radiation Therapy: Conformal Radiotherapy, Radiosurgery and Treatment Planning*, by S Webb. This book introduced the specific red colour Series banner on its cover. A full list of all books in the Series is presented at an ANNEX here.

After 1997 the Series became more active. The Series Editors at that time were R F Mould (UK), C G Orton (USA), J A E Spaan (The Netherlands) and J G Webster (USA). This intensification of the Series continued in 2010 with new Series Editors: Kwan-Hoong Ng (Malaysia), Russell Ritenour (USA), Slavik Tabakov (UK) and John G. Webster (USA). After 2017 the first three Editors remained (John Webster retired from the Series) and most of the textbooks were in the field of Medical Physics. The latter team of Editors is associated with about 75% of all books in the Series.

During 2017 the CRC-IOMP Series formed a sub-series *Focus Series in Medical Physics and Biomedical Engineering*, aimed at small focused hot-topic textbooks with quick publication. Its Editors were selected as Tae Suk Suh (S Korea) and Magdalena Stoeva (Bulgaria). In 2019 IOMP added some changes in the structure of the IOMP-CRC Series Editorial Board, including the Chair of the Publication Committee (currently Francis Hasford, Ghana).

The Editors of the IOMP-CRC *Series in Medical Physics and Biomedical Engineering* are formally linked to the IOMP Publication Committee. Their work is on voluntary

basis, related mainly to commissioning and first assessment of new textbook proposals. The following process is with the Publisher CRC Press (Taylor and Francis). The main CRC Editors during the period after 2010 were Francesca McGowan, Rebecca Davies, Kirsten Barr and Danny Kiely. Recently the Series is also associated with Routledge – another Publisher member of the Taylor and Francis Group.

The Taylor and Francis Group is one of the four largest Publishers in the fields of Science, Technology, Engineering and Mathematics (STEM). Part of the Contract with IOMP includes 30% discount of the books to IOMP members and 30 free books, to be donated to LMI countries. The free books from the CRC-IOMP Series entered in many libraries in the LMI countries (an activity also related with the AAPM-IOMP Library Programme). This difference between the CRC-IOMP Series and other potential Publishers is important for the growth of the profession.

Another very important publisher of textbooks for the profession is the IAEA. Its specific Textbooks *A Handbook for Teachers and Students* (in various fields of medical physics) cover the most important educational materials in the profession [11]. The books are again a free contribution of many eminent specialists, developed under the guidance and support of the IAEA. These free textbooks (often distributed as e-books) form the backbone of many educational modules from the MSc programmes worldwide. Their content is complemented by other free IAEA Guides, which further deliver practical aspects to the academic content. These Guides are again developed on voluntary basis by eminent specialists within the frame of specific IAEA projects, associated with medical physics.

A specific book to be mentioned is the Encyclopedia of Medical Physics. A project was developed over 5 years with over 150 contributors from 50 countries. The Encyclopedia is very useful for educational programmes, as it is aimed at Master-level colleagues and students. Its second edition (published in 2022) includes 3300 cross-referenced full entries related to medical physics and associated technologies [12]. The materials are supported by over 1300 figures and diagrams. The Encyclopaedia also includes over 600 synonyms, abbreviations and other linked entries. The materials of the Encyclopaedia are available as free resource at [www.emitel2.eu](http://www.emitel2.eu). The website links the Encyclopaedia entries with a Scientific Dictionary of Medical Physics Terms, cross translating terms in 32 languages. Both resources use an original specially built website [13].

In 2013 IOMP launched the Journal Medical Physics International (MPI) with the main aim to support educational and professional activities in medical physics. Statistic shows that the papers related to education (incl. Review papers) have around 10,000 downloads each [14].

The MPI Journal was made deliberately as an open access Journal [www.mpjournal.org](http://www.mpjournal.org), delivering this information free to all medical physicists, and also publishing information about their educational materials and activities.

In order to further distribute information about these very important educational resources IOMP and its ROs provide

lists of resources on their websites. As an example, such is the new European EFOMP e-learning platform e-LEMENT (e-Learning for Education in Medical physics and New Technologies), available at: <https://e-lement.efomp.org/> [15]

#### IV. DISCUSSION

It is well known that educational materials and textbooks are the backbone of any educational programmes and professional development. With the increased need of medical physics specialists for global healthcare, it is clear that the number of such publications should increase. However, this is not an easy task.

Usually, it takes a lot of experience and at least one or two years to write a textbook on any subject. At the same time writing a standard research paper is often related to one-two months work. Having in mind that a number of universities and other institutions in the world place the accent of their staff assessment on the paper citation indexing, textbook writing naturally is given less priority by a number of specialists. There are some paradoxes – e.g. including the value of a textbook (in staff assessment) as almost equal to a small paper assessing this very textbook.

Similar problem is that textbooks are rarely included in the List of reference materials to a paper. Large Review papers, describing the development and application of a specific method or equipment, normally cite the relevant textbooks in the specific field. However, other papers on the subject cite the Reference paper, and not the related books. Also, some websites with e-materials are often not cited.

The predominant use of citation indexes for staff assessment does not favor the development of specialists from smaller (usually LMI) countries. Now most Journals with high citation indexes require payment for publishing a paper. This is often impossible for colleagues from LMI countries. Thus, their assessment in global terms falls back, despite the fact that they could be promising specialists.

Similarly, specialists in smaller professions (such as medical physics or biomedical engineering) have naturally smaller number of citations, compared with other larger groups of specialists (e.g. radiologists and other medical specialists). Also, specialists working in a niche field will have less citation, compared with specialists working in large fields.

