International Journal of Research in E-learning
Vol. 2 (2), 2016, pp. 81–91

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Coherence Model of Instruction

Abstract

The article deals with three main issues: the understanding of curriculum in context, the ability of contextualisation, and retention of knowledge in long-term memory. The paper first suggests principles based on the coherence model of instruction, which aims to achieve coherence of knowledge of isolated facts through a network of semantic relationships. Then, the theoretical basis of the model is described, including spatial learning strategies, cooperative learning, and excursions in an authentic environment supported by mobile devices. A methodology of teaching was designed according to the principles of the coherence model, and a virtual guide through educational exhibitions was developed. The virtual guide was tested with students of a primary school during an experimental lecture in the Ostrava Zoo. An evaluation of the coherence model and the virtual guide was carried out using three methods: an observation of students' behaviour and learning during the experimental lecture, a pedagogical experiment, and an evaluation of questionnaires. The results of the evaluation proved that the coherence model of instruction has a positive impact on understanding in context, ability of contextualisation, and retention of the curriculum in long-term memory.

K e y w o r d s: retention of the curriculum in long-term memory, excursion, coherence model of instruction, cooperative learning, mobile learning, museum pedagogy and didactics, understanding in context, spatial learning strategies

Introduction

The paper deals with understanding in context and retention of the curriculum in long-term memory. The author believes that the scope and objective of teaching in schools should not only be mechanical, mindless memorisation of individual facts without context, memorised by a student just to pass the closest test or exam. On the contrary, it is desirable that the student should truly understand the curriculum and, after analysing a problem, be able to synthesise the individual findings as well as to use the gained knowledge in practice. True understanding – when a student is able to organise the learned elements into a network of semantic relationships – also represents a path to long-term memorisation and practical application of those elements.

The paper describes the design, implementation, and evaluation of an educational model, methodology, and an educational application using mobile technologies, all of which aim to achieve a demonstrably positive impact on understanding the curriculum in context. The secondary object is to determine whether the developed model, methodology, and the educational application have a verifiable positive impact on retention of the curriculum in long-term memory.

Pillars of the Coherence Model of Instruction

To improve understanding in context and retention of the curriculum in long-term memory, the author created his own educational model with the working title “coherence model.” This working title is to emphasise coherence, that is – the interconnection and cohesion of acquired knowledge and skills of students. The coherence model of instruction is based on spatial learning strategies, on nonlinear representation of knowledge, activating teaching methods, and organisational forms of teaching in an authentic environment, such as excursions in educational exhibitions. First, basing on this model, a methodology was created. Then, the methodology was used to design, implement, and evaluate the educational application for mobile devices (tablets). The pillars of the coherence model and the subsequent stages of its implementation are shown in Figure 1.

The following overview describes the theoretical basis for the coherence model of instruction.

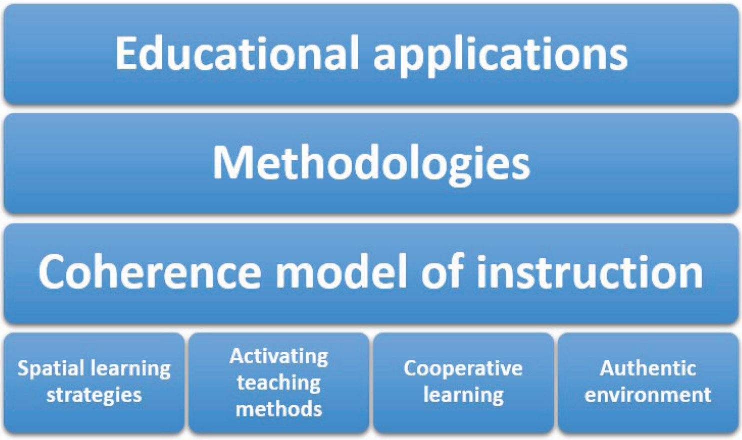

Figure 1. The pillars of the coherence model of instruction and the stages of its implementation.

Spatial Learning Strategies

The theoretical starting point in finding ways for students to develop understanding in context and achieve long-term curriculum retention are spatial learning strategies. These strategies use a nonlinear representation of knowledge, i.e. the curriculum. The underlying principle for various approaches in this area is a two-dimensional visualisation of the subject matter structure and relationships between concepts. Spatial learning strategies are built on the assumption that a student first has to "organize everything in his own head," that is – to consciously construct and reconstruct the network of concepts and relationships in his or her n-dimensional long-term memory (Mašek & Zikmundová, 2010, p. 8). Besides extended concept mapping, there are other methods of nonlinear knowledge representation, for example hypertext, structuring key concepts, recurrent graphic organising, and semantic networks.

