

EUROPEAN POLICYBRIEF

ENCOURAGING LIFELONG LEARNING FOR AN
INCLUSIVE & VIBRANT EUROPE

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**Decision support for policy
makers: Building an
intelligent system with
coherent knowledge of
diverse lifelong learning
interventions in EU countries**

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Rong Qu
Claire Palmer

INTRODUCTION

This policy brief reports research conducted to demonstrate the feasibility of establishing an intelligent decision support system (IDSS) on interventions to support policy making for education and training for young adults in Europe. Although there is rich practical knowledge of what makes educational interventions for these young people successful, and the related literature is extensive, documentation is often scattered and inconsistent in form. Much of it also lacks sufficient detail to support informed decision-making. Here ENLIVEN presents novel research spanning two disciplines (education and computer science) – areas which seldom interact.

The foci of this research are:

- First, we undertake ‘knowledge discovery’ on interventions across EU countries, focusing on programmes for young people Not in Education, Employment and Training (NEETs). The

research findings include a unified template of attributes which represent various interventions (collect as cases), and a similarity measure model which assesses how similar cases are.

- Then an intelligent decision support system (IDSS) is built, based on research findings at the knowledge discovery stage. When a stakeholder is interested in a new case, the IDSS retrieves cases previously stored, ordered by their similarity to the new case. This supports decision-making based on previous programmes. The performance of the IDSS can be further improved by the inclusion, over time, of new cases from policy makers or stakeholders in the unified template.

This work was carried out in Work Packages 8 and 9 of the ENLIVEN project, led by the University of Nottingham.

EVIDENCE AND ANALYSIS

The main research outcomes are summarised in the following two research findings. Corresponding recommendations are presented in the following section.

As a key area of policy focus, young people defined as NEETs (Not in Employment, Education or Training) represent an interesting and representative target group in lifelong learning. Based on the existing rich literature, and discussions within the consortium, NEET programmes were selected as an example for building and demonstrating the decision support system. In future, systems can be built using similar methodologies for other target groups.

Research finding A. A unified template facilitates effective documentation of rich knowledge in policy making practice. At present documents take diverse forms and often lack sufficient detail.

Along with the analysis on the existing documentations in the ENLIVEN consortium, we collected data on interventions addressing NEETs in different countries. The sources of documentation we explored include the following:

- Eurostat: background information aggregated at country level
- CEDEFOP VET toolkit for tackling early leaving database and database of Management Practice
- Government departments / agencies and third sector funders in the UK (England, Northern Ireland, Scotland, Wales)
- CEDEFOP Fields of Training Manual: subject classifications Eurostat: Regions in the European Union Nomenclature of territorial units for statistics
- NUTS 2013/EU-28: Country code, European Commission qualification frameworks.
- EXCEPT project (Horizon 2020: <http://www.except-project.eu/>)

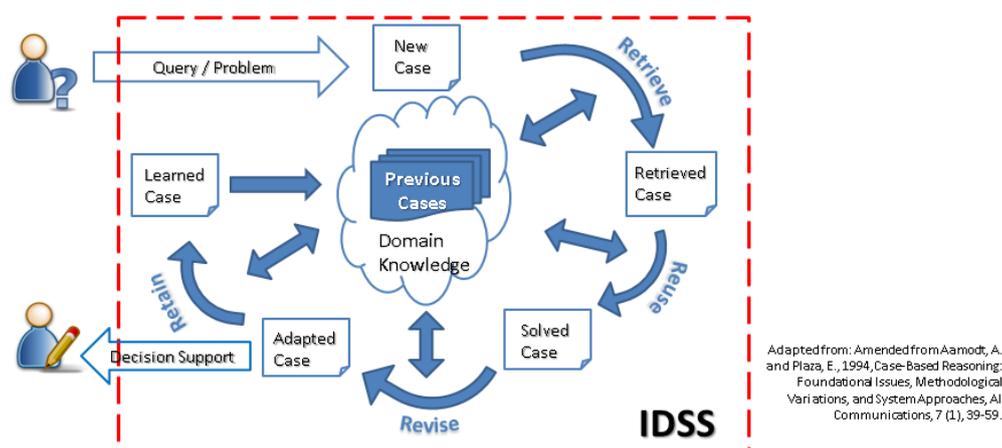
We found that while many policy documents have been archived over the years, quite often they are in highly diverse forms: databases, documents, web sites, brief summaries, free text descriptions, etc. In most of the sources, insufficient detail is documented to provide useful information for future decision making in similar scenarios.

However, some of the sources explored do contain useful information and knowledge. The following contain sufficiently extensive detail to inform knowledge extraction, and we have therefore processed and stored these in the IDSS.

