

Upgrading of an SAT Based Design Approach for Nuclear Education and Training Programs

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1. Introduction

The Nuclear Training and Education Center (NTC) of the Korea Atomic Energy Research Institute (KAERI) is offering in-house education and training, domestic courses for students who are majoring in nuclear science and technology and for nuclear industry personnel, and international courses for foreign participants. As such, the NTC education and training (E&T) programs are diverse in terms of their target audience, delivery type, technical area, etc. For an effective management of these courses, NTC introduced a Systematic Approach to Training (SAT) in the early 1990s, which is one of the E&T course management methodologies [1, 2].

SAT consists of five stages, namely, needs analysis, design, development, operation, and evaluation. The design stage is taking on a leading role by converting E&T needs into course objectives, based on which the requirements are established for the following stages, i.e., development, operation, and evaluation.

Although SAT was introduced to the NTC E&T programs in the early 1990s, its applications have been rather individual along with education and training program areas, e.g., in-house programs, student and industry personnel programs, and international programs. Therefore, the levels and methods of their applications have been diverse.

With this emerging nuclear E&T environment, NTC began upgrading its program management system by enhancing the levels and methods of SAT applications, as well as bringing diverse applications to an integrated rule [3, 4]. The adoption of SAT for upgrading in a manner to establish an integrated system that is unique to NTC and practical for implementation is essential to enhance the quality, management efficiency, knowledge management, and eventually the competitiveness of the NTC E&T programs.

As a part of the upgrading effort, a reference design guidance, which actually takes a leading role in the other SAT steps is established. Its applicability is then evaluated by applying guidance to some of the NTC E&T programs.

This paper presents a reference design guidance established through an adoption of SAT and its applicability for the upgrading of the NTC E&T programs.

2. Methods and Results

2.1 Reference Design Approach

The reference design is intended to be representative of similar and/or repetitive programs and to integrate the NTC E&T programs into a set of unified guidance, aiming at the following enhancements:

- quality by placing an emphasis on content design based on a KSA gap analysis and feedback
- management efficiency through the compilation of key program information in unified design requirements that can serve as the basis for cross checking throughout the course implementation activities, and for different uses such as course announcements, the preparation of a course operation plan to obtain management authorization, etc.
- knowledge management by referencing the design to related information and records of the implemented programs
- competitiveness through enhanced quality, management efficiency and knowledge management.

2.2 Establishment of Design Framework

A framework of the course reference design is determined through an identification of the E&T elements, i.e., learner, instructor, contents, administration and service, and infrastructure. Then, the major components that have to be specified in terms of the requirements for the respective elements in the design stage of the SAT steps are identified, as shown in Figure 1. The identified components are a summary of the needs analysis results as bases of the design, course purpose/objective and content requirements, learner qualification, instructor qualification, content development requirements, operation requirements, evaluation requirements, and infrastructure requirements.

Additional components for the framework are also identified to address considerations on the course competitiveness, knowledge management, etc.

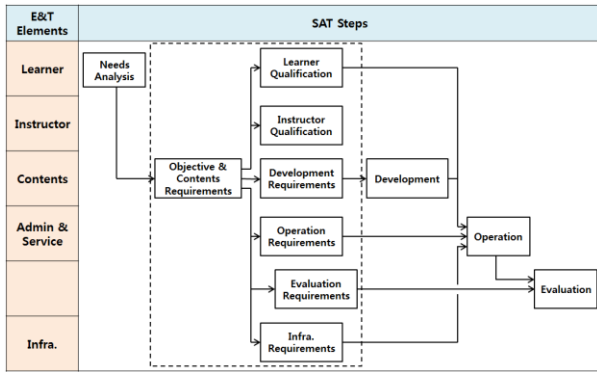


Fig. 1. Framework of the reference design for NTC E&T programs.

2.3 Identification and Specification of Design Items

With the established design framework in mind, detailed items being used in the NTC E&T programs and from other references are reviewed. This is followed by a selection of relevant items to fit the framework and a description of the items in terms of the requirements for the next steps of SAT. Special considerations are given to the needs analysis, as mentioned in the following section.

Considerations given in the identification and specifications are as follows:

- flexibility to accommodate all cases of the NTC E&T programs and allow room for course specific issues to be dealt with sufficiently;
- practicality to reflect real situations of the course implementation and avoid any unnecessary requirements;
- feedback to reflect important lessons learned from previous course implementations, if any;
- consensus building through involvement of all staff members of NTC in the preparation of the reference design guidance.