The research papers are extremely important for any profession, but staff assessment would need to be updated to include also the efforts and high value of textbook publishing. We can hardly expect the existing staff assessment practices to be updated overnight, but if this question is often discussed, some progress in the field can be made. Meanwhile large professional organisations, such as IOMP and its Regional Organisations, will need to encourage their members to contribute more actively to the writing of textbook and other educational materials.

## V. CONCLUSION

The production of more content for the students will be one of the most important activities supporting the necessary significant growth of the profession by 2035 (aiming to reach approximately 60,000 medical physicists globally) [1, 16]. Publishing of textbooks has its own frame, not only in the IOMP-CRC Series, but with various Publishers, and only needs encouragement of authors. However, the production of e-books, websites and other materials is related to specific educational projects. The experience from the period 1995-2015 showed how the high impact of these e-materials influenced professional growth [1]. The same is needed for the new coming decade 2025-2035 and IOMP could have a leading role in the encouragement of colleagues to initiate such new projects.

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## ANNEX: TEXTBOOKS IN THE IOMP-CRC SERIES 1985-2025

- Proton Therapy Physics, 3rd Edition  
2025 Forthcoming, Edited By Harald Paganetti
- Essentials of Functional MRI: Basic Concepts to Advanced Applications, 2nd Edition  
2024, Patrick W. Stroman
- Biomedical Photonics for Diabetes Research  
2024, Edited by Andrey Dunaev, Valery Tuchin
- Image-guided Focused Ultrasound Therapy: Physics and Clinical Applications  
2024, Edited By Feng Wu, Gail ter Haar, Ian Rivens
- Clinical Insights for Image-Guided Radiotherapy: Prostate  
2024, Mike Kirby, Kerrie-Anne Calder
- Calculating X-ray Tube Spectra: Analytical and Monte Carlo Approaches  
2024, Gavin Poludniowski, Artur Omar, Pedro Andreo
- Handbook of Nuclear Medicine and Molecular Imaging for Physicists: Instrumentation and Imaging Procedures, Volume I  
2024, Edited By Michael Ljungberg
- Handbook of Nuclear Medicine and Molecular Imaging for Physicists: Modelling, Dosimetry and Radiation Protection, Volume II  
2024, Michael Ljungberg
- Handbook of Nuclear Medicine and Molecular Imaging for Physicists: Radiopharmaceuticals and Clinical Applications, Volume III  
2024, Michael Ljungberg
- Handbook of Nuclear Medicine and Molecular Imaging for Physicists - Three Volume Set  
2024, Edited By Michael Ljungberg
- Introduction to Medical Physics  
2024, Edited By Stephen Keevil, Renato Padovani, Slavik Tabakov, Tony Greener, Cornelius Lewis
- Radiotheranostics - A Primer for Medical Physicists I: Physics, Chemistry, Biology and Clinical Applications  
2024, Edited By Cari Borrás, Michael G. Stabin
- Practical Biomedical Signal Analysis Using MATLAB® 2nd Edition  
2024, Katarzyna J. Blinowska, Jarosław Żygierewicz
- Monte Carlo in Heavy Charged Particle Therapy: New Challenges in Ion Therapy  
2024, Edited By Pablo Cirrone, Giada Petringa
- Spectral Multi-Detector Computed Tomography (sMDCT): Data Acquisition, Image Formation, Quality Assessment and Contrast Enhancement  
2023, Xiangyang Tang
- Clinical Nuclear Medicine Physics with MATLAB®: A Problem-Solving Approach  
2023, Edited By Maria Lyra Georgosopoulou

- Auto-Segmentation for Radiation Oncology: State of the Art  
2023, Edited By Jinzhong Yang, Gregory C. Sharp, Mark J. Gooding
- Electrical Impedance Tomography: Methods, History and Applications, 2nd Edition  
2023, Edited By Andy Adler, David Holder
- Problems and Solutions in Medical Physics - Three Volume Set  
2022, By Kwan-Hoong Ng, Robin Hill, Alan Perkins, Jeannie Hsiu Ding Wong, Geoffrey Clarke, Chai Hong Yeong, Ngie Min Ung
- Problems and Solutions in Medical Physics: Radiotherapy Physics  
2022, Kwan-Hoong Ng, Robin Hill, Ngie Min Ung
- Diagnostic Radiology Physics with MATLAB®: A Problem-Solving Approach  
2022, Edited By Johan Helmenkamp, Robert Bujila, Gavin Poludniowski
- A Practical Approach to Medical Image Processing  
2020, Elizabeth Berry
- Contemporary IMRT: Developing Physics and Clinical Implementation  
2020, S. Webb
- Proton Therapy Physics, Second Edition  
2020, Edited By Harald Paganetti
- e-Learning in Medical Physics and Engineering: Building Educational Modules with Moodle  
2020, Vassilka Tabakova
- Minimally Invasive Medical Technology  
2020, Edited By John G. Webster
- The Physical Measurement of Bone  
2020, Edited By C.M. Langton, C.F. Njeh
- Achieving Quality in Brachytherapy  
2019, B.R. Thomadsen
- Diagnostic Endoscopy  
2019, Edited By Haishan Zeng
- Quantifying Morphology and Physiology of the Human Body Using MRI  
2019, Edited By L. Tugan Muftuler
- Handbook of Photonics for Biomedical Science  
2019, Edited By Valery V. Tuchin
- Correction Techniques in Emission Tomography  
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- Intelligent and Adaptive Systems in Medicine  
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- Advanced MR Neuroimaging: From Theory to Clinical Practice  
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1997, Editor: John G. Webster
- Linear Accelerators for Radiation Therapy, Second Edition  
1997, David Greene, P.C Williams
- The Physics of Conformal Radiotherapy: Advances in Technology  
1997, S. Webb
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1995, Rory A Cooper
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