

School Science in the National Repository of Open Educational Resources (NROER): An overview of the developmental process of Physics content

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Abstract

Open Educational Resources (OERs) are increasingly being promoted by enthusiasts in the field of education as a solution to the challenges of access, quality and cost of digital content worldwide. The National Policy on Information and Communication Technology by Ministry of Human Resource Development, Government of India (2012), in its policy goals discusses about creating an environment for collaboration, cooperation, sharing and promoting universal, equitable, open and free access to ICT. The most important aspect of openness is the free availability of resource over the Internet, and recurrence of as few as possible restrictions, in the form of licensing activity, on the use of resource by the users. Central Institute of Educational Technology (CIET), National Council of Educational Research and Training (NCERT) and Department of School Education and Literacy, Ministry of Human Resource Development, Government of India has launched National Repository of Open Educational Resources (NROER), which is a digital repository of open educational resources offering resources for all school subjects and grades in multiple languages. The resources are available in the form of concept maps, videos, multimedia, interactive objects, audio clips, talking books, photographs, diagrams and charts, articles, lesson plans and textbook pages. This research paper provides a glimpse to the NROER with special reference to the subject of Science with special emphasis on Physics content of Elementary and Secondary school level. It is an attempt to provide an overview to the complete methodology of development of Science content in the form of concepts, concept maps and multiple resources on the NROER, including the suggestive use of NROER by the Teachers, Teacher educators, Pupil teachers and students.

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Introduction

Open Educational Resource (OER) is a new phenomenon which may be seen as a part of a larger trend towards openness in education including more well-known and established movements such as Open Source Software (OSS) and Open Access (OA). The most important aspects of openness are the free availability of resource over the Internet, and recurrence of as few restrictions as possible on the use of the resource by users. There should be no technical barriers (undisclosed source code), no price barriers (subscriptions, licensing fees, pay-per-view fees) and as few legal permission barriers as possible (copyright and licensing restrictions) for end-user. The end-users not only to use or read the resource but also to adapt it, build upon it and thereby reuse it, given that the original creator is attributed for her/his work.

The term Open Educational Resources first came to use in 2002 at a conference hosted by UNESCO. Participants at that forum defined OER as: "The open provision of educational resources, enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes." Open Educational Resources are digitised materials offered freely and openly for educators, students and self-learners to use and re-use for teaching, learning and research.

OER is said to include the learning content which have full courses, courseware, content modules, learning objects, collections and journals; tools which are software to support the development, use, re-use and delivery of learning content including searching and organization of content, content and learning management systems, content development tools, and on-line learning communities; and implementation resources comprising of intellectual property licenses to promote open publishing of materials, design principles of best practice, and localization of content.

National Repository of Open Educational Resources (NROER)

Keeping in line with the OER movement throughout the world, CIET, NCERT is involved in the development and management of the National Repository of Open Educational Resources (NROER) (Figure 1). The National Repository is developed in collaboration with the Department of School Education and Literacy, Ministry of Human Resource Development, Govt. of India. Metastudio, the platform hosting the repository is an initiative of Gnowledge Labs, Homi Bhabha Centre for Science Education, Mumbai. NROER was launched by Honourable Union Human Resource Development (HRD) Minister, Govt. of India Dr. MM Pallam Raju in presence of Honourable Minister of State for HRD Dr. Shashi Tharoor, Secretary, Higher Education Shri Ashok Thakur, Secretary, School Education and Literacy Shri Rajarshi Bhattacharya, Director, NCERT Prof. Parvin Sinclair and other distinguished guests during the National Conference on ICT (Information and Communication Technology) for School Education on 13th August 2013 in New Delhi.



Fig. 1. Interface of National Repository of Open Educational Resources (NROER)

NROER is a solution, developed to address the challenges faced by the education sector of our country. It intends to reach the unreached, include the excluded and extend education to all. It is a collaborative platform involving everyone who is interested in education. It offers resources for all school subjects and grades in multiple languages. It brings together all the digital resources for a school system such as educational videos, concept maps, audio clips, interactive objects, photographs, diagrams, charts, images, articles, learning objects, talking books, textbook pages and documents, any resource that can be served digitally. The major objectives for developing the national repository are:

- To make digital electronic content available for teachers and students.
- To enable the participation of the institutions/ organizations, community in development and sharing of digital resources.
- To create mechanism to evaluate digital content.
- To provide platform for teachers and students to participate in online courses.

