Computer-aided Decision Support for Policy Making in Lifelong Learning

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Intelligent Decision Support System – What is IDSS?

- An **IDSS system** “uses artificial intelligence, machine learning, taught algorithms and data analytics to help support decision-making in real-time, by setting out possible courses of action and evaluating the likely results of these proposed actions”. (Field, J. (2005) *Social Capital and Lifelong Learning*. Bristol: The Policy Press)

- A document-driven IDSS is a computerized support system that integrates a variety of storage and processing technologies to provide document retrieval and analysis.
Intelligent Decision Support System – What is IDSS?

• ENLIVEN IDSS - online at [http://enliven.cs.nott.ac.uk/](http://enliven.cs.nott.ac.uk/)
  – To provide a repository for existing programmes to
    • identify types of actions which have been previously employed
    • examine how similar programmes have worked
    • examine what measures have worked
    • enable their assessment against suitable criteria
  – To aid those making decisions on developing interventions and interested in offering programmes for young adults (particularly those from disadvantaged groups) to improve the transitions of young people into employment or education
  – To utilise collected projects to enable learning from the experience of others
ENLIVEN IDSS – Case-Based Reasoning

ENLIVEN IDSS – Case-Based Reasoning

• CBR

  – Assumption
    • Similar problems may have similar solutions, recommendations, advices, clarification, or interventions, etc.
  – Adapts previous solutions for similar problem in solving new problem
  – Experts offer advices based on previous cases
  – Stores domain specific knowledge as cases
  – Examples
    • Court legal reasoning, help desktop, design, and medical diagnosis, etc.
• Case Base
  – Methods
    • Workshops, text analytics (mining): analyse databases, case studies and surveys
  – Case representation template:
    • Intervention description: a list of attributes of values / categories, e.g. text, numbers, categories, etc.
    • Recommendation: interventions and good practice, etc.
    • Outcome: what happened after the solution is applied, i.e. evaluation
CBR in ENLIVEN IDSS – Developments

Data
Raw details of the interventions, often in free text

Database
List of data records stored in unified format

Case base
List of interventions stored in unified template of attributes

Knowledge base
- Interventions indexed by key attributes
- A similarity measure to retrieve useful interventions

User interface
- To take user input query in the form of attributes
- To output retrieved projects ordered by similarity

Query
Decision Support

Knowledge discovery on key attribute and similarity measure
• 222 interventions in the Case Base (September 2019) of 31 locations including UK, Australia, Canada, Netherlands, Italy, Spain, Belgium, Greece, Bulgaria, Slovakia, France, etc.
  – **CITISPYCE**: FP7 Project Repository of Case Studies([http://www.citispyce.eu/citispyce-repository-case-studies](http://www.citispyce.eu/citispyce-repository-case-studies))
  – **Case studies** supplied by ENLIVEN partners (Italy, Australia, Bulgaria)
CBR in ENLIVEN IDSS – Data Sources

- 222 interventions in the Case Base (September 2019) of 31 locations including UK, Australia, Canada, Netherlands, Italy, Spain, Belgium, Greece, Bulgaria, Slovakia, France, etc.
  - The STYLE database: database of youth employment measures created by the STYLE (Strategic Transitions for Youth Labour in Europe) project (http://www.style-research.eu/)
  - Government departments / agencies and third sector funders in the UK. For example, Evaluation of the Day One Support for Young People Trailblazer, 2014, UK Department of Work and Pensions. Contains a profile of programme participants, their barriers to work, and the outcomes resulting from attending the programme.
CBR in ENLIVEN IDSS – Case Base

- Case Base (September 2019)
  - 222 cases of 31 countries in an unified case template of 78 categorised attributes

Knowledge base of NEETs interventions

Knowledge
- Similarity measure
- Key attributes

IDSS
- Target group: young NEETs of 16-35 years old
- Interventions: regional levels in 31 countries incl. EU, Australia, Canada & USA
- End users: different types of stakeholders and practitioners at regional and country levels
### CBR in ENLIVEN IDSS – Attributes

#### Project Information Attributes
- Project Name
- Project Description
- Location (NUTS code)
- Aim
- Intervention Level 1
- Intervention Level 2
- Funders
- Provider types
- Cost
- Intervention **target** sector
- NEET attributes: Age, Barriers
- Intervention size, start and end date & length
- **Main Activities** of the Intervention
- Learning Approaches Used
- Voluntary/ Sanctions applied

#### Project Participants Attributes
- % Age profile
- % Male
- % Female
- % by ethnicity
- % by religion
- % Married/co-habiting
- % Parents
- % Lone parent
- % by social class
- % Work experience
- % Unemployment period
- % Disabled
- % by qualification level
- % Migrants