- The STYLE database: a database of youth employment measures created by the STYLE (Strategic Transitions for Youth Labour in Europe) project (<https://www.style-research.eu/>). This database is well structured with relevant attributes, such as programme aim, target group, programme activities, duration, numbers of beneficiaries, and also contains intervention outcomes, evaluations and source data references.
- Black Country Talent Match Annual Report 2016. Talent Match Young and Successful: survey data of young people from the Talent Match programme for Derbyshire and Nottinghamshire, UK, provided by practitioners and used to inform attributes for the case base.
- A survey of programme providers undertaken by ENLIVEN¹
- Evaluation of the Day One Support for Young People Trailblazer, November 2014, UK Department of Work and Pensions. This is the most complete programme evaluation located. It contains a profile of programme participants, their barriers to work, and the outcomes resulting from attending the programme. The outcomes analysed are both “hard” (number of participants with increased job search activity and finding paid work) and “soft” (increased self-confidence, confidence relating to employment).

In an IDSS, knowledge is usually modelled and stored in the form of rules or cases to assist future decision making in the same or similar scenarios. The IDSS developed by ENLIVEN has focused on NEETs, to demonstrate intelligent decision support for policy making can address a key issue in lifelong learning. As shown in Figure 1, at the centre of the IDSS is a “case base” which stores previous interventions on NEETs as cases. Knowledge from the policy domain is thus modelled in the IDSS to support future decision making. When a new problem or query is input by a user as a new case, the IDSS retrieves the most similar cases for the user, who can then make an informed decision by reusing or revising them. The adapted new cases can be “learned” by the IDSS to improve decision making in future similar scenarios.

Figure 1. A schematic diagram of an IDSS



The IDSS has been built step by step, addressing in the process a number of research issues. These include case representation (a unified template to store the NEETs programmes), and a similarity measure (which assesses similarity between cases so the most useful ones can be retrieved for decision making).

A unified case representation template is needed to represent programmes in the IDSS. Even the documentation of interventions which contain rich detail often lack a commonly used universal

¹ <https://h2020enliven.org/2017/07/17/info-tool-guide-neet-policy-decisions/>; online from July 2017.

template to facilitate sensible comparisons between interventions and support policy decision making . This is, of course, understandable in the light of the broad range of interventions across a range of different countries, and their different aims, activities and target groups.

To address this, a list of 78 attributes has been collected within the consortium through several rounds of workshop discussions. The resulting new unified universal template (with fields of 78 attributes) stores details of interventions, and models knowledge in policy making for NEETs. A total of 77 interventions have been processed and stored as cases in this IDSS unified template (as of September 2018). A further set of 37 cases is being processed, and will be added in the next stage.

There are also weaknesses in the evaluation of programme outcomes. Where such evaluations exist, they are generally inconsistent. This is a known problem² but little action has been taken to address it. There is a need to assess the most appropriate evaluation techniques for this type of data (for which precise numerical outcomes are difficult to achieve), and to learn from evaluation techniques employed in other social science disciplines such as healthcare.

A similarity measure has been built to assess the similarities between cases. This uses a range of knowledge acquisition and data mining techniques. Among the 78 attributes, four (Locations, Target groups, Aims and Activities) have been identified as key for decision making. For each of these key attributes, categories are extracted as their possible values in different cases. By using clustering and knowledge acquisition, similarities have been obtained between different category values . These are used to calculate the overall similarity between programmes in the IDSS.

The IDSS, now established with a preliminary user interface, will be extended and used to acquire more knowledge; it will be enhanced step by step in the next stage of the project.

Research finding B. Knowledge acquisition across disciplines in building intelligent systems in policy making presents a research challenge and opens interesting future research directions.

Knowledge discovery is always challenging in building an IDSS, especially for complex problems where knowledge is difficult to model, such as policy-making. Based on our research findings, especially the category typology and country-based analysis and knowledge acquisition, 78 attributes (including four key attributes) have been used to assess similarity between interventions.

One of the cases collected (the Talent Match programme) has been intensively analysed using the decision tree approach. This has generated insights into NEETs programmes and demonstrated the value of data mining techniques in building the IDSS. The analysis aims to determine underlying barriers to employment faced by young NEETs using a “Distance to labour market” measure created by Sheffield Hallam University³. This considers how likely a young person is to be in work given their characteristics, experiences and capabilities. The decision tree approach is a key data mining techniques in machine learning; it shows we can effectively extract key features and identify the strongest predictors of employment outcomes (Palmer et al. 2018b).

² Mawn, L., et al. (2017) Are We Failing Young People Not in Employment, Education or Training (NEETs)? A Systematic Review and Meta-Analysis of Re-Engagement Interventions. *Systematic Reviews* 6: 16. PMC. Web. 28 Mar. 2017.

³ Sanderson, E. & Wilson, I. (2015) *Talent Match Evaluation and Learning Contract: 2013-19 - Common Data Framework: Annual Report*. <https://www4.shu.ac.uk/research/cresr/sites/shu.ac.uk/files/tm-cdf-annual-report-2015.pdf>.