Licensing process on NROER

Open Educational Resources provide teaching learning fraternity with the quality study materials to facilitate the expansion of learning worldwide. By the use of open licensing the teachers and learners can be liberated from the concerns of the permissions and other conditions attached with the use of content or software. NROER uses Creative Commons license for promoting quality education. Creative Commons has six types of licences. NCERT has taken the initiative of declaring that NROER carry the CC-BY-SA license instead of CC-BY-SA-NC which contains a more restrictive clause and was advocated by Wikimedia and other advocates of open educational resources (Figure 2). This decision by NCERT is in tune with UNESCO's Paris Declaration on Open Education Resources and will ensure that all the resources are freely accessible to all. To put it in the language of the Creative Commons-to reuse, revise, remix and redistribute.

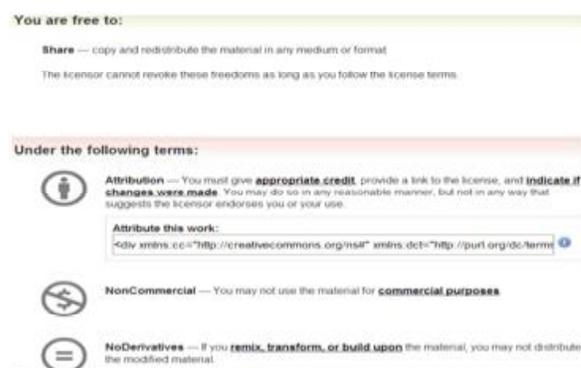


Fig 2. Details of licensing process provided by Creative Commons.

Development of Science Content specifically in Physics on NROER

NROER is based on concepts; the complete structure of it is knitted around the concepts which are extracted from the

syllabus text of NCF 2005 of NCERT. The Repository is offering the content for all the levels of school education, starting from Elementary level and proceeding to Secondary and Senior Secondary Levels. In the subject of Science the NROER is starting with Elementary level to Secondary level, there are more than 554 concepts listed in the subject. All these concepts are linked with each other to constitute a concept map. The whole process of development of Science content on the NROER is discussed as under:

(1) Identification of concepts

Concepts were identified by thorough study of the Textbooks for specific classes along with the syllabus document of NCF 2005 by in house faculty members and through workshop mode. The concepts were listed out and debated among the group of and the final list of concepts to be shown to public after uploading on NROER was finalised (Figure 3 and 4). In the meantime the concepts identified by the internal faculty was also standardised through the workshops by the group of teachers.

Level	Subject	Concept
Secondary and Higher	Mathematics (VI - VIII)	Circular Motion
Secondary Level	Social Science (VI-VIII)	Rectilinear Motion
Elementary Education	Science (VI-VIII)	Periodic Motion
	Art Education (VI-VIII)	Odometer
		Displacement
		Speed
		Speedometer
		Friction
		Sliding Friction
		Rolling friction
		Fluid friction
		Force
		Contact force
		Non-contact force
		Pressure

Fig. 3. Concept list of Science for Elementary level displayed on NROER

Level	Subject	Concept
Secondary and Higher	Science (IX-X)	Velocity
Secondary Level	History (IX-X)	Momentum
Elementary Education	Geography (IX-X)	Light
	Political Science (IX-X)	Concave lens
	Economics (IX-X)	Convex lens
	Mathematics (IX-X)	Reflection of light
	Physics (IX-X)	Spherical lenses
		Mirage
		Advanced sunrise & delayed sunset
		Twinkling of stars
		Mirrored surfaces
		Refraction through a prism
		Plane mirror
		Curved mirror

Fig. 4. Concept list of Science for Secondary level displayed on NROER

(2) Concept mapping

As the NROER is based on concepts, it organizes its collections into an ever growing semantic map of concepts. Concept mapping is the essential part of process of development of the repository; therefore the institute is working towards this direction. The concept map itself is a learning resource for teachers, providing an opportunity for critically assessing the curriculum and aiding the construction of their own unique learning themes for their classrooms. The digital resources are mapped to concepts. This enables access to a library from which teachers can choose appropriate resources. Each resource is tagged to related concepts making it accessible for

use. The resources can be downloaded, commented upon and are released for free use.

The concept maps on NROER are prepared by groups of teachers along with CIET faculty members in workshop mode. The concept maps primarily were sketched on charts or sheets of paper by the group of teachers by making discussions on the different aspects on which the relationships between the concepts constitute in order to produce a complete semantic map. The speciality of concept maps on NROER is that there is 'inverse relationship' with every relationship among the concepts. The concept maps then were presented in front of the forum of teachers and subject experts for verification, after verification the uploading of concept maps was executed on NROER web site.