Long, continuous, and unstructured text – whether a spoken commentary by a teacher or a written record in a book – could be too monotonous, overwhelming, and thus poorly understood by the students. Therefore, *typographical features* or *text structures* are being used (Čáp & Mareš, 2007, p. 237). These two highlight the important parts of the curriculum, partially capture its structure, or regulate the student's progress in learning.

Structuring an otherwise linear textbook not only serves better navigation and easier understanding, but also partially reflects the structure of the phenomena of the outside world. The attempts to create a structure are apparent from the highest level, which is a division of knowledge between individual teaching subjects, to the lowest level, which are the individual paragraphs of the textbook. However, this way of structuring has its weaknesses.

The distribution of knowledge into various subjects is to some extent a matter of convention. Isolation of individual subjects can be an obstacle to understanding in context, finding interdisciplinary links, and also to creative thinking, because many new ideas and innovations arise on the verge of two disciplines.

Structuring a linear text is not sufficient for expressing the fact that the object of learning (the element) can be a part of multiple systems. For example, the object of learning "orangutan" may be included as a part of the curriculum in different systems, for instance in the taxonomic classification system or in the food chain. In terms of higher levels, the same object may be taught about in different subjects as seen by various disciplines, which again makes it difficult for the linear method of teaching.

Print media, diagrams, and figures allow only a static record of the immediate state of phenomena or structures. However, numerous phenomena in nature and in the society are dynamic processes, and their representation through a static record is not as vivid and comprehensible as an animation using information and communication technologies (ICT), especially for younger students. Also, for instruction purposes, static phenomena can be presented better using animation. Explaining the structure can be rendered gradually from the central concept towards more remote concepts so that the students are not confronted with the whole phenomenon at once but gradually. ICT allow for the rendered structure to be complemented with spoken commentary and other multimedia elements, so that the students can engage multiple senses in their learning. Moreover, if touch devices are used in instruction, then students also get to use their sense of touch and fine motor skills.

Another indispensable advantage of ICT used for nonlinear representation of curriculum is the interactivity of educational applications. In such a case, the student is no longer a passive recipient of the multimedia information flow, but he or she becomes an active co-creator of his or her learning process. The advantages of interactivity are especially apparent when providing the student with feedback, i.e. during the formative assessment of the student, because the instruction commentary can be interspersed with automatically evaluated self-tests.

Nonlinear representation of the curriculum using ICT also has its disadvantages. The biggest risk is that a student "loses the thread," because the educational process in not linear, providing a lot of offshoots, and thus some taught structures can be too complex for the student's overall comprehension. Moreover, it is not desirable for the student to think only in nonlinear structures, since most communication acts – whether spoken or written – proceed linearly from the introduction through the body to the conclusion, and individual thoughts expressed in paragraphs should smoothly concur in a logical order. According to the author's personal experience, it is also a big problem for many university students, who possess only limited ability to consistently express themselves.

Linear and nonlinear ways of representation are best combined in order to eliminate the drawbacks of each of them; furthermore, a synergistic effect may possibly occur, in which the educational effect of the whole is greater than the sum of its parts. The combination of various means of curriculum representation and various ways, methods, and forms of teaching – in order to suppress their weaknesses and intensify their strengths – is the strategy of the coherence model of instruction.

Cooperative Learning

The basis of the coherence model of instruction are spatial learning strategies, and these must somehow be incorporated into the process of teaching. Therefore, the usage of activating teaching methods (Maňák & Švec, 2003, p. 152) and group classroom forms of instruction (Janiš & Lorencovič, 2008) in an authentic environment using ICT is an integral part of the coherence model of instruction.

Activating teaching methods assume that the student is a significantly active element of the instruction. The student's activity is not purposeless, rather being a starting point on the path "activity>autonomy>creativity." Among the means of activating teaching methods are discussion, and heuristic, situational, and staging methods or educational games.

Cooperative learning was selected from the existing means of group classroom forms of instruction for the needs of the coherence model of instruction in the sense of the following definition (Kasíková, 1997, p. 67):

> Cooperative learning differs from individual learning by being built on the cooperation of people in solving complicated tasks. The solvers are encouraged to be able to divide their social roles, plan the whole task, divide the sub-tasks, learn to counsel each other, help each other, align their efforts, monitor each other, solve partial disagreements, unite the partial results into a greater whole, evaluate the contribution of the individual members and etc.

