

Attitudes of Irish and Indonesian Science Teacher Towards Using Medical Physics Module

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Abstract: This study focus on investigating the Attitudes of Irish and Indonesian science teacher Using medical physics module. Descriptive survey design was adopted in the study. A total 30 physics teachers from Indonesia and Ireland were included the samples for data analysis. Frequency tables and percentage were used in analysing the data collected. The analysis of teachers' questionnaires included a number of aspects: teaching time indicated, teaching objectives and learning outcomes framework, level of detailed in each lesson plan in terms of subject content for the students, and the recommendation of the teaching package. Findings from the study revealed that both science teacher in Ireland and Indonesia were very appreciate of the resources supplied for the practical activities of the package. Overall, teachers felt that the intervention packages was an excellent module to engage student's interest, increase student's curiosity, and included valuable resources for students.

Keywords: Attitude, Irish and Indonesian Physics Teacher, Medical Physics Module.

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I. Introduction

At the end of 2019, results of the latest round of the internationally-standardised tests of maths, science and literacy skills among 15 year-old students were released. Of the 79 countries that participated in the PISA (Programme for International Student Assessment) tests, Indonesia ranked 74th in literacy skills, and 71th in maths and science (OECD, 2018). The PISA in Math and Science results for Indonesian students in 2018 were the eight lowest in the league table, worse than PISA results in 2015 when Indonesia ranked 79th (OECD, 2016). Both results in 2015 and 2018 showed that the students' performances were not improving. Meanwhile, Ireland is one of the leading countries in the field of science education. It consistently has a high science performance based on PISA results while Indonesia has a low performance in the last three test years. These are the results of the most recent PISA tests that we could find at the present time because the results of PISA test year 2020 will not be released until late 2022 because of pandemic (OECD, 2021).

The stakeholders in education need to address the issue of increasing the students' performance in science test. Science teachers have to reflect about how they teach and how to improve students' attitude towards science in order to increase students' performance. In addition, the teaching methodology used is an essential part on how to engage students' interest in science, especially in the area of physics (Sudirman and Aditya, 2019).

It is widely accepted that teaching and learning physics at secondary school level has tended to be dominated by teacher-centred perspective (Tuti, S et.al. 2020). The students receive knowledge from the teacher without any significant teaching interaction. Very often teachers focus on the curriculum targets and exam results. Consequently the learning process in the classrooms becomes less meaningful in terms of everyday life. Teaching physics at junior high school and senior high schools emphasizes the process of understanding of natural phenomena, which is broadly known as the deductive process. It successfully helps students develop critical analytical skills. Unfortunately this method stifles the students' creativity and students are not able to synthesize and analyse data in order to generate hypotheses or models of theoretical concepts. Thus, some of the students argued that physics is dull, boring, difficult and a waste of time (Sudirman, 2016).

An Overview of the teaching package

This module is designed to promote the science behind medical physics. It is hoped that the module will encourage an interest in physics among young students through a hands-on interactive learning experience. The module offers an approachable and personally meaningful introduction to medical physics through investigative and cooperative learning experiences.

The module is divided into five units with the objectives of each units clearly stated at the beginning of each unit. Each unit focuses on basic physics concepts presented in a logical sequence with learning outcomes

stated at the end of each unit. The medical physics module is designed to challenge and motivate students. Whereas each lesson can be taught in a single class (40 minutes), it is recommended that, if possible a double class be devoted in each lesson in order to allow time for discussion and other activities (Sudirman, 2015). The topics area included:

1. X-Rays
2. Ultrasound
3. Endoscopy
4. MRI & CT Scan
5. Radioactivity

All stages of this module can be carried out by the student of all abilities. It is designed for students in the Transition Year Program in Ireland and students for the first year Senior High School (SMA/SMK/MA) in Indonesia aged between 14 and 16. It is also design as an introduction for those students who have not previously studied science.

The module encourages an approach involving Inquiry Based Science Education (IBSE) and Direct Instruction (DI) approaches. Practical work activities are included throughout the module. In some cases, this practical activities are used to model scientific principles as applied to medical physics. Expert Group Tasks are included in the module and are designed to encourage IBSE. The students work collaboratively and prepare presentations for the rest of the class. In addition this module is designed for teaching using an integrated IBSE-DI approach in each lesson.

This module also consists of a PowerPoint presentation in each unit and this PowerPoint Presentation is designed to help everybody in the class to understand the basic aspect of the topic being studied. Further information, including relevant website listing, is contained in the Expert Group resource. Focused questions are included in each PowerPoint presentation and the worksheet to help students with the tasks. In the Expert Group Tasks students are given an incentive to teach each other what they have learned. Student exercises for each unit are based on key words and concepts encouraging literacy. This philosophy ensures good communication both within and between the groups, increasing confidence, building teamwork and developing communication skills. The aims of this teaching package are:

- To develop students' understanding of the role of physics in the area of medical science.
- To provide students with a background in the basic physics principles involved in medical science.
- To assessed student as part of a team.
- To improve students' problem solving, analytical, and inquiry skills.
- To foster students' skills in independent learning, communication and teamwork.
- To develop students' ability to become experts and share their expertise.
- To allow students making inform choices about the subject that they will study in the senior level.
- To raise students' awareness of the many and varied career opportunities in medical physics in Ireland and Indonesia.

It is recommended that the teacher attempts to structure the lessons so that the methods of teaching use a combination of IBSE – Direct Instruction within a learning outcomes framework (Kennedy, 2013). This allows the students to get into the spirit of discovery and thus promote investigation and creativity. It is recommended that the teacher:

- a. Keep questions open-ended
- b. Organize structured groups
- c. Act as facilitator as well as instructor
- d. Give positive reinforcement and feedback to groups and individuals
- e. Promote research techniques
- f. Organize discussion and debate sessions
- g. Make the classroom topic relevant to the students' lives
- h. Promote the use of all ICT equipment
- i. Promote student initiative
- j. Promote creativity in the students
- k. Make the students' research important and relevant to the world around them.
- l. Allow for student ownership of their own work

In general, it is hoped that:

- a. On working individually and pairing up and then sharing with the class that students become comfortable when participating in the lessons. Hopefully they will also realize that this is not a right/wrong exercise but an understanding by doing the exercise.
- b. The class is to be divided into groups of three or four to enable all students to converse and to be heard in small groups within a short time space.

- c. It is recommended that some practical activities are carried out by the students.
- d. The teacher will have to ensure students will be able to explain concepts in each lesson.
- e. It is hope that if the teachers plays some video clips in each lesson that this will increase the level of interest of the students.