If command ctrl + click is executed with any concept of the concept map the concept map expands, and on clicking to any concept of the concept map the designated page for the concept opens, which comprises the Concept Name with its definition(s), and other details like related concepts, resources and a comment box, this resultant feature of getting the page for a particular concept is same when we search or browse any concept on the NROER (Figure 5 and 6).

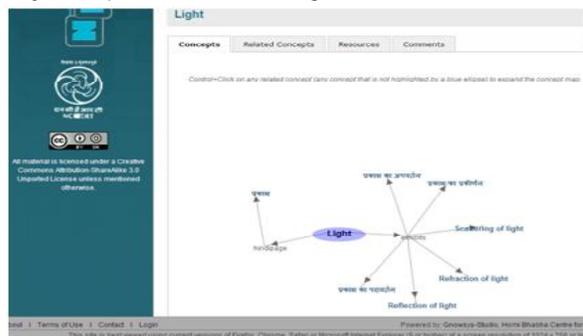


Fig. 5. A concept page from the Science concept list on NROER, showing definition of the concept, tabs for related concepts, resources, comments and concept map as default feature.

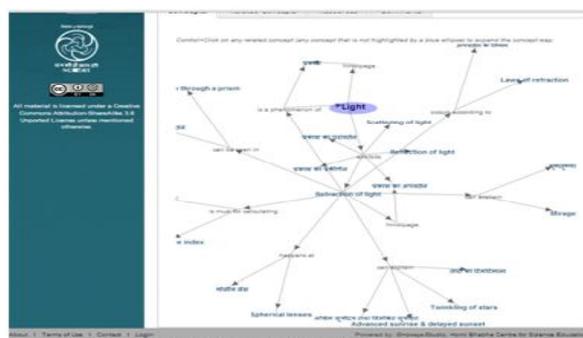


Fig. 6. A ctrl + click expands the concept map to its extension limits

Adding multiple resources with every concept After linking the concepts with each other the individual concepts were mapped with available related resources like videos, audio clips, images, documents, etc. (Figure 7). These resources can be accessed by the users in various ways, they can view, download, use, reuse, revise, remix and redistribute these resources, but they have to take care of releasing the revised resource again on NROER under CC BY-SA license.

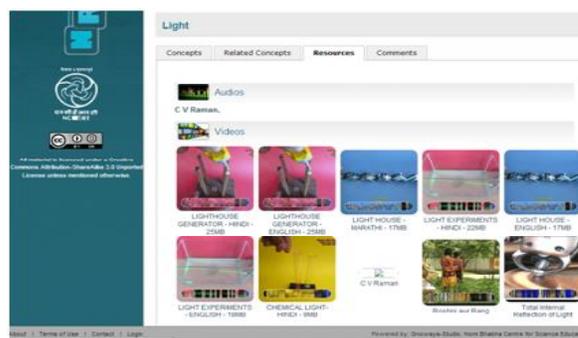


Fig. 7. The resource page on NROER showing multiple resources for the concept of 'Light'

(3) Tagging of concepts to allow multiple access with other related concepts and resources

On the NROER every concept is provided with certain tags, these tags are the nearest neighbourhood terms or most appropriate related key term with the concept. By assigning tags the application of search option is enhanced as these key terms help in navigating through the related resources for the concept because every related resource for the concept is also tagged with the same tags/key words (Figure 8).

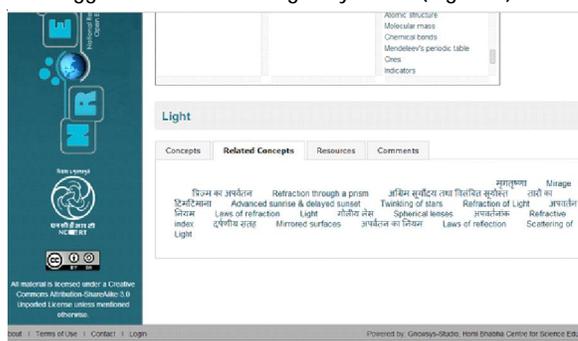


Fig. 8: The window on NROER showing related concepts/tags with the concept 'Light'

Concept mapping as a tool for learning

NROER is completely based on concept mapping and online accessibility of resource in such a form which bridges the gap between cognitive learning and application based learning. Concept maps are based primarily on the learning theories of cognitive psychologists, specifically Ausubel's Assimilation theory. A concept map helps represent ideas in a way that models an individual's cognitive structure.