When using cooperative learning, the class is divided into groups. There is supposed to be an active cooperation among the students within the same group, which among other things means that an individual's success in achieving a goal is tied to the success of other group members. Developing social skills necessary for working in groups is also a part of learning. When evaluating group learning, it is important to consider not only what the students have learned, but also what the social interactions among them were like.

Also, there is one more reason for using cooperative learning in the coherence model of instruction. In strengthening the understanding in context, among others, a method called "learning by teaching" is used, not only as a way of teaching but also as a way of assessing students. In the coherence model, this assessment is not just summarised in the final presentations of students, but it is formative throughout the whole learning process. The work and communication in the students' teams during cooperative learning produces a wide range of planned and unplanned situations. During these situations the students are forced to clearly explain something to other members of the team or to the teacher. In so doing, they get feedback and formal or informal evaluation of their ability to convey their understanding to other people.

An Excursion at an Educational Exhibition

To increase motivation and provide an immediate and lasting knowledge, experiential learning (Hanuš & Chytilová, 2009, p. 53) in an authentic environment was chosen. This means an environment outside of the classroom, as close as possible to the actual object of instruction. Given the fact that in most cases it is not feasible to carry out the instruction in a truly authentic setting, it is possible to use educational exhibitions in museums. In this paper, museums are defined in a broader sense (Museum Definition, 2007), which – in addition to conventional scientific and technical museums – also include zoological and botanical gardens, nature trails, geoparks, planetaria, or art galleries.

Museums are increasingly aware of their educational function, as evidenced, for example, by the rise of children museums, most of which are usually a part of the original museum (Jůva, 2004, p. 35). Museum pedagogy and didactics are developing, which again is evidenced by the number of publications concerning this topic. Nevertheless, according to the author's findings, a systemic use of museums for the extension of formal school education is still not on the same level as in Western Europe, not only when it comes to the frequency of school excursions, but also in terms of the museums' readiness for adequate instruction (from suitably qualified museum tutors through appropriately designed exhibitions to worksheets).

The Preparatory Stage of the Excursion

An educational excursion in a museum as a specific organisational form of teaching was chosen for the implementation of the virtual guide through educational exhibitions. A full-fledged excursion consists of three stages: preparatory, implementation, and final (Bílek, 2009, p. 17).

During the preparatory stage of the excursion, the students, preferably by their own efforts, get acquainted with history and reality of the individual objects of instruction and start to connect them into free associations. During this stage, the students also learn about the organisational guidelines, in particular in regards to group work and division of roles. The main objective of this stage is to stimulate an interest in both the excursion and the given subject.

The excursion concept of three stages has an analogy with the constructivist model of teaching (Šimík, 2012). The first stage of the excursion corresponds to the phase called "evocation." This phase is about identifying what the students already know about the issue and the problem, or what they think they know. Subsequently, the students form questions and express their confusion. The result should be a particular passion for solving a task or project.

The Implementation Stage of the Excursion

The implementation stage of the excursion takes place in the Ostrava Zoo and is carried out as a form of cooperative learning. The students work in groups of three to five using a tablet and are engaged in active observation, measurements, and experiments. The main objective of this stage is to become familiar with the real objects (exhibits) and recognise the relationships of the actual object (exhibit) with other objects.

A proper excursion is crucial for acquiring knowledge and developing understanding. In the constructivist model of instruction, a phase called "perception of a meaning" corresponds to this stage of the excursion. The student discovers new information, clarifies his or her views and confronts them with his or her original conceptions.

The Final Stage of the Excursion

During the final stage of the excursion, the acquired knowledge of the students should become systematic, categorised, and organised into various hierarchies.

The students who worked in the same group during the implementation stage of the excursion in the educational exhibition present their comprehensive knowledge to others and discuss it. This part may have a competitive or cooperative form. In the first case, all groups worked on the same task, and now it needs to be decided who performed best on the task. In the second case, each group performed a part of a larger task and now it is time to assemble the pieces of knowledge into a whole and to formulate general conclusions.

The final stage is concluded by a teacher, who summarises the acquired knowledge and benefits of the excursion, and initiates discussion on how to use the acquired knowledge, skills, and experiences in further education and life. The "reflection" phase of the constructivist model of instruction, which leads to deepening the understanding of the curriculum, mirrors this final stage of the excursion. The students categorise and systematise their knowledge and place it into context and schemata.

All three stages in the coherence model of instruction are considered equal. However, according to the author's verification, it is often not so in practice, and the initial and final stages tend to be somewhat overlooked by the teachers.