II. Materials And Methods

A. Research Design

Research design is the overall process and strategy through which research is undertaken to integrate the different research elements in a scientific and coherent way in order to ensure the success of addressing the research questions (Wellington, J.,2013). Research design and selection of its methods in any study is influenced by many factors, such as the nature, objectives, context, number and type of people participating in the study, as well as the amount of time and funding available for the research project (Creswell and Clark, 2007; Robson, 2003). This study adopted the descriptive survey research design (O’leary, 2014). Descriptive survey research is suitable for this study because the study obtained data from physics teacher in both countries through the use of questionnaire.

B. Research Instrument

In this study, we used a survey tool which is composed of three components. The first component covers the demographic profile of physics teacher in both countries (gender, number years of teaching, and subject specialism), the second part is consist of 4-item statements covering the students’ perceptions in terms of the Teaching time indicated in each lesson, the teaching objectives and the learning outcomes framework specified in each lesson, level of detail included in each lesson plan in terms of subject content, recommending the teaching packages, and the last part contains an open-ended question. A series of questionnaires based the teaching package was designed. The process of developing these questionnaires took a consider amount of time as discussions were held the with validator, physics teacher in the Irish Science Teachers' Associations (ISTA). The researcher joined the scienceteachers organizations both in Ireland (ISTA) and in Indonesia (Ikatan Guru Indonesian).

C. Method of Data Collection

The research instrument was administered to the respondents by researcher with the help of physics teacher from Ireland and Indonesia. Out of the 30 questionnaires distributed to the respondents, 92 copies of the instrument were retrieved representing 97% return rate.

D. Data Analysis

The data collected from the respondents were analysed using frequency tables and percentages in describing the opinion of the respondents in both countries.

III. Results And Discussion

E. Descriptive data

1. Gender of teachers

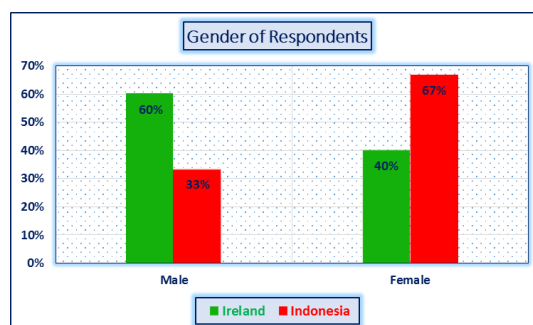


Figure 1 Gender of teachers

Based on the bar chart, it was found that in Ireland 60% of science teachers were male and 40% of science teachers were female. In contrast, 33 % of Indonesian science teachers were male while the majority of science teachers 67 % were female. This data suggest that overall, the number of science teachers between male and female who participated in this study were quite similar. One hypothesis contends that a teacher's gender affects how they communicate with their students, while another contends that regardless of what they say or do,

teachers serve as gender-specific role models. This second idea contends that when a teacher is a member of their own gender, kids are more engaged, behave more appropriately, and perform better (Thomas S.De, 2006).

2. Number of years teaching

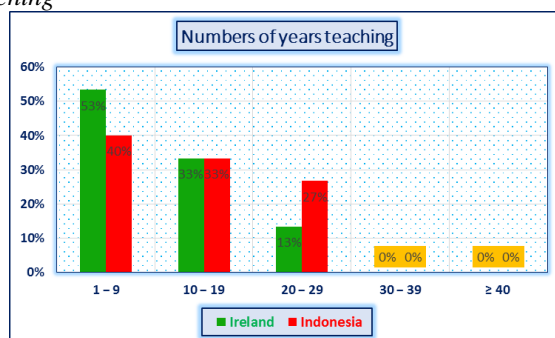


Figure 2 Number of years teaching of science teachers

In Ireland; the majority (53%) of the science teachers were teaching from ‘one to nine years’. 33% of science teachers were teaching for ‘ten to nineteen years’, while 13% were teaching for twenty to twenty nine years. It also noted that no science teacher taught for more than 30 years. However, In Indonesia, of the 15 science teachers teaching this module, 40% of science teachers were teaching for ‘one to nine years’. Only 4 (27%) science teachers were teaching for twenty to twenty nine years, while 33% were teaching for ten to nineteen years, no science teacher taught for more than 30 years.

These data indicated two point of view. *Firstly*, the number of Indonesian science teachers who taught from ‘20 to 29 years’ category was higher than Irish teachers. *Secondly*, both of this group were in the same ‘ten to nineteen years’ category. Teachers experience have a significant affect the science learning process (Anthony, et.al, 2019).

3. Subject specialism

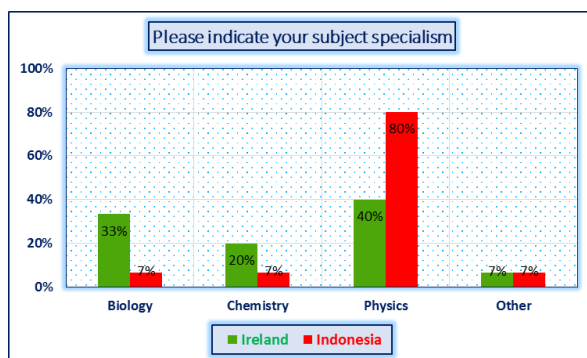


Figure 3. Subject specialism of teachers in this study

When the science teachers who participated in this study were asked to indicate their subject specialism (education background or teaching qualification), 40% of the Irish teachers who participated were from a physics background, followed by 33% that were from biology. 20% of teachers were from a chemistry background and only 7% of Irish teachers that were ‘other’ category (molecular biology). Interestingly, twelve of fifteen Indonesian teachers (80%) who participated in this study were from a physics background, followed by 7% science teachers that were teaching biology, chemistry, and other subject specialisms. One teacher stated that she was from a civil engineering discipline.