According to David Ausubel, "the most important single factor influencing learning is what the learner already knows" (Novak, 1998). Relationships between concepts are formed when two concepts overlap on some level. As learning progresses, this network of concepts and relationships becomes increasingly complex. Ausubel compares meaningful learning to rote learning, which refers to when a student simply memorizes information without relating that information to previously learned knowledge. As a result, new information is easily forgotten and not readily applied to problem-solving situations because it was not connected with concepts already learned.

However, meaningful learning requires more effort, as the learner must choose to relate new information to relevant

knowledge that already exists in the learner's cognitive structure. This requires more effort initially, however after knowledge frameworks are developed, definitions and the meanings for concepts become easier to acquire. Further, concepts learned meaningfully are retained much longer, sometimes for a lifetime. Teachers can encourage creative thinking by using tools such as concept maps.

Educational Implications of NROER: What people (teachers, students, etc.) can do on the Repository?

The NROER provides multiple resources for every concept in order to make the teaching-learning process of the same more effective. These resources are present in the form of videos, audio clips, interactive objects, images and documents. Anyone who accesses the repository can view, download, use, remix, revise, reuse and redistribute the selected resource, but the revised resource should be shared again on the repository for further dissemination of the same, as all the resources are released under CC BY-SA licence on the NROER. This process has a wide scope of frequent use of digitised content by the society, fulfilling the most important objective of NROER. In addition there are some more educational implications, listed as under:

(a) For Teachers and Educators

- Use in classrooms
- Use for self-development
- Participate in special interest groups
- Share their creations

(b) For Governments

- Help to develop digital resources
- Translate the resources
- Share resources on the Repository
- Help integrate into teaching learning
- Enrol teachers
- Suggest NROER in curriculum
- Help organise activities around NROER
- Contests
- Events

(c) For Public

- Making public well informed about different aspects of NROER
- Scope of NROER
- Activities on NROER
- Showcase progress of NROER

(1) Contribution of digitised resources by teaching-learning community on the NROER

The collaborative creation of e-content is among the aims of NROER, to fulfil this aim NROER invites contribution of resources from the teaching-learning community or anybody who has created or retrieved any open educational resource and want to release the same under CC BY-SA license (Figure 9). For making a contribution one has to register on the Repository after that a small form with fields for licensing attribution and details of the contributed resource is to be filled, this is followed by attaching the resource to be contributed, and submitting on the NROER. The contributed resource will be uploaded on the Repository after evaluation of the same, evaluation

is done by a structured mechanism on NROER.

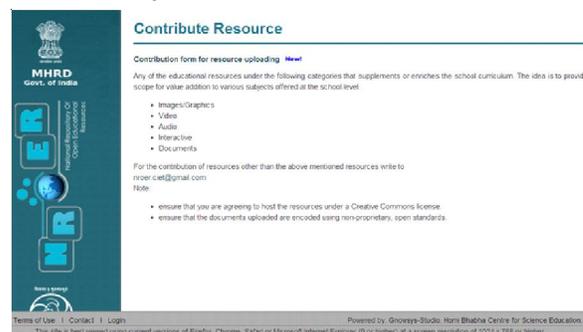


Fig 9. Window for contribution of resources on the NROER

(2) Commenting, critique on the concepts or related resources

NROER follows a democratic mode of action which includes active involvement of users and contributors by the means of commenting or critique on any aspect of the Repository, be it resources, descriptions, concept maps, definitions or others (Figure 10). The users can also rate a resource by assigning stars to it. This process allows the management team to continuously receiving feedbacks and acting accordingly. This process also allows a user to share the ownership of a resource as everything is released under Open Access Scenario on NROER.



Fig. 10. Window showing comment/critique option on the NROER

Conclusion

The open educational scenario worldwide and especially in India is gaining popularity with every passing day. National Repository of Open Educational Resources (NROER) is an enthusiastic project in this row. Resources housed on NROER are free to access, reuse, remix and redistribute by anybody, as they are released under the CC BY-SA licence. With NROER the NCERT is demonstrating one of the ways of going beyond the textbook. The Science content is one of the examples in this line. The dream of NROER will be realized when it becomes useful for each and every teacher, each and every child, across geographies, bridging the digital divide. This dream requires the contribution and critical participation of each one of us. Be a part of the movement. Join today.

Web Resources

- <http://nroer.gov.in>
- <http://www.oecd.org>
- <http://www.openaccessweek.org/>

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