Shifting from physics teacher to basic-science teacher: adequate or not? (a self-study)

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Abstract. For years, basic concepts of physics were taught in Universitas Pendidikan Indonesia as a subject in primary-school teacher education study program. Nonetheless, since 2015/2016 school year that course was removed from the program curriculum and basic-science enrichment is a new subject instead. Basic-science enrichment subject contains basic physics, basic chemistry and basic biology and all of them are simply in one course. Meanwhile, the author who has physics educational background and usually taught basic concept of physics should teach basic science including basic chemistry and biology. This paper is a result of a self-study research as self-reflection on teaching that elaborates the advantage and drawback of being a teacher with physics educational background, but eventually should immerse herself in a basic science (not-only physics) teaching and learning environment. Some questionnaire results from the students about the impressions they got from the teacher related to this case were also discussed.

1. Introduction
Previously, primary-school teacher education study program in Universitas Pendidikan Indonesia had specific courses of science in its curriculum for the third-year students, which were basic concepts of physics (4 credits), basic concepts of chemistry (4 credits), and basic concepts of biology (4 credits). Unfortunately, since 2015/2016 school year, those basic science courses were removed from the curriculum, and instead of those three courses, only one course of basic-science enrichment (3 credits, with physics, chemistry, and biology embedded) was provided to be the new course representing science learning.

Meanwhile, the author was a physics lecturer with physics academic background who usually dealt with physics-related courses. Due to the recent policy of compressing physics, chemistry, and biology courses as mentioned above into only one-course of basic-science enrichment (3 credits), the author was assigned to teach this new course. This was a quite huge challenge to the author because the author has no formal chemistry and biology educational background. Nonetheless, the classes of basic science enrichment were run and there were some aspects that could be reflected by the author in handling a non-physics class. In this paper, the author discussed the advantage and the disadvantage of being a teacher with physics educational background but has a responsibility to also lecture a science course with non-physics material in it. The author also discussed the impression of the students taught by the author about the author’s performance in classes with physics material and non-physics material. Furthermore, the comparison of the author’s performance in various subjects of science (physics and non-physics) was analyzed in order to be an input to the author so that the author could perform her teaching better in the future. This self-analysis would be useful to check whether the author already
well-suited to non-physics teaching or not. Moreover, any science teachers with similar conditions could reap benefits from this research by maximizing their potentials in getting the advantages of being a physics-background science teacher and by being aware of any disadvantage that may occur.

2. Methodology

This study was a self-study research which was one of the practitioners research. Self-study research is like an action-research but it emphasizes on reflecting the practitioners’ practices. This self-study was held in order to improve practice (here it was the teaching) of the practitioners, as it is said by Samaras and Freese [1] and it is quite common among teacher educators worldwide. However, this self-study research has not been really frequently found in Indonesian practitioners.

The class that was analyzed was a basic-science enrichment course (3 credits) with 42 students of primary-school teacher education study program. Some learning processes examined in this study involved learning of heat (physics), changes in matters (chemistry), plant life and environment (biology), simple machine (physics), animal life and environment (biology) and digestion (biology).

The learning of heat was conveyed with some teacher’s presentation. Subsequently, it was accompanied by an experiment held by the students about heat from ’101 Cool Science Experiments’ [2]. Changes-in-matters was delivered with a presentation. Besides, the students were asked to do an experiment with some bottles of soda based on ‘Soda Pop in a Balloon’ experiment [3]. Plant-life-and-environment learning was conveyed with giving an assignment to the students to observe the changes on some leaves of a living plant for a week, which was an experiment taken from ’101 Cool Science Experiments’ [2]. In addition, in class the teacher gave a presentation about the material. Next, the students were asked to examine more about the structure of leaf from the material taken from ‘Succeed in Science’ [4]. For simple-machine subject, the author delivered simple concepts of simple machine and rolled some videos about it, then assigned the students to design something useful from the combination of several different simple machines. Animal-life-and-environment material was learnt with a presentation by the teacher and added by a group discussion about how an animal would look like if a specific environment exists. The students were asked to draw the most logical look of animal that can exist due to the adaptation to the specific environment. The idea was taken from ‘Design Your Own Animals!’ [5]. Digestion was given by a presentation from the material taken from ‘Fun Finding Out Your Incredible Body’ in Indonesian version [6]. The learning of the digestion was enriched with a competitive game which was done in groups. The students should stand in a row (in a group) then every one member of the group was given a question related to digestion, and they raced to the board to write the answer of the question as fast as possible.

3. Results and Discussion

3.1. Advantage of being physics-educational background teacher on handling science but non-physics classes

One of the advantages of being a physics-background teacher teaching non-physics subject is that the author was already really accustomed in the way of thinking in physics experiments that also can be implemented in the non-physics subject experiment. For example, for subject ‘Changes-in-Matters’ (chemistry), in the experiment of Soda Pop to show that gasses could dissolve in liquid, there were some original steps requiring to open a bottle of soda, and then slipping the end of a balloon on the top of the bottle, shaking the bottle and watching the result [3]. However, as a physics-background teacher, it could be achieved without great effort to think of some additional steps to be done by the students following the original steps. For instance, the author could ask the students for: not to shake the soda bottle, but check on the balloon about every 10 minutes for any changes; or do the same experiment for different kind/brand of soda; or do the same experiment for different volume of soda; or do the same experiment for different temperature of the soda; or all of those choices; or anything different from those that have been mentioned. The students were asked to be as creative as they can. This technique of varying one
variable and to maintain other variables constant to check the scientific phenomena involving in an experiment could be applied in various experiments.