The responses of the teachers toward the teaching package is displayed using a numbers of variables. The teachers were asked if the teaching time indicated in each lesson was sufficient. It is displayed in Fig. 4

4. Teaching time indicated in each lesson.

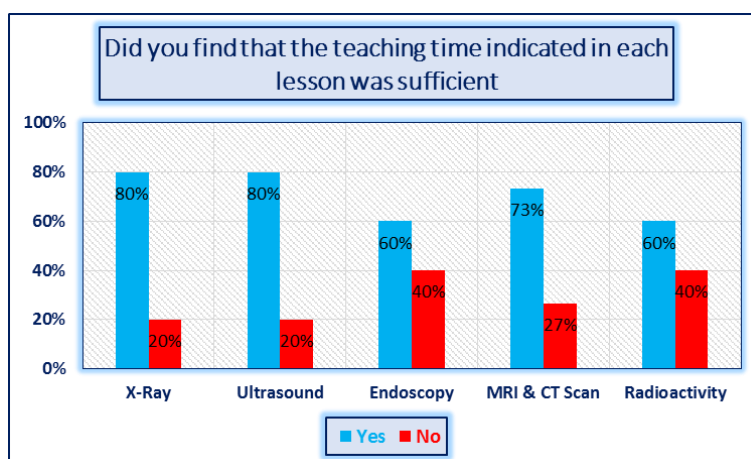


Figure 4 Irish teacher's responses regarding the teaching time

The responses of teachers in relation the teaching time in Ireland can be summarised as follows;

- For lesson 1 (X-Ray), 80% of science teachers revealed that teaching time was sufficient; while only 20% of science teachers said it was insufficient.
- For lesson 2 (Ultrasound), again, 80% of the science teachers indicated that the teaching time was sufficient; while 20% of science teachers argued that the teaching time was insufficient.
- For lesson 3 (Endoscopy), 60% of science teachers stated that teaching time was sufficient; while 40% of them said it was insufficient.
- For lesson 4 (MRI & CT Scan), 73% of science teachers revealed that teaching time was sufficient, while the minority (27%) said it was not.
- Finally, for lesson 5 (Radioactivity) 60% of the science teachers said that teaching time was sufficient while 40% of science teachers felt it was insufficient.

This result compares to the response of the Indonesian teachers that shown in Fig. 5.

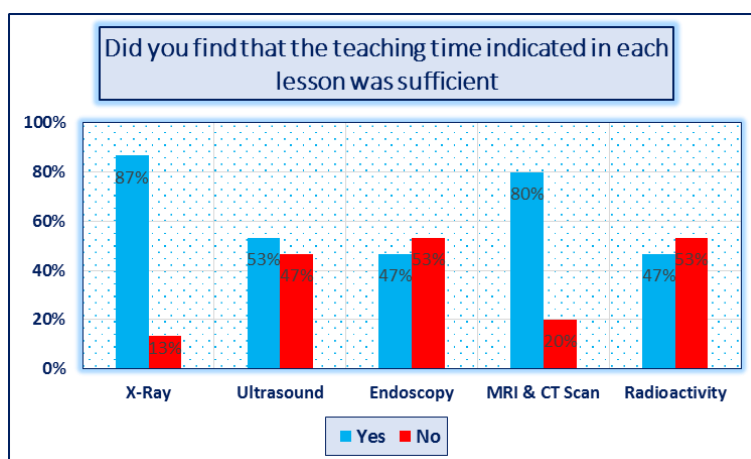


Figure 5. Indonesian teachers' responses regarding the teaching time

The responses of the Indonesian teachers can be summarised as follow;

- For lesson 1 (X-Ray), 87% of science teachers revealed that teaching time was sufficient; while only 2 science teachers (13%) said it was insufficient.
- For lesson 2 (Ultrasound), 8 of the science teachers (53%) indicated that the teaching time was sufficient; while 47% of science teachers argued that the teaching time was insufficient.
- For lesson 3 (Endoscopy), 7 of science teachers (47%) revealed that teaching time was sufficient; while 53% of them said it was insufficient.
- For lesson 4 (MRI & CT Scan), 80% of science teachers revealed that teaching time was sufficient, while the minority (20%) said it was not.
- Finally, for lesson 5 (Radioactivity) 7 of the science teachers (47%) said that teaching time was sufficient while more than half (53%) of science teachers felt it was insufficient.

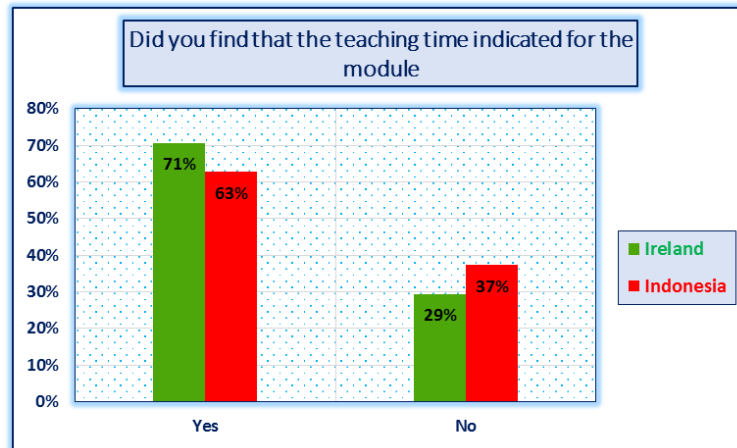


Figure 6 Comparative analysis on teachers’ response regarding the teaching time for the module

The analysis on Fig. 4 and Fig. 5, clearly, there is a difference perceptions towards the teaching time between Indonesian and Irish teachers for two lessons i.e. the third lesson on Endoscopy and the fifth lesson on Radioactivity.

Analysis of Fig. 6. Shows that in terms of teaching time allocation in the teaching package, Irish teachers have a higher percentages than Indonesian teachers. On the other hand, the Irish teachers were more positive about the teaching time allocated in this teaching package. 71% of Irish teachers felt that it was enough to complete the lesson activities. It compares to 63% of the Indonesian teachers. Only 29% of Irish teachers indicated that it was not sufficient. This compares with 37% of Indonesian teachers.

Overall, teaching time with respect to the teaching package was sufficient (the satisfaction rate was over 60%). The following findings identify the level of agreement of science teachers with the teaching objectives and learning outcomes in the medical physics module, and whether these helped their students to acquire that they obtained a good understanding of this module. The results are shown in Fig. 7 (Ireland) and Fig. 8 (Indonesia).

5. The teaching objectives and the learning outcomes framework specified in each lesson

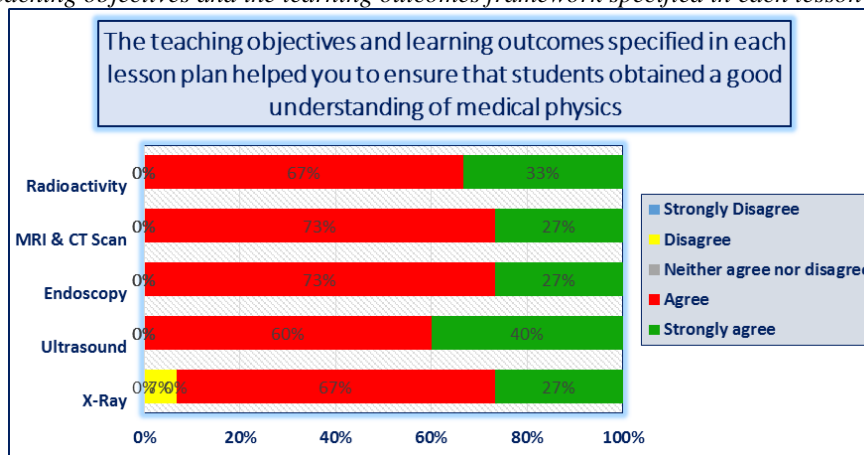


Figure 7. Teachers’ responses in the teaching objectives and the learning outcomes framework on each lesson in Ireland

