Dissemination of statistical physics learning materials based on KKNI with the constructivist approach

R Afrizon*, S Y Sari, H Hidayati, and R Anshari

Physics Department, Faculty of Mathematics and Science, Universitas Negeri Padang, Indonesia

*afrizon@fmipa.unp.ac.id

Abstract. Learning materials of statistical physics that have been developed are syllabus, course plan, and handout. It has very valid criteria based on to expert judgment. According to lecturers and students as users, it has also been practically used. However, the learning materials are still in limited use, so it needs to be disseminated to similar department and majors in West Sumatra. The purpose of this research was to determine the effectiveness of the dissemination’s result of learning materials based on the Indonesian National Qualification Framework (Kerangka Kualifikasi Nasional Indonesia, KKNI) with a constructivist approach. Dissemination is one of the stages of Research and Development (R & D) using the 4-D model developed by Thiagarajan (1974) which is used as steps in this research. At this stage, the learning materials has been distributed to lecturers of physics education department of IAIN Batusangkar and STKIP PGRI Sumatera Barat. The timeline of the learning materials’ dissemination is adjusted to the semester schedule of statistical physics course in both institutions, namely semester of July-December 2016. The research data was collected using questionnaires that were given to lecturers who teaches statistical physics courses. The data analysis technique used is descriptive data analysis. The analysis results of the questionnaires show that the learning materials that have been disseminated are has an clarity, valid, has an impact and benefits, has an timelineness, and practical so that it can be accepted for use in lectures. The conclusion of this research is the dissemination of learning materials based on KKNI with constructivist approach that have been developed effectively used by the user in similar department and majors in West Sumatera.

1. Introduction

Need analysis is a preliminary research that represents the analysis phase in the 4-D development model. The results of the needs analysis as part of the define phase that consist of front-end analysis, student analysis, task analysis, and concept analysis. The front-end analysis illustrated that it’s criteria such as lecturer performance, learning environment, student competency, soft skills for working competence and the difficulty of students in attending statistical physics lectures, are in the sufficient category. Student analysis showed that: (1) 57.14% students had good initial competency, (2) 40.74% students still experience misconceptions in statistical physics lectures, (3) 40.72% students require to improve their understanding through the activity of repetition of matter, problem solving exercises and structured assignments, (4) environment greatly influences student mastery learning. Student task analysis suggests that: (1) group study and repetition of matter still need to be increased, (2) structured assignments provided have supported the expected learning competencies. Analysis of concept
illustrates that statistical physics material needs to be enriched from basic to complex materials[1]. Needs analysis have direct contribute to the syllabus design. The front-end analysis contributes to the expected learning outcome. Analysis of student characteristics contributes to the components of the method, activity and learning experience designed in the syllabus. The task analysis contributes directly to the assessment component in the design of the syllabus. Concept analysis contributes to the components of the short description of the course, learning material and references used in the syllabus. Formulated learning objectives contribute directly to learning outcomes and final abilities planned in the syllabus. After the syllabus was designed based on needs analysis, then continued with course plan design and handouts.

Learning materials that have been designed based on needs analysis, require to be tested for validity by 4 experts. Validation in the syllabus shows that the validity for content aspect is 93.75%, validity for construct aspect is 96.25% and validity for aspect of language is 93.75%. The validated course plan shows that validity for content aspect is 91.96%, validity for construct aspect is 96.25% and validity for language aspect is 91.67%. Course plan construction aspect shows the highest proportion, means course plans designed have been based on KKNI and constructivist approach. Validation of the handouts shows that validity for content aspect is 89.58%, validity for construction aspect is 92.71%, validity for aspect of language is 91.67% and validity for aspect of graphics is 89.58% [2]. The highest percentage is seen in the construct aspect of syllabus, course plan, and handouts. This shows that the designed learning materials have been based on KKNI, constructivist approach and are valid to use.

Statistical physics learning materials also need to be assessed for practicality as part of the development stage. Practicality can be used to see the extent to which users (lecturers and students) and other experts consider whether the product is attractive and can be used in normal conditions [3]. The syllabus has a practicality of 90.28% based on lecturer responses and 73.64% based on questionnaires filled by students based on student responses. Meanwhile, handouts have a practicality of 92.15% based on lecturer responses and 71.44% based on student responses. Course plan practicality is 89.58% based on lecturer response questionnaire. [4]. So, the learning material that have been developed are in the practical state category. In addition, the effectiveness of the learning materials is carried out through classroom trials and is seen as having an effect on expected learning outcomes. One of the learning materials that is seen as effective is handouts. Handouts used by students are quite effective in influencing learning outcomes from students. Mastery learning of statistical physics course can be seen from 57% of students who have minimum score in good enough level. Learning materials that have been developed have very valid criteria based on expert appraisal. According to lecturers and students as users, learning materials have been practically used and have been effective enough to influence student learning outcomes.