#### Project Outcome Attributes
- % Participant completion rate
- % Participant gaining employment
- % Participants gaining a qualification
- % Participants securing a formal educational course
- % of Participants attending at least one job interview
- % of participants securing a work placement/apprenticeship
- % of participants more optimistic about finding a job
- % of participants reporting a gain in confidence

**Extra Survey Attributes**
- Participant attributes associated with successful outcomes? Reasons for saying this?
- Value for money?
- Improvements?
## CBR in ENLIVEN IDSS – Attributes

<table>
<thead>
<tr>
<th><strong>Personal</strong></th>
<th><strong>Individual</strong></th>
<th><strong>Age-related</strong>, e.g. Young people who are unemployed, Young people with secondary education, Young carers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Disability/Health</strong>, e.g. Physical disability, Learning disability</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Educational</strong>, e.g. Early school leavers</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Additional Social disadvantage</strong>, e.g. Homeless, Care leavers, Lone parent</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Ethnicity</strong>, e.g. Ethnic minority, Refugees/asylum seekers, Gypsy/travelling</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Gender</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Structural</strong></th>
<th><strong>Institutional</strong>, e.g. Transport barriers, People living in deprived areas/disadvantaged communities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Labour Market</strong>, e.g. Lack of jobs locally, Job seekers allowance claimant, Unemployed</td>
<td></td>
</tr>
</tbody>
</table>

<table>
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<th><strong>Cultural</strong></th>
<th><strong>Workless households, Low income families, Chaotic family background, Lower socio-economic backgrounds</strong></th>
</tr>
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</table>

| **Social Welfare** | e.g. access to support disabled people |

YaS programme used to identify issues relating to barriers and access to work, education and training within Bounded Agency model.
Program Name: Upgrade
Program Aim: Teaching programmes to enable people wishing to enter a VET programme but who do not have the required grades.
Location: Hovenstaden (including Copenhagen) DK01
Program Level 1: Regional
Program Level 2: Urban
Provider types: Public
Intervention Length: 7-14 weeks
Main activities of Intervention: Vocational Education and Training
Learning Approaches used: Teaching of English, Maths and Personal Competencies
Intervention target sector: Basic skills
Cost: No information provided
Participant completion rate: 65 people completed out of 69 who had signed up (94 %)
CBR in ENLIVEN IDSS – Similarity Measure

- The similarity is calculated per attribute (target, aim, activity, location) and then aggregated.

- Each attribute similarity (e.g. similarity of Aim between input vs. and source cases) is calculated using an expert-driven similarity matrix.

<table>
<thead>
<tr>
<th>AIM SIMILARITY</th>
<th>Education/Training</th>
<th>Employability</th>
<th>Direct Support Measures</th>
<th>Work Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education/Training</td>
<td>1</td>
<td>0.6</td>
<td>0.8</td>
<td>0.4</td>
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\[
S' \text{: source case; } I \text{: input case; Similarity}(I, S) = w_1 \times sim_{tg}(I, S) + w_2 \times sim_{aim}(I, S) + w_3 \times sim_{act}(I, S) + w_4 \times sim_{loc}(I, S)
\]
ENLIVEN IDSS – Interactive Online Tool

http://enliven.cs.nott.ac.uk

Key attributes
Search parameters
Importance weights
Search results

\[ S': \text{ source case; } I: \text{ input case} \]

\[
\text{Similarity}(I, S) = w_1 \times \text{sim}_{tg}(I, S) + w_2 \times \text{sim}_{aim}(I, S) + w_3 \times \text{sim}_{act}(I, S) + w_4 \times \text{sim}_{loc}(I, S) \]
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Findings:

- **ENLIVEN IDSS**: prototype system with interactive interface to take in new cases / knowledge; Intelligent systems in policy making presents a research challenge and opens interesting future directions in research and practice.
- A **unified template**: effective documentation of knowledge in policy making in practice, which at present is in scattered forms and often lack of enough details
- **Similarity measure**: key cases attributes for meaningful comparisons between cases

Recommendations:

- A **taxonomy** (e.g. semantic networks: graphs of related concepts with labelled relationships) to allow for meta-analysis and building templates and similarity measure with a **common vocabulary**
- **Evaluation**: different (top-down vs. bottom up) methods at different EU countries

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**Work Experience Programme UK**
- a net benefit of ~ £1,950 per participant;
- a neutral impact on employers;
- a net benefit to society of ~ £2,050 per participant;
- and a net benefit to the Exchequer of ~ £150 per participant.

**Guarantee for Youth France**
- Target group 94% are NEETs & 80% have no or low qualifications BUT unable to reach unregistered NEET
- 29% had found a job after the measure (12 months)
- 14% had entered a training programme

**Youth Unemployment Free Netherlands**
- Employment (after 1 month) is 52%
- Some 77% are in employment which matches their qualification level & 60% are in employment which relates to the content of their education.
IDSS in Policy Making – Questions?