The results of the Irish teachers’ responses in terms of the teaching objectives and the learning outcomes framework can be summarized as follows:

- As regards lesson 1 (X-Ray), it is clear that 67% the majority of science teachers strongly agreed and 27% agreed. Only one teachers disagreed.
- For lesson 2 (Ultrasound), it was found that 60% of science teachers agreed and the remaining 40% strongly agreed with this statement.
- For lesson 3 (Endoscopy), most of the science teachers 73% agreed and 27% strongly agreed.
- For lesson 4 (MRI & CT Scan), a significant majority 73% of science teachers were agreed and 27% strongly agreed.

And for *lesson 5* (Radioactivity), again, most of the science teachers (67%) were strongly agree and 27% strongly agreed. It must be noted that none of the Irish teachers felt that it was not helpful, except for the first lesson (X-Rays). In overall of the lesson, the teacher's responses were very positive. This result compares to Indonesian teachers replies in Fig. 8 below

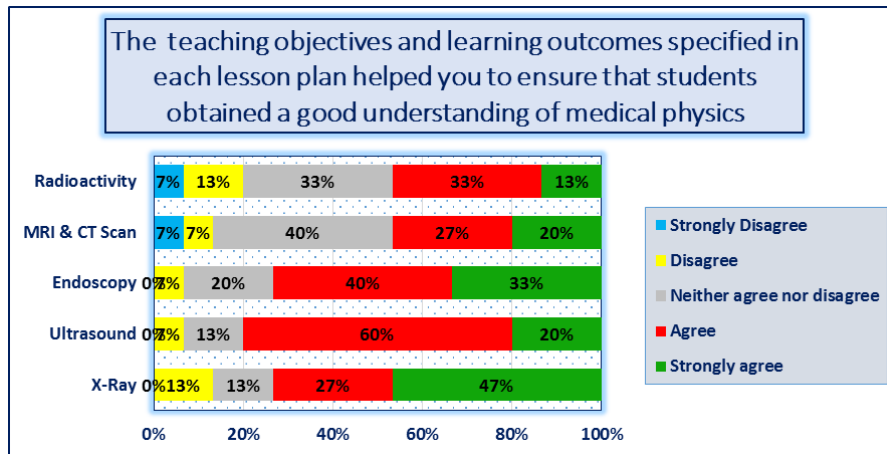


Figure 8 Teachers' responses in the teaching objectives and the learning outcomes framework on each lesson in Indonesia

The responses for each lesson can be summarized as follows

- As regards *lesson 1* (X-Ray), it is clear that majority 47% of science teachers strongly agreed and 20% agreed. Followed by 13% neither agreed nor disagreed and the remaining 13% disagreed.
- For *lesson 2* (Ultrasound), it was found that 60% of science teachers agreed and 20% strongly agreed with this statement. A further 13% neither agreed nor disagreed and the remaining 7% of science teachers disagreed.
- For *lesson 3* (Endoscopy), most of the science teachers 40% agreed and 33% strongly agreed with this statement while a further 20% neither agreed nor disagreed. A further 7% disagreed.
- For *lesson 4* (MRI & CT Scans), a significant majority 40% neither agreed nor disagreed while 27% were in agreement. Only 20% of science teachers strongly agreed, while a further 7% disagreed and the remaining 7% strongly disagreed.
- For *lesson 5* (Radioactivity), 33% of sciences teachers were in agreement, also, 33% were neither in agreement nor disagreement category. Only 13 % strongly agreed, followed by 7% of science teachers who disagree and the remaining 7% who strongly disagreed.

The comparative results of the science teachers in both countries is presented in Fig. 9

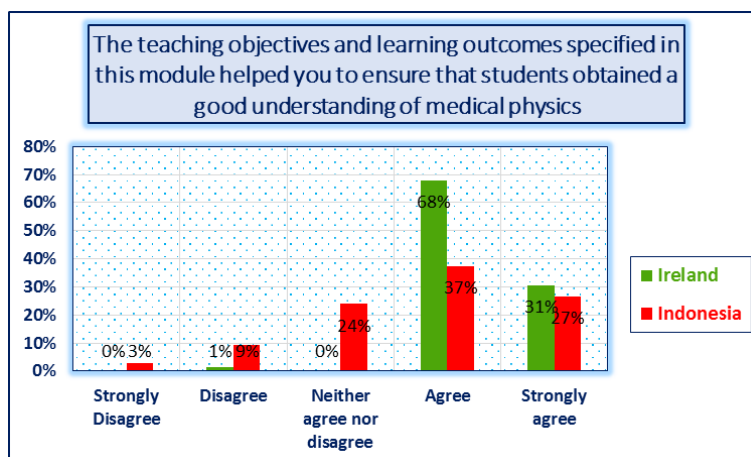


Figure 9 Comparative Analysis regarding the teaching objectives and the learning outcomes framework

From this comparative analysis above, it was found that 68% of Irish science teachers agreed the teaching objectives and the learning outcomes were helpful. This result compares to 37% of Indonesian teachers; 31% of Irish teachers strongly agreed with this statement, while 27% of Indonesian teachers expressed

in this category;21% of Indonesian teachers neither agreed nor disagreed while no Irish teachers in this category;9% of Indonesian teachers disagreed and only 1% of Irish science was disagreed. And a further 3% of Indonesian teachers felt strongly disagreed while no Irish teachers indicated this category.It should also be noted that only two lessons (MRI & CT scan and Radioactivity), had a significant minority, 7% of each, strongly disagreed with this statement.

6. Level of detail included in each lesson plan in terms of subject content

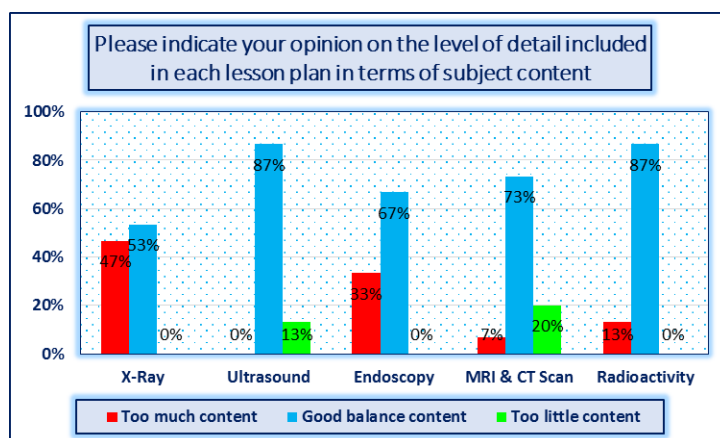


Figure 10 Irish teachers’ responses towards the level of detailed in each lesson plan in terms of subject content for the students.