The stages are connected into a homogeneous whole by a unifying activity, which may be for example:

- a didactic game;
- a problem-based learning to reinforce research activities and independent creative thinking; or
- a project-based learning (Trnová, 2012, p. 72) with a "tangible" outcome, for example creation of the world map of animal biotopes or starting a zoological corner in the classroom.

The recommended unifying activity among the specific applications of the coherence model of instruction is an expedition undertaken by the students. Unlike the incorrectly understood "excursion" as a one-time event, expedition is intended as a long-term student project. From the very beginning of the expedition, the students assume team roles and work together to achieve an atypical goal.

Conclusion

A total of 48 pupils attended the excursion in Ostrava Zoo. Pupils were divided into two equally large groups (experimental and control), whose level of knowledge was comparable. The pupils worked in groups of three – expedition teams. Using statistical tools, it was tested whether the results of the experimental and control groups are different. First of all null and alternative hypotheses were formulated.

Null hypothesis H_0: the results of the experimental group of pupils are not different from the results of the control group of pupils in the posttest (PostE= PostK).

Alternative hypothesis H_1: the results of the experimental group of pupils are different from the results of the control group of pupils in the posttest (PostE<> PostK).

Results of testing are shown in Figure 2.

Hypothesis H_0 was rejected on the basis of the results of statistical analysis. This justifies the assertion that the level of understanding among pupils of the experimental group, after completion of education which was based on the coherence model of instruction, is significantly higher than the level of understanding among pupils of the control group, who attended classes not based on this model.

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Alternative Hypothesis	Z-Value	Prob Level	Decision (5%)
E<>K	-2,4820	0,013063	Reject Ho
E<K	-2,4820	0,993468	Accept Ho
E>K	-2,4820	0,006532	Reject Ho

Plots Section

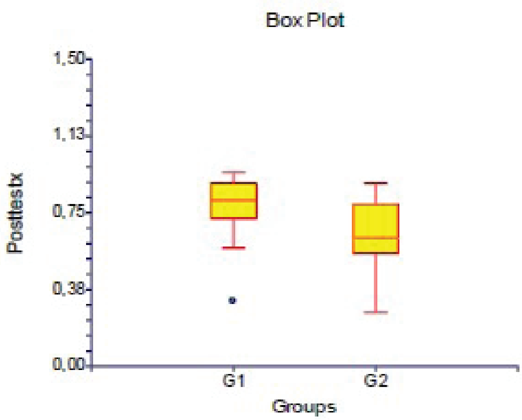

Figure 2. Statistical comparison of the results of the experimental and control group.

The evaluation of the coherence model of instruction, specifically the educational application for tablets, which is based on this model, proved that this way of teaching has a demonstrably positive impact on understanding the curriculum in context and on long-term retention of the curriculum. The students rated working with tablets negatively, especially because the tablets distracted them from learning.

References

Bílek, M. (2009). *Muzejní didaktika přírodovědných oborů a technických předmětů: přírodovědná a technická muzea a možnosti jejich využití ve vzdělávání.* Hradec Králové: Gaudeamus.

Čáp, J., & Mareš, J. (2007). *Psychologie pro učitele.* Second edition. Praha: Portál.

Janiš, K., & Lorencovič, J. (2008). *Organizační formy výuky: odborný text k rámcovému vzdělávacímu programu pro základní vzdělávání.* Ostrava: University of Ostrava.

Jůva, V. (2004): *Dětské muzeum: edukační fenomén pro 21. století.* Brno: Paido.

Hanuš, R. & Chytilová, L. (2009). *Zážitkově pedagogické učení.* Praha: Grada.
Kasíková, H. (1997): *Kooperativní učení, kooperativní škola.* Praha: Portál.
Maňák, J. & *Švec*, V. (2003). *Výukové metody.* Brno: Paido.
Mašek, J. & Zikmundová, V. (2010). *Výukové využití softwarových systémů pro techniku pojmového mapování.* Plzeň: University of West Bohemia.
Museum Definition. (2007). International Council of Museums. Accessed 31 October 2014. Retrieved from http://icom.museum/the-vision/museum-definition/.
Šimík, O. (2012). *Utváření obsahu přírodovědné výuky na 1. stupni* ZŠ v *konstruktivistickém pojetí.* Ostrava: University of Ostrava.
Trnová, E. (2012). *Základy kvalitní projektové výuky.* Brno: Lipka – školské zařízení pro environmentální vzdělávání.