Thus, the prepared design items are provided in Table 1 and major considerations given on the design components are presented in the following sections.

2.3.1 Summary of needs analysis

A summary of the needs of the course from the previous step of SAT, i.e., a needs analysis, has to be provided in terms of the background of initiating the course, the needed competency of the target audience, and any feedback from previous course implementations, such that it can serve as the bases for the establishment of the course purpose and learning objectives. The needed competency should be presented in terms of knowledge, skills, and attitude (KSA) together with KSA gaps of the audience [5, 6].

2.3.2 Course purpose/objective and contents

The purpose and learning objectives of a course have to be clearly indicated by converting the required competency into E&T requirements taking account of the specialty of NTC and any other factors, if any. There

may be additional purposes from the course organizer to utilize the course results for NTC management purposes.

Table 1. Course Design Items

Design Items	Requirement Description
1. Course title and code number	<ul style="list-style-type: none"> • Course title • Course code number
2. Needs	<ul style="list-style-type: none"> • Background • Needs • Feedback
3. Course purpose and learning objective	<ul style="list-style-type: none"> • Course purpose • Learning objective
4. Organizers	<ul style="list-style-type: none"> • Organizations managing, sponsoring, cooperating the course
5. Duration	<ul style="list-style-type: none"> • Required course duration
6. Place	<ul style="list-style-type: none"> • Requirements for place of the course
7. Learner	<ul style="list-style-type: none"> • Optimum number of learners • Learner qualification • Target country/organization/department (if necessary) • Cooperation relationship or priority * Other selection criteria
8. Prerequisite courses	<ul style="list-style-type: none"> • Courses required, if any, to attend the course
9. Language	<ul style="list-style-type: none"> • Language to be used in the course
10. Qualification of organization and course manager	<ul style="list-style-type: none"> • Qualification of course management organization • Basic qualification of the course manager
11. Lecturers	<ul style="list-style-type: none"> • Experience, expertise, delivery skill, etc.
12. Course contents	<ul style="list-style-type: none"> • Conceptual course framework and course subjects • Learning objectives of each subject • Contents of each subject, learning methods, time allocation * Feedback, if any
13. Infrastructure requirements	<ul style="list-style-type: none"> • Facility, equipment, computer codes, educational tools, etc. * Including requirements for hardware and software
14. Development requirements	<ul style="list-style-type: none"> • Main text, sub-text(s), supporting material • Development methods • Items for examination and survey * If some of them are already available, those should be indicated.
15. Operation requirements	<ul style="list-style-type: none"> • Items of orientation • Requirements for cooperation • Requirements for language, culture, safety & security, protocols • Requirements for operational procedure • Others
16. Evaluation requirements	<ul style="list-style-type: none"> • Indicators and methods for evaluation • Certification criteria
17. Expected effects	<ul style="list-style-type: none"> • Effects expected from the course
18. Implemented courses	<ul style="list-style-type: none"> • List of the same or similar courses that have been implemented
19. Related information	<ul style="list-style-type: none"> • Relevant information related to the course
20. Superiority and particularity of the course	<ul style="list-style-type: none"> • Indication of points that are superior to other courses and/or special characteristics of the course
21. Design records	<ul style="list-style-type: none"> • Indication of design versions, revision dates and designers
22. Comments	<ul style="list-style-type: none"> • Provision of comments if any

The course contents have to primarily identify the major subjects to be covered in order to achieve the purposes and objectives mentioned above. Together with these elements, a presentational drawing that shows the conceptual structure of the course is recommended. Then, each subject needs to specify its learning objectives, detailed learning subjects at the lecturing level, delivery methods, and time allocation. Delivery methods have become more innovative (e.g., the use of information and communication technology, or ICT), diversified, and customized

Any feedback for the preparation of the course purpose/objective and contents from the previous course implementations need to be mentioned.

2.3.3 Content development

The required learning materials in terms of the main text and/or learning materials, and the supporting texts and/or learning materials have to be indicated. Then, development methods of the materials need to be described. Examples of such methods will be development in a formal textbook by designated authors for the respective technical areas involved or the assemblage of lecturing materials, the use of existing texts/materials, and so forth.

In addition, the development requirements for the examination items have to be specified in accordance

with the course evaluation requirements mentioned in Section 2.3.5.

2.3.4 Course operation requirements

The requirements for the course operation have to encompass operational procedures, topics to be addressed in the course orientation, and issues to be considered for technical and administrative cooperation with associated parties at KAERI, at the national and international levels. In addition, aspects that need to be considered in relation to safety, security, and protocol have to be indicated. For international courses, issues requiring provisions to respect cultures of learner countries, such as religion, food, and etc.