The Irish teachers were asked to indicate the level of detail included in terms of subject content, the detailed responses can be summarized as follows:

- For Lesson 1 (X-Rays), more than half (53%) of science teachers indicated that it had a ‘good balance content’. However, 47% of science teachers revealed that ‘too much content’ was included while no science teacher felt that X-Ray had ‘too little content’.
- For Lesson 2 (Ultrasound) lesson, 73% of science teachers revealed that there was ‘good balance of content’, while a further 20% science teachers indicated that ‘too little content’ was included. Interestingly, no science teacher said that ‘too much content’ on this lesson.
- For Lesson 3 (Endoscopy), 67% of science teachers revealed that there was a ‘good balance content’ while 33% said that ‘too much content’ was included in this lesson. This results also showed that no science teacher felt that ‘too little content’ on this topic.
- For Lesson 4 (MRI & CT Scan), the majority of science teachers (73%) indicated that it had a ‘good balance of content’, 20% indicated that the lesson of MRI CT Scan had ‘too little content’, and while 7% of science teachers revealed that there was ‘too little content’ on this lesson.
- Finally, for Lesson 5 (Radioactivity) 87% of science teachers indicated that this lesson had a ‘good balance of content’. Only 13% of science teachers said that there was ‘too much content’ and interestingly, no science teacher said that there was ‘too little content’ in this lesson.

This results compare to Indonesian teachers (see Fig. 11)

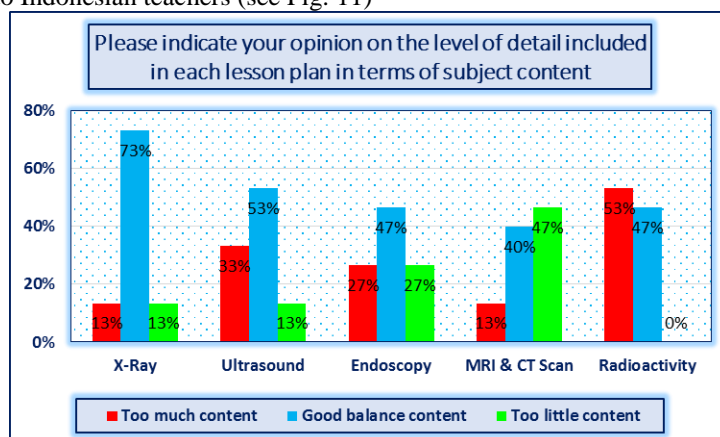


Figure 11 Indonesian teachers’ responses towards the level of detailed in each lesson plan in terms of subject content for the students.

The responses of Indonesian teachers to the level of detail included in terms of subject content can be summarized as follow;

- For *Lesson 1* (X –Rays), 13% of science teachers indicated that ‘too little content’ was included, 10% of science teachers revealed that ‘too much content’ was included. Significantly, 73% of science teachers said that the x-ray lesson had a ‘good balance’ in terms of subject content.
- For *Lesson 2* (Ultrasound), 27% of science teachers indicated that there was ‘too much content’, more than half 53% of science teachers said that the ultrasound lesson had a ‘good balance of content’, while a further 13% science teachers revealed that ‘too little content’ was included.
- For *Lesson 3* (Endoscopy), 27% of science teachers said that ‘too much content’ was included in this lesson, 47% of science teachers indicated that this topic had a ‘good balance’ in terms of subject content, while 27% of the science teachers revealed that ‘too little content’ was included in this lesson.
- For *Lesson 4* (MRI & CT Scan), 2 of the science teachers (13%) said that ‘too much content’ was included, 40% indicated that the lesson of MRI CT Scan had a ‘good balance of content’, while 47% of science teachers said that there was ‘too little content’.
- Finally, for *Lesson 5* (Radioactivity) 53% of science teachers indicated that there was too much content in this lesson, 47% of science teachers revealed that this lesson had a good balance of content; no science teacher indicated that there was too little content in this lesson.

The comparative analysis on this section from both groups is given on Fig. 12

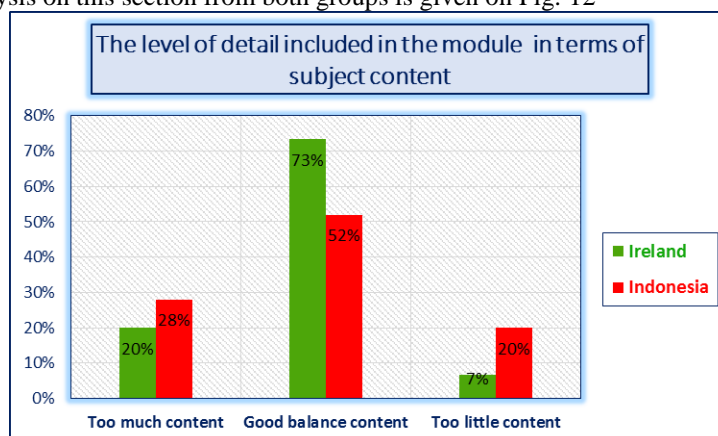


Figure 12 Comparative analysis regarding the level of detailed in terms of subject content

73% of Irish teachers indicated that the module had a good balance of content. It compares to 52% of Indonesian teacher’s responses at the same category;

28% of Indonesian teachers said that there was too much content in this module and compares to 20% of Irish teachers responses and Interestingly, 20% of Indonesian teachers felt that the module had a ‘too little content’ while only 7% of Irish said this statement.

From these comparative analysis above, two points have emerged. First, the number of teachers from Indonesia who indicated ‘too much content’ or ‘little content’ was higher than from Irish teachers. Second, the percentage of Irish teachers who indicated that ‘good balance content’ were higher than Indonesian teachers.

The next section, the teachers then were asked to list three lessons which were most engaging of students’ interest in terms of subject content (Fig. 13 and Fig. 14) below.