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Model spójności nauczania

Streszczenie

Niniejsza praca zajmuje się trzema głównymi kwestiami: rozumieniem programu nauczania w kontekście, umiejętnością kontekstualizacji i zatrzymywaniem wiedzy w pamięci długoterminowej. W pierwszej kolejności, niniejsza praca sugeruje zasady oparte na modelu spójności nauczania, który ma na celu osiągnięcie spójności wiedzy w zakresie pojedynczych faktów poprzez sieć powiązań semantycznych. Następnie opisana jest teoretyczna podstawa modelu, włącznie ze strategiami nauczania przestrzennego, nauczaniem opartym na współpracy i wycieczkach w rzeczywistym środowisku, wspieranych urządzeniami mobilnymi. Metodologia nauczania została zaprojektowania zgodnie z zasadami modelu spójności. Opracowany został wirtualny przewodnik po wystawach edukacyjnych. Funkcjonowanie wirtualnego przewodnika zostało przetestowane z uczniami szkoły podstawowej podczas eksperymentalnego wykładu w zoo w Ostrawie. Ocenę modelu spójności i wirtualnego przewodnika przeprowadzono przy użyciu trzech metod: obserwacji zachowania i nauki uczniów podczas eksperymentalnego wykładu, eksperymentu pedagogicznego i oceny kwestionariuszy. Wyniki oceny wykazały, że model spójności nauczania posiada pozytywny wpływ na rozumienie w kontekście umiejętność kontekstualizacji i zatrzymywania programu nauczania w pamięci długoterminowej.

Słowa kluczowe: zatrzymywanie programu nauczania w pamięci długoterminowej, wycieczka, model spójności nauczania, nauczanie oparte na współpracy, mobilne nauczanie, pedagogika i dydaktyka muzealna, rozumienie w kontekście, strategie nauczania przestrzennego

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Когерентная модель обучения

Аннотация

Статья посвящена трем основным вопросам: понимание учебного плана в контексте, способность контекстуализация и удержания знаний в долговременной памяти. В работе предлагаются принципы, основанные на когерентной модели обучения, целью которой является достижение согласованности знаний изолированных фактов через сеть семантических отношений. Далее описывается теоретическая основа модели, в том числе пространственных стратегий обучения, совместного обучения и экскурсий в аутентичной среде, поддерживаемые мобильными устройствами. Методика обучения была разработана в соответствии с принципами модели когерентности, и был разработан виртуальный гид через образовательные выставки. Виртуальный гид был протестирован с учащимися начальной школы во время экспериментальной лекции в зоопарке Остравы. Оценку модели когерентности и виртуального гида проводили с использованием трех методов: наблюдение за поведением и обучением учащихся в ходе экспериментальной лекции, педагогический эксперимент и оценка вопросников. Результаты оценки показали, что когерентная модель обучения оказывает положительное влияние на понимание в контексте, способность контекстуализации и сохранение учебного плана в долговременной памяти.

К л ю ч е в ы е с л о в а: сохранение учебного плана в долговременной памяти, экскурсии, когерентная модель обучения, кооперативное обучение, мобильное обучение, музейная педагогика и дидактика, понимание в контексте пространственных стратегий обучения

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Modelo de coherencia de la instrucción

R e s u m e n

La tesis trata de tres temas principales: la comprensión del currículo en el contexto, la capacidad de contextualización y la retención de conocimiento en la memoria a largo plazo. El artículo sugiere primero principios basados en un modelo de coherencia de la instrucción, cuyo objetivo es lograr la coherencia del conocimiento de hechos aislados a través de una red de relaciones semánticas. A continuación, se describe la base teórica del modelo, incluyendo estrategias de aprendizaje espacial, aprendizaje cooperativo y la incursión en un entorno real basado en dispositivos móviles. Se diseñó una metodología de enseñanza según los principios del modelo de coherencia y se desarrolló una guía virtual a través de prácticas educativas. La guía virtual fue probada con estudiantes de una escuela primaria durante una clase experimental en el Zoológico de Ostrava. La evaluación del modelo de coherencia y de la guía virtual se realizó mediante tres métodos: una observación del comportamiento y aprendizaje de los alumnos durante la clase experimental, un experimento pedagógico y una evaluación por cuestionarios. Los resultados de la evaluación demostraron que el modelo de coherencia de la instrucción tiene un impacto positivo en la comprensión en contexto, en la capacidad de contextualización y en la retención de los contenidos currículares en la memoria a largo plazo.

P a l a b r a s c l a v e: retención del contenidos curriculares en memoria a largo plazo, excursión, modelo de coherencia de enseñanza, aprendizaje cooperativo, aprendizaje móvil, pedagogía y didáctica de museos, comprensión en contexto, estrategias de aprendizaje espacial