The IDSS we have developed, with its unified representation of programmes, presents an excellent platform for future research to extract extensive knowledge using artificial intelligence data mining techniques.

POLICY IMPLICATIONS AND RECOMMENDATIONS

Recommendation A. A consistent standard of documentation within a coherent framework across countries for future development in research and practice.

The rapid development of intelligent systems across many applications makes pressing demands for the large amount of data collected to be archived and used in coherent and efficient ways for future research and practice. Current policy making documents and related literature do not record documentation and data collection on interventions in a coherent or consistent template. Building and establishing a standard for data recording at the EU level is crucial if the rich knowledge is to be extracted from practitioners and policy makers and used in future decision making.

ENLIVEN has demonstrated such a standard, using a unified template to represent and model various NEET interventions. The same methodology could be extended and applied to other programmes with different target groups or aims across different countries.

The current literature includes no framework, applicable across different countries and locations, incorporating clearly defined stages of the policy making process (associated with the corresponding policy makers and stakeholders). Building a consistent framework, or frameworks, presents a challenging task. It would, however, be highly valuable for practice and research, as well as providing a standard framework for future IDSS development.

Recommendation B. More research schemes supporting inter-disciplinary research within a standardised infrastructure.

Current literature suggests a lack of research at the interface of education and computer science. ENLIVEN presents an exemplar of novel, inter-disciplinary research across two, usually isolated, disciplines, and shows that good progress can be made generating significant research findings and insights. It is important to establish effective infrastructure which will support cross-disciplinary research, and to facilitate and sustain efficient future research collaboration nationally and internationally, to enhance decision making.

RESEARCH PARAMETERS

The ENLIVEN research models how policy interventions in adult education can become more effective. Different work packages focus on the role of governance and policy, participation, workplace learning and adults' well-being. It implements and evaluates an innovative Intelligent Decision Support System and provides a new and more scientific underpinning for policy debate and decision-making on adult learning, especially for young adults. The project investigates these lifelong learning aspects through quantitative and qualitative analyses.

PROJECT IDENTITY

PROJECT NAME	Encouraging Lifelong Learning for an Inclusive & Vibrant Europe (ENLIVEN)
COORDINATOR	Professor John Holford University of Nottingham, Nottingham, England, United Kingdom john.holford@nottingham.ac.uk
CONSORTIUM	University of Nottingham – Nottingham, England, United Kingdom 3s Unternehmensberatung GmbH – Vienna, Austria Bulgarian Academy of Sciences, Institute for the Study of Societies and Knowledge – Sofia, Bulgaria KU Leuven/University of Leuven, Leuven – Belgium Slovak Academy of Sciences, Centre of Social and Psychological Sciences – Bratislava, Slovakia Tallinn University/Tallinna Ülikool –Tallinn, Estonia Universidad de Deusto – Bilbao, Spain University of Edinburgh – Edinburgh, Scotland, United Kingdom University of Melbourne – Melbourne, Australia University of Verona/Università degli Studi di Verona – Verona, Italy
FUNDING SCHEME	European Union Horizon 2020 Framework Programme for Research and Innovation (2014-2020) – Societal Challenge 6 – Europe in a changing world: inclusive, innovative and reflective societies”, call YOUNG-3-2015, topic “Encouraging Lifelong Learning for an Inclusive and Vibrant Europe (ENLIVEN)” Grant Agreement No. 693989
DURATION	October 2016 – September 2019 (36 months).
BUDGET	EU contribution: €2 499 788.50
WEBSITE	https://h2020enliven.org/
FOR MORE INFORMATION	Contact: Professor John Holford john.holford@nottingham.ac.uk Contact: Ruth Elmer ruth.elmer@nottingham.ac.uk
FURTHER READING	<i>Related ENLIVEN publications:</i> <ul style="list-style-type: none">▪ Claire Palmer, Sharon Clancy, Richard Hazledine, Rong Qu. (2018a) “Can Maslow’s Hierarchy of Needs illuminate the problems Young People Face in Finding Employment?”, under preparation, to be submitted to <i>Social Science Computer Review</i>.▪ Claire Palmer, Sharon Clancy, Richard Hazledine, Jason Atkin, Rong Qu. (2018b) “The Effect of the Young and Successful Programme on a young person’s proximity to the labour market”, under preparation, to be submitted to <i>IEEE Transactions on Computational Social Science Systems</i>.▪ Claire Palmer, Sharon Clancy, Jason Atkin, Rong Qu. (2018c) “The need for more evidence to enable the application of Artificial Intelligence to policy making for young people not in employment, education or training (NEETs)”, under preparation, to be submitted to <i>Journal of Computational Social Science</i>.