7. Three lessons which were most engaging of students' interest

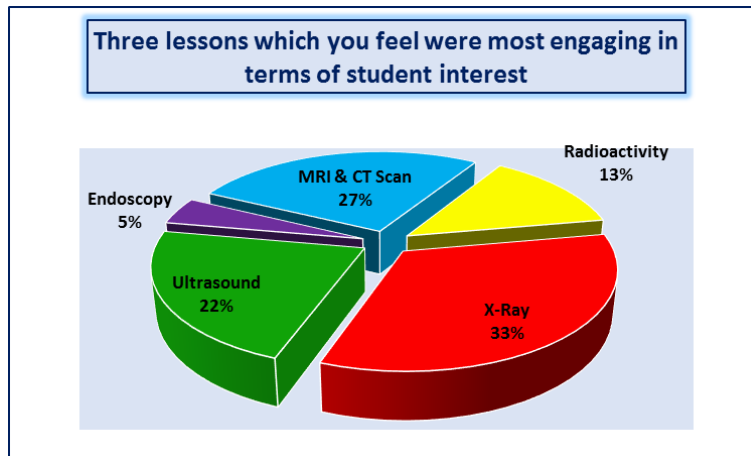


Figure 13 Irish teachers' responses regarding the most engaging lessons in terms of student interest

This result show that the three lessons which were the most engaging in terms of student interest, X-Ray (33%), MRI &CT Scans (27%), and Ultrasound (22%) followed by Radioactivity (13%), and Endoscopy (7%). This result is compared with the Indonesian teachers responses in Figure 14 below;

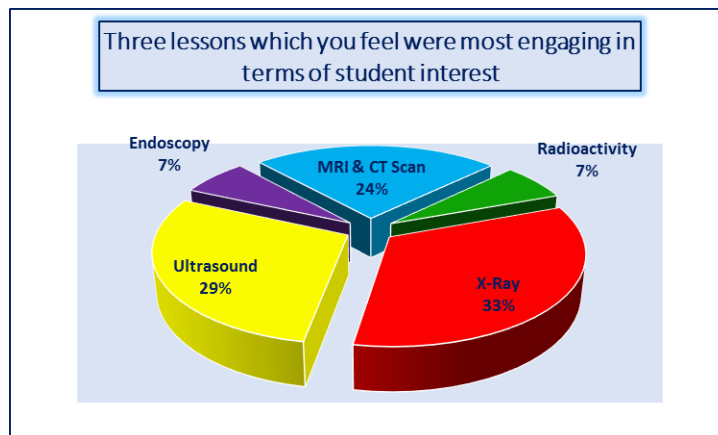


Figure 14 Indonesian teachers' responses regarding the most engaging lessons in terms of student interest

In Indonesia, the three lessons which were the most engaging in terms of student interest, X-ray (33%), Ultrasound (29%), and MRI-CT Scan (24%) followed by Endoscopy (7%), and Radioactivity (7%). Clearly, from these comparison above, the teachers from Indonesia and Ireland indicated the lesson that most engaging of students' interest were X-Ray, Ultrasound, and MRI & CT Scans.

The only things that make the responses in both groups different were for Irish teachers, MRI &CT Scans was the second most interesting lesson while the second in Indonesia was Ultrasound.

8. *Recommending the teaching packages*

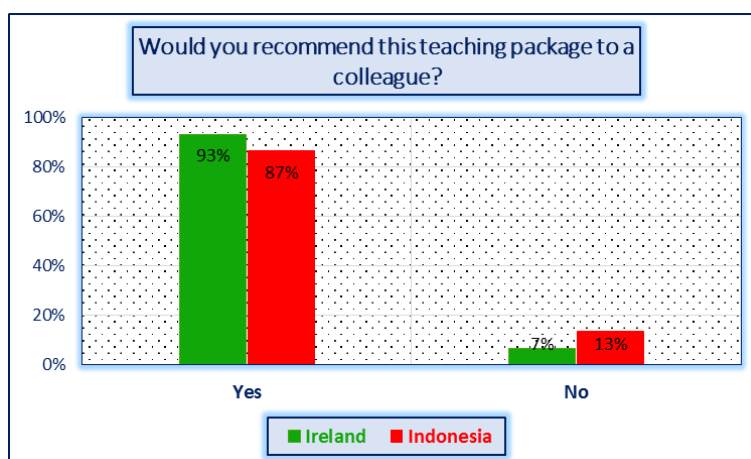


Figure 15. Teachers’ responses for the recommend the teaching package

Finally, when the science teachers were asked to recommend the medical physics intervention packages to their colleagues, 93% of Irish science teachers said that they would recommend this teaching package to their colleagues while only 7% would not recommended. This compares to Indonesian teachers’ responses, 13 of the science teachers (87%) revealed that they would recommend them to their colleagues. A significant minority, 13% of science teachers, would not recommend the packages to their colleagues. It must be noted that there is no transition year programme (TY Program) in the national education system of Indonesia. The teachers were very positive in their attitude towards the teaching package, the teaching approach, and also a number of students activities included. The comparative analysis showed that the teaching package were effective to engage the students’ interest. The responses of the Indonesian teachers were more varied than Irish teachers. It shows that Irish teachers were more positive than Indonesian teachers. However, it is clear that both of the group of teachers appreciated the positive response regarding the teaching objectives and the learning outcomes framework included.

F. Analysis of questionnaires of the teachers.

All of the teachers were highly experienced second level physics teachers. The questionnaires were completed following a demonstration by the researcher on the medical physics module at a teacher workshop. As stated earlier, the questionnaires included Likert-Scale, and open-ended questions. The purpose of this questionnaire was to obtain information or perspectives of teachers relating to certain aspect of the teaching package being implemented. The analysis of teachers’ questionnaires included a number of aspects: teaching time indicated, teaching objectives and learning outcomes framework, level of detailed in each lesson plan in terms of subject content for the students, and the recommendation of the teaching package.

1. Teaching time

In this section of the questionnaire, teachers were asked to comment on teaching time indicated for each lesson of the intervention package. Most responses from Irish teachers were very positive and stated that the time teaching indicated was sufficient.

Examples of comments received were:

“I think the allocation of instructional time has been very good, detailed and covered all of the students’ activities”.

“Very good, I had no problems with the allocation of instructional time in each lesson. Combining inquiry and direct teaching approach is very helpful for me”

The Irish teachers commented that the detail of instructional time in each stage of teaching was very detailed as well as the mixed teaching method approach included was very helpful. Correspondingly, the positive responses were also received from Indonesian teachers. It is heartening in the typical comments below:

“Yes, the teaching time indicated overall for the lesson was sufficient, supporting the effectiveness of learning. In addition, the stage of teaching which is included in each lesson is very detailed as well as the time allocated for each student’s activities”.

“Very good, the stage of learning is quite clear. With time estimates in each stage of learning, allowing me to follow the time allocated. Also the student activities can be restricted. Challenges in the learning process can be overcome”.