3.2. Disadvantage of being physics-educational background teacher on handling science but non-physics classes
As a physics-background teacher, the author has no formal education that could enrich the author’s knowledge on chemistry and biology thoroughly. It needed enormous and serious effort for the author to learn subject related to chemistry and biology.

3.3. Students’ opinion analysis on the science-teaching performance of a physics-background teacher
To examine more about the author’s performance when having a non-physics subject class, the author has conducted a simple survey to 42 students of primary school teacher candidate program students. The questionnaire contained two questions: 1) which subject do you think the lecturer masters the most? (rank from the highest to the lowest), and 2) which subject do you think the most interesting subject referring to the lecturer delivery? (rank from the highest to the lowest). For those two questions, the subjects that should be ranked by the students were heat (physics), changes in matters (chemistry), plant life and environment (biology), simple machine (physics), animal life and environment (biology), and digestion (biology).

The answers of the students regarding the rank of teacher’s mastery on various subjects mentioned above can be seen in figure 1, and the rank of the attractiveness-level of subjects according to the students is represented as a graph in figure 2.

![Figure 1. Mean of Subject-Mastery Level According to the Students](image)

It is indicated in figure 1 that according to the students, among all subjects, the teacher mastered subject of heat (physics) the most. This was very reasonable referring to the teacher’s background which is physics. On the contrary, simple-machine material got the lowest score on teacher’s mastery although it was also categorized as physics. It was assumed that the teacher considered that simple-machine was as a ‘not-so-difficult’ subject to the students. Consequently, the teacher might neglect to convey some important (and more-complicated) facts of simple-machine in the class. The teacher only gave some examples of simple-machine principles and directly went to roll a video about simple-machine.
Furthermore, the teacher assigned the students to design something related to simple machine, which might be regarded by the students as a ‘too-simple’ assignment.

![Figure 2](image-url)

**Figure 2.** Mean of the Attractiveness-Level of Subject According the Students

It is represented in figure 2 that digestion (biology) got the highest score for the attractiveness level. It was compelling to find because in point of fact, as a part of biology, digestion material was not perfectly mastered by the teacher. One day before the class started, the teacher only asked the students to read some sources about digestion, and it was followed by a brief presentation about digestion in the day of the teaching. Most of the time of the learning process in class was elapsed with playing a kinesthetic game involving students working in a group then competed to come to the board answering some questions related to digestion. It was presumed that the game was interesting to the students and not the teacher’s mastery on digestion. The delivery (here it was a game) intrigued the students although the teacher was not necessarily good in the content.

Ironically, the subject of heat (physics) which the teacher was proficient in the most (and the students’ questionnaire resulted the same idea) was only in the fourth place (out of six) for the attractiveness-level (beaten by digestion (biology, first place), changes-in-matters (chemistry, second place), and animal-life-and-environment (biology, third place)). It was presumed that the teacher tended to be too serious on heat-subject since it was regarded that she had good understanding on heat (better than any non-physics subjects). The teacher was inclined to have more confidence in teaching heat and might teach that subject conceptually right. However, the delivery might become uninteresting and monotonous since the teacher was too invigorated by her proficiency on the subject, and neglected the need of the students on an interesting learning process and delivered the material in a plain lecture only.
4. Conclusions and suggestions
From this self-study, it could be inferred that being a physics academic background teacher made the author easier to adapt on non-physics science subject teaching, although she should make more efforts to master chemistry and biology material.

Moreover, good mastery does not always mean good delivery. Good mastery on particular subject by the author did not always mean that the teaching on that material would intrigue the students well, too. There was an indication that the author tended to deliver the subject that she was not really good at in more interesting way (i.e. in this case for the material ‘digestion’ (biology)). The author should change this tendency and should always try her best in teaching so that the delivery can be interesting for the students, whatever the subject to learn is.

In addition, the interesting part of this self-study was that actually the impression of the teacher’s subject mastery according to the students could be different from the teacher’s actual subject mastery.

In the future, the author should try to acquire better knowledge on non-physics science content and not merely achieved the successfulness of the teaching by relying on good delivery. The author as a teacher may try to apply more basic physics laboratory concepts (i.e. simple mathematical modeling, creating linear equation from some situations as variables) on non-physics science experiments teaching. It is highly suggested that the author should try her best to deliver any subject either it was physics or non-physics subject.

This study could bring an additional perspective for basic-science teachers whose academic backgrounds do not necessarily cover the whole subjects on the basic-science curriculum. This study might cue in the teachers for preparing themselves better in teaching something which is not a part of their main academic strengths.

Acknowledgments
The author thanks Dawn Garbett for inspiration and general discussion about self-study. The author also thanks all primary-school teacher education students of Universitas Pendidikan Indonesia at Sumedang campus who took part in this study.

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