However, this learning materials is still limited for use in the physics department of Universitas Negeri Padang, so it needs to be disseminated to similar study programs in West Sumatra. Dissemination is one of the stages of the 4-D model from research and development. The dissemination phase aims to find out the use and promote the learning materials so that it can be accepted in the midst of users both lecturers, students and study programs. Dissemination can also be carried out through a process of transmission to related learning practitioners in a particular forum. This form of dissemination aims to obtain input, correction, advice, assessment, in order to improve the final product so that it is ready to be adopted by product users. The effectiveness of dissemination also needs to be monitored whether it meets the criteria. Therefore, this study purpose to determine the effectiveness of dissemination of statistical physics learning material on similar study programs at universities in West Sumatra.

2. Research Methods
This research is in the final stages of the 4-D model from research and development. This study took place from July to December 2016. The steps taken by the dissemination stage are clearly illustrated on Figure 1.
The research that has been conducted has entered the packaging section and diffusion stage as in Figure 1. Before the learning materials is distributed to the users, it needs to be evaluated formatively and summatively. Formative evaluation relates to the revision of the learning materials in accordance with suggestions / input from experts and practitioners (lecturers and students). Summative evaluation is related to the effectiveness of the learning materials and the overall evaluation for each stage. The revised learning materials is in accordance with the suggestion, being a statistical physics learning materials that is already feasible to be distributed (product). Dissemination activities in the diffusion stage need to consider several things, namely: analysis of users, determining strategies and themes, timing, and media selection. Product users are lecturers of the physics education study program at IAIN Batusangkar and STKIP PGRI Sumatera Barat to teach statistical physics courses. The strategy used is psychological strategy. This is due to the suitability of the curriculum and lecture time. Statistical physics courses at STKIP PGRI Sumatera Barat were taken by students of 5th semester (http://fisika.stkip-pgri-sumbar.ac.id/index.php/akademik/2016-07-19-07-49-39). Meanwhile, the IAIN Batusangkar issued a statistical physics course also in the 5th semester (http://iainbatusangkar.ac.id/akademik/fakult-tarbiyah-dan-ilmu-keguruan/prodi-pendidikan-fisika). The media used in the dissemination of learning materials is sending via email. Data was collected using a questionnaire. Data analysis techniques used were descriptive statistical data analysis techniques using percentages with 5 criteria: 1) invalid / impractical (0% < proportion ≤20%), 2) less valid / less practical (20% < proportion ≤40%), 3) quite valid / quite practical (40% < proportion≤60%), 4) valid / practical (60% < proportion ≤80%), and 5) very valid / very practical (80% < proportion ≤100%) which has been modified from[6].

3. Result and Discussion
Dissemination has been carried out on two similar study programs at two universities in West Sumatera. Results of the dissemination questionnaire of statistical physics learning materials can be seen from the following components.
3.1. Clarity
Information from disseminated learning materials is obvious although there are some things that need to be slightly revised according to the results of the questionnaire analysis. Practitioners from STKIP PGRI Sumatera Barat stated that the syllabus had clarity of information and needed to be discussed about phase space because it had something to do with particle distribution systems, while course plan already had clarity of information, and handouts had obvious information. This is due to the existence of several symbolic equations that are close together (accumulate) so that it needs to be trimmed again. Meanwhile, practitioners from IAIN Batusangkar described that syllabus already had clarity of information, course plan had information that was obvious enough and needed to be added in duration so that learning of statistical physics could take place effectively. The handout has obvious enough information and it is recommended to be given a title for each figure.

3.2. Validity
The validity of the statistical physics learning materials was carried out by experts at study programs at two universities which were the purpose of dissemination. The following are the validation’s results of the learning materials from aspects of content, construct, linguistic, and face.

3.2.1. Syllabus
The first statistical physics learning materials validated at the time of dissemination was syllabus. The results of validity in content, construct and linguistic aspect in the syllabus are shown in Figure 2.