“I have taught all the lessons on the module. I followed the stage of learning and kept my time based on the lesson plan and teacher’s guide. I have no problem with the time teaching in each lesson”.

It is quite clear that the teachers from both countries were happy with the teaching time indicated for each lesson. However, a number of Irish teachers commented ‘lack of time’ in their teaching process. Some examples of comments were:

“There was too much in some lessons, but this is good as some years you could have a class that would complete all the tasks in the allocated time”.

“Videos could have been embedded into PowerPoint to save time”.

“Lack of time. It is because there is too much learning content and also learning activities using the inquiry approach. My difficulties are the teaching time allocated”.

Moreover, the Indonesian also teachers expressed their opinion that the teaching time was insufficient. Here is the typical comments:

“No, included inquiry activities for this lesson affect the learning process, teaching time allocated was not sufficient. I and my students couldn’t perform some activities because of the limited teaching time. Inquiry Based Science Education activities took extra time teaching”.

“I think the teaching time allocated is insufficient, there is a lots of learning activities that must be undertaken to achieve the teaching objectives. In my class, the ability of learners is varied”.

“Overall, it was not enough; a lot of time was required for the students’ activities that I thought were important. Dilemma, reduce the activities or add the time teaching for learning”.

The teachers felt lack of time for learning activities which is part of the Inquiry Based Science Education. Another aspect mentioned was the difference between lower and high skills among students. It must be noted that in this module it is highly recommended to teach in double classes. One of the Irish teachers highlighted the time teaching required for effective learning process.

“I think that there is enough material in each lesson for two periods (80 minutes) if not longer”.

“X-rays experiments took up quite a bit of time ex-sand box- but students enjoyed doing it. Could have spent longer on all topics with all resources etc. Some of the more interested students wanted time to take down more notes as they are planning to do physics next year. Great!”.

“Extra time needed for outclass activities, and it will be perfect”.

Likewise, the Indonesian teachers suggest:

“It was sufficient, to support the learning process purposefully and effectively. Some lessons cannot be taught in single class (45 minutes) disproportionate learning content was required for students to work independently, find ideas and solve problems. Not to mention the number of students in each class that exceeds the ideal limit. So it is highly recommended to teach in double class or 2 x 45 minutes”.

Clearly, both Irish and Indonesian teachers felt that double class would be more effective than singles class. In other words, the inquiry activities would be covered completely if double class are given. The Irish teachers stated that they incorporated the lesson with outclass activities such as field work, visiting a medical centre, or local hospital. One the teachers highlighted this very well:

“A lot of information, and I linked this activity to a visit of local hospital such as X-ray/scanning dept. and definitely need additional time to make it”.

The Indonesian teachers also agreed with this suggestion. They argued that the teaching time should be divided into double class, it also important to bring the students into the local hospital or other medical centre. One Indonesian teacher suggested curtailing classroom activities and increasing outclass activities such as; field work, visiting medical hospital, or local hospital. It was summarised by one of the Indonesian teachers.

“Lack of time. However, if these lessons were taught in double class (2 x 45 minutes), all the learning activities would be carried out properly and in accordance with the allocation of instructional time. Certainly, instructional time is not the same for each topic considering there are topics that are experimental and others are not. I think there needs to be a visit to a local hospital to learn and understand the significance for learners”.

From the comparative analysis above referring to the teaching time, there are two points of views emerging form the teachers in both countries. Firstly, it was revealed that ‘Inquiry activities’ on each lesson took a lot of time in the teaching process, and thus reduced effective teaching time. Secondly, there was a different teaching time allocation between Indonesia and Ireland, it was quite clear that Irish teachers spend *40 minutes* in single class

while Indonesian teachers spent 45 minutes in single class. It was reflected in the OECD report that Ireland is one of the countries that has class period that too short. In addition, students in Irish schools receive a lower proportion of teaching time in science compared to the OECD and EU average (OECD, 2021).

2. *The teaching objectives and the learning outcomes framework*

In this section teachers were asked to rank their level of agreement on whether the teaching objectives and learning outcomes specified in each lesson plans help them to ensure that students obtained a good understanding of medical physics module. The scale of responses was: *strongly agreed, agreed, neither agreed nor disagreed, disagreed and strongly disagreed*. Teaching objectives are specific statements of teaching intentions and are involved into each lesson of teaching package. Each lesson plan also contained specific information about what the teaching of the module hopes to achieve. In general, teachers were very positive in their comments about teaching objectives and the learning outcomes framework.

Some typical comments received from Irish teachers:

“Outcomes are made clear in each lesson plan and successfully clarify what should be achieved”.

“I thought the lesson did an excellent job of increasing students' understanding”.

“Agreed, helped me focus on the learning process”.

Furthermore, the Indonesian teachers also commented positively in respect to the teaching objectives and learning outcomes framework. It can be seen in comments as follows:

“Agreed, these two elements have a vital role in lesson planning; these two components have made this medical physics module easier to be taught. I have no doubt the majority of students understand the lessons very well”.

“Strongly agreed, it helped me and my students to keep to the outlined learning process. Students have a good understanding of each lesson in this module”.

The teachers believed that these two aspects of the teaching package were very helpful. The teaching objectives and the learning outcomes framework also allows teaching medical physics easier to teach and students to acquire a good understanding during the teaching process. It is highlighted from one of the teacher:

“Can encourage students to learn with an effective process, this module is very good to help students to acquire understanding of physics behind medical analysis”.

Nevertheless, some of teachers felt that having the learning outcomes at the end of the lessons was not a good idea. It can be seen in the following statement from Indonesian and Irish teachers who participated in this study.

“Too many objectives”.

“I think that these did not influence the students' experience of learning. I'm afraid that students did not establish a good understanding of the module”.

“The teaching objectives at the beginning and the learning outcomes at the end of the lesson was not a good idea, as a teacher I might focus but some students might overload due to student ability. I'm afraid the students do not understand the material taught. I also noticed they were not balanced between objectives and learning outcomes on several topics of learning”.

In contrast, a numbers of teachers commented on this issue and they felt the teaching objectives and learning outcomes in each lesson was satisfactory. It is clear from the teachers' response below:

“Clearly written and understand by all the students”.

“Strongly agreed, and helped me achieve a standard of learning goals. As a result, students have a good understanding”.

Moreover, this recurring theme is summarised by one of the Indonesian as follows:

“As a learning target, it certainly, helped me focus on the learning process. The teaching objectives are shown at the beginning of the lesson, while learning outcomes displayed at the end of the lesson. I had never taught this module before; students do not focus only on results but also on the process. It is very important to inculcate scientific enquiry to students”.