There may be important experiences gained and issues raised from previous course operations. These have to be reflected as recommendations, if relevant, at the design stage.

2.3.5 Course evaluation requirements

The required performance indicators of the course and the evaluation methods of the indicators have to be guided. At the moment, NTC introduces three levels of performance in a course evaluation depending on the characteristics of the course [7, 8, 9], i.e., are degree of satisfaction by the learners, learner achievement, and affection to the performance of the learners in their organization. NTC practice for an evaluation method includes a survey, examination, and so forth.

The criteria for course certification are also a part of the evaluation requirements. The minimum percentage of the course attendance and/or minimum score of the examination are examples of such criteria.

2.3.6 Others

As mentioned earlier, directions for systematic management knowledge and enhancement of course competitiveness are important components of the design framework.

The design requires a list of courses with key information including the course title, dates, place, and organizer that have been implemented, if any, under the same or similar title. The list is intended to link with detailed information of the respective course in the NTC knowledge management system, so that relevant knowledge of courses is maintained systematically for an effective sharing and succession.

The competitiveness and particularity of the course needs to be mentioned at the design stage to draw attention and provide guidance for the implementation of the following stages of SAT. An enhanced national and international competitiveness of the NTC E&T programs can be achieved by addressing innovative scientific/technical areas, improving the quality of the contents, introducing an innovative delivery methodology, selecting well-qualified instructors, utilizing advanced facilities and equipment related to the scientific/technical areas of the course, and so forth. For this, NTC is in a position to make use of advanced knowledge and skills encompassing diverse areas of

nuclear technology, potential instructors with good expertise, and small- and large-scale research facilities, which are readily available at KAERI. Concerning the particularity issue, the design has to indicate the special characteristics of the course, if any, that should be kept in mind during the implementation of the course development, operation, and evaluation.

2.4 Establishment of Design Guidance

A set of reference design guides together with a design format is established by preparing descriptions of the requirements on each design item that has been identified as mentioned above. The guidance containing 22 items is finally reviewed by all staff members of the NTC to obtain a consensus in the adoption of its use throughout the center. This consensus building is believed to be crucial for the integration of diverse course management activities in NTC.

2.5 Application to Programs

With the established reference design guidance, 12 ongoing courses of NTC, shown as follows, have been designed by their respective course managers, and then reviewed by the NTC management.

- RACRO/KAERI Regional Workshop on Radiation Technology and its Application
- WNU Course on Key Issues in the World Nuclear Industry
- KAERI-K.A.CARE HCB Program: Fundamental Nuclear Engineering for the SMART Design
- Course on the Role of HRD for Successful Nuclear Power Program
- Basic Course for Proton Accelerator/Ion Beam Application Technology
- Radiology Experimental Course on Using HANARO and National Radiation Research Facilities
- Radio Pharmacy Experimental Course on Using HANARO and National Radiation Research Facilities
- Training Course on Nuclear Reactor Experiments for University Students
- Course on PSA and Risk information
- Course on Radiation Spectrum Analysis
- Course on Thermal Heat Transfer Engineering
- Course on Nuclear Thermal Hydraulic System and Safety.

To confirm the applicability of the design guidance, a survey is conducted by soliciting the views of the course designers with respect to the difficulty, usefulness, ambiguity, and other factors encountered during their preparation. The survey shows the following:

- It is important to check the identification of the KSA from the needs analysis step for constructing the contents of the curriculum.

- Significant effort is needed to ensure that the instructors are well suited to the course purpose and learning objectives.
- In the design step, the linkage of KSA-based textbook development along with the course operation should be considered.
- The 22 design items established will be very helpful for strengthening the capacity of the course manager.

3. Conclusions

As part of an effort to upgrade the nuclear education and training system of the Nuclear Training & Education Center (NTC), a unified reference design guidance that actually takes a leading role over the other SAT stages is established. The design guidance together with a design format covers 22 items, which deals with course elements and their requirements along with a needs analysis, development, operation, and evaluation, as well as with aspects regarding the superiority of the course and knowledge management.

The established design guidance has been applied to 12 ongoing courses, from which the applicability of the design guidance has shown to be favorable. Any feedback from future application will be reflected in an improvement of the guidance.

The reference design effort is meaningful because it will enable the integration of diverse course management activities and contribute to an upgrade of the education and training programs of NTC.

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