![Figure 2. The Results of Syllabus Validity](image)

Figure 2 shows that the syllabus in general has been very valid criteria both in terms of content, construct and linguistic. This is indicated by the syllabus validity score above 87%.

3.2.2. Course Plan
The second set of statistical physics learning materials validated at the time of dissemination was course plan. The results of validity in content, construction, and linguistic aspect in course plan are shown in Figure 3.
Figure 3 shows that course plan in general has been very valid criteria according to experts. Course plan has a validity score above 90% both in terms of content, construct and linguistic.

3.2.3. Handout
The third set of statistical physics learning materials validated during dissemination is handouts. The results of validity in content, construct, and linguistic aspect in the handout are shown in Figure 4.

Figure 4 shows that handouts in general have been very valid according to experts on aspects of construct, linguistic, and face. Meanwhile, the aspect of the contents of the handout is in a valid category with a significantly different score.

3.3. Pervasiveness
Practitioners from STKIP PGRI Sumatera Barat explained that the syllabus and course plan that have been disseminated can make lectures more focused on specific topics, statistical physics handouts that have been disseminated to become a guide for students. Meanwhile, practitioners from IAIN Batusangkar said that the dissemination of syllabus, course plan, and statistical physics handouts could
be used as guidelines by lecturers for giving lectures. So, statistical physics learning materials that have been distributed have provided benefits.

3.4. Impact
Practitioners of STKIP PGRI Sumatera Barat stated that syllabus and course plan that had been disseminated had an impact on the lecturers where it helped the lecturers in preparing learning material. Meanwhile, handouts are helpful in preparing learning material also. The impact that emerges on students is that students become more focused on studying statistical physics. Practitioners from IAIN Batusangkar described that giving syllabus, course plan and handouts can make lectures activities more effective.

3.5. Timeliness
The learning materials of statistical physics was disseminated at the appropriate time for the two universities which are the objectives of the dissemination of learning materials. Statistical physics courses are taught in the same semester as the time of dissemination.

3.6. Practicality
Practicality of statistical physics learning materials is carried out by practitioners in two universities which are the purpose of dissemination. The following are the practicality of the learning materials in terms of ease of use, interesting, and efficient.

3.6.1. Syllabus
Syllabus is a set of statistical physics courses that need to be tested for practicality. The results of the practicality of the syllabus are shown in Figure 5.

![Figure 5](Image)

**Figure 5.** The Results of Syllabus Practicality

Figure 5 shows that the syllabus in general has been practical according to practitioners. Syllabus has a very high score on aspects of ease of use. Whereas, the interesting aspect of the syllabus has the lowest score of all available indicators.

3.6.2. Course Plan
Course plan is a part of the statistical physics learning materials that needs to be tested for practicality. The practicality of course plan is shown in Figure 6.
Figure 6. The Results of Course Plan Practicality

Figure 6 shows that course plan in general has been practical according to practitioners. Course plan has a very high score on aspects of ease of use. Meanwhile, the interesting components of course plan has the lowest score of all available indicators.

3.6.3. Handout

The handout is a statistical physics learning materials that also needs to be tested for practicality. The practicality of the handout is shown in Figure 7.

Figure 7. The Results of Handout Practicality

Figure 7 describes that handouts in general have been very practical according to practitioners. Handouts have very high scores on aspects of ease of use. Meanwhile, the interesting aspect of the handout has the lowest score of all available indicators.
The results of a questionnaire analysis shows that the learning materials is obvious, valid, has an impact and benefits, on time, and practical so that it can be accepted for use by users in their lectures class. The dissemination of statistical physics’s learning materials based on KKNI and constructivist approach has been effectively implemented. Dissemination can be said to be effective if it conforms to the following criteria. 1) clarity, information should be clearly stated, with a particular audience in mind, 2) validity, the information should be present a true picture, 3) pervasiveness, the information should reach all of the intended audience. 4) impact, the information should evoke the desire response from intended audience, 5) timeliness, the information should be disseminated at the most opportune time, 6) practicality, the information should be presented in the form best suited to the scope of the project, considering such limitations as distance and available resources [5].

4. Conclusion
Dissemination of statistical physics learning materials based on KKNI and constructivist approach is obvious, valid, has an impact and benefits, on time, and practically after being tested at two universities. This result shows that the dissemination has been effectively carried out on users in similar study programs in West Sumatera.

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