It is important to note that identifying the learning outcomes at the beginning will encourage students to focus only on the important points of the topic being taught. Thus the learning path is solely based on the output regardless of the results. One of the greatest advantages of the learning outcomes framework of this module, is that it shows some point of view, and clear statements of how the students are expected to demonstrate that achievement.

3. *Level of detailed in each lesson plan in terms of subject content for the students*

In this section, teachers were asked to indicate their opinion on the level of detail included in each lesson in terms of subject content. Overall, the teachers were happy with the subject content included. It can be seen from the comment of the Irish teachers:

“Linked to students’ everyday life, very good content”.

“Combining theory and practice or activity outside the classroom”.

Teachers indicated that each lesson included a good balance of subject content. The Indonesian teachers also expressed positive response. An example of such comments were:

“Very detailed, links to everyday life and my students didn’t have any problem in understanding the materials”.

“Systematic, it included the learning and teaching resources and also helped to realise the teaching objectives and learning outcomes”.

“Fantastic, very good. Increased the learning experience for my students”.

Clearly, the teachers were satisfied with the subject content of each lesson. The resources included were sufficient to help students in their achievement of teaching objectives as well as the learning outcomes needed. Nevertheless, a numbers of science teachers suggested reducing the subject content for some lessons. It can be seen in the following statement by Irish teachers:

“For transition year I felt there was too much content but it was easy to skip sections that I felt weren’t necessary”.

“Would prefer too much content. Can select the bits of interests the students are interested in. Too much detailed for weaker students”.

The teachers felt that not all of the content of the lesson engaged the student’s interest, especially for students who are lacking in a scientific background. Teachers reduced the material content for some lesson. In the same way, Indonesian teachers expressed this view in comments:

“Good, but it would be perfect if content was reduced for some particular lessons; such as Ultrasound and Radioactivity”.

“Overall, the subject content is detailed and has a good balanced. However, for Radioactivity, it should be reduced”.

It is also noted that of all the lessons, only one teacher stressed that too little content was included, particularly on the lesson 4 (MRI and CT scan). Overall, science teachers felt that the content of the lesson plan included was well balanced content.

4. *Recommending the teaching package*

In the final section of the teacher’s questionnaires, teachers were asked their opinion on recommending this teaching package to their colleague. Most replies were very positive. Some typical comments were received from Irish teachers were:

“Encourages more young students’ interest in physics through a hands-on interactive learning experience”.

“Fantastic resource”.

“Students are able to express their own ideas in medical physics about what they have read and learnt”.

Furthermore, some of Indonesian teachers commented in the following statement:

“It was an outstanding module that encouraged students select science, and in particular physics”.

“Of course, I would recommend. This module can increase students’ interest in studying physics”.

Clearly, this teaching package can engage students’ interest and learning, showing physics in a more meaningful way in relation to students’ everyday life. Other teachers wished to use the teaching package next year. Irish teachers described as follows:

“Promote the science behind medical physics”.

“It was an outstanding module that encouraged student closed to science, in particular physics area”.

Otherwise, Indonesian teachers stated that:

“Very good packages, for first year senior high level; Helps teachers and students to enjoy science”.

“Yes of course, because the module is suitable to be taught to students. In particular in transition from junior high to high school”.

However, two of Indonesian teachers wouldn’t recommend the teaching package as it was not a part of the physics syllabi for first year student in senior high school (SMK/SMA/MA). One teachers’ summarized this:

“This topic irrelevant in the physics syllabi, but encourages more young students to become interested in physics through a hands-on interactive learning experience”.

5. *Additional comments received from science teachers*

The last question on the questionnaire was a sweep question that allowed teachers freedom to give any opinion they wished. Most of the replies were very positive. It is encouraging to read some of the Irish teacher's responses:

"Very good and of interest to the students but, for 4th year students they lack a lot of basic knowledge necessary for some of the PowerPoints e.g. Electromagnetic spectrum, total internal reflection, etc".

"I would use this with a LC class also".

"Excellent package, well done".

Likewise, Indonesian teachers perceived the comments as follow:

"Very good, this module inspired me to teach physics by inquiry model. The content of this module is also very interesting to study. Primarily it discusses physics as used in the medical field".

"Excellent, I will teach this module for the new students, next year".

"Good, increased students' interest and enjoyment of physics".

The teachers commented that they were very happy using this module as it was explored concepts of physics behind medical analysis and was a good starting point for first year students in senior secondary level. They also concluded that the teaching package encouraged students' interest in physics. Some suggestions given by science teachers:

"The packages are excellent and whilst I would alter them slightly to suit my needs I think every teacher would like them".

Similarly, Indonesian teachers' comments:

"This is a good idea; always connecting physics with everyday life. I think it's important to add some additional activities such as visiting a hospital, or a study tour of the nearby health center".

"I would be more interested in this module if there was less in class activity and more outdoor activity, as in visiting a hospital or health center".

This intervention package includes activities called 'expert group task'. The students carried out a number of activities related to physics in medical analysis. The teacher suggested adding more of these activities. Dillon, J (2011) believed that learning science beyond classrooms, field work improve knowledge, skills, and motivation. Moreover, he stated that denying student's fieldwork is like denying them books, or pens, or computers. Denying students fieldwork while allowing others to benefit from it is intellectually bankrupt and morally indefensible.

Again, one of science teachers suggested to put all the material on the website. Typical comment were:

"Should be put on the website or blog; some activities such as visit hospital, medical analysis will be more powerful potential to increase students' interest".

"Create a website or blog easily accessible to learners".

"Perfect, a little suggestion to improve this module: information material should be placed on the website allowing students easy access."

It is important to note the suggestion that came from a teacher who taught in city centre schools. Most of the schools in Indonesia have a problem with network support. Not all of the schools can access the internet properly.

IV. Conclusion And Recommendation

The findings of this study revealed that both physics teacher in Ireland and Indonesia were very appreciate of the resources supplied for the practical activities of the package. In the light of the findings of this study, the researcher recommends that:

1. The challenges faced during implementing the teaching package. Clearly, teaching time allocated was the most significant problem when using Inquiry Based Science Education in teaching physics.
2. Having laboratory support directly helps the effectiveness of the students learning behaviour. The teachers were enthusiastic about the practicality and usability of the package and were very appreciative of the availability of the resources supplied for the practical activities of the package.
3. Physics teachers in both countries would recommended the teaching package will teach the module for up-coming years
4. Three of fifteen Indonesian teachers would not recommended the teaching package, while all of the Irish teachers recommend. Indonesian teachers stated that they will accompanied this topic with material content in physics syllabi for the first-year high school.

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