

# Scientific Laboratory of Interdisciplinary Research in Education: Examples of Pedagogical Studies with Math Methods Use



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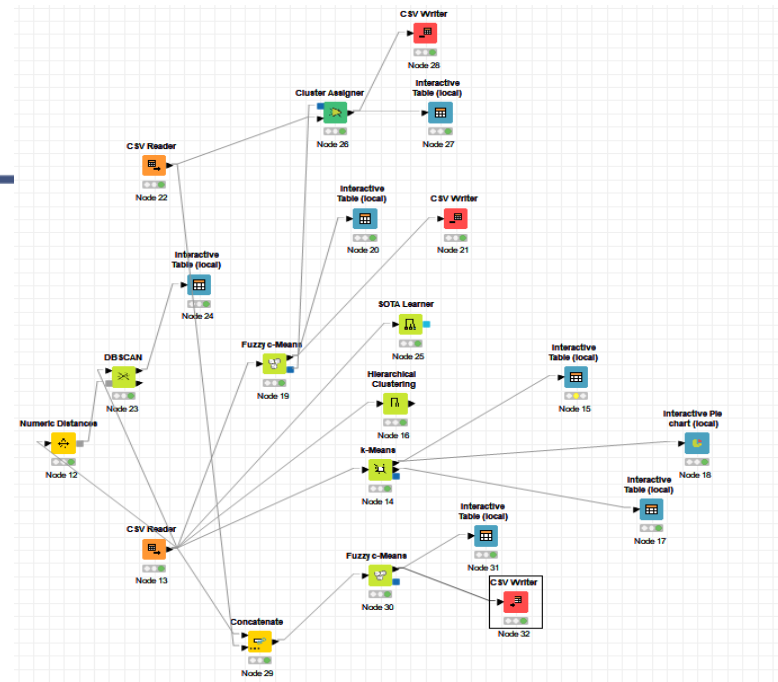
**Head of Scientific Laboratory of Interdisciplinary Research in Education**

# Ethical Using Issues of Digital Intellectual Support Technologies in Professional Training

The characteristics of electronic educational resources are proposed based on students' activities: efficiency of assistance as a characteristic opposite to independent search, practicality as a presentation of solutions, specificity as focus on the task, completeness as the systematic nature of the material. A questionnaire was compiled on the use of electronic educational resources with different characteristics, including open online learning platforms, master classes on video hosting sites, electronic educational resources on the university website, chats on professional sites, student chats, student sites, educational chat bots, voice assistants, intelligent support chatbots.

The clustering method was used to identify groups of students based on a survey of the use of electronic educational resources of different types, for each group a description of the characteristics according to the methods of learning was given, and the correspondence was made with the type of indicative activity in preparation for control events.

The relationship between the indicative basis for performing practical, professionally oriented tasks by university students and the attitude towards the ethics of using digital technologies for intellectual support in the educational process has been identified.



## Cluster Centers

0: 0.97300252944898, 0.1321545089061175, 0.0816881620757647, 0.2342300860624993  
 1: 1.812122634708395, 1.8026226029392, 1.76626172065747, 1.207557797043834  
 2: 1.68258899478458, 0.4260557271483332, 1.086657210653889, 1.966280897327143  
 3: 0.903751507019978, 0.183746020713611, 1.019604358820046, 1.124915822464925  
 4: 2.75071902552429, 3.52124571528372, 2.67400996804445, 2.63863869482671

## WithinClusterVariations:

Cluster 0: 0.8456938615922133  
 Cluster 1: 1.434632763768545  
 Cluster 2: 1.094092965994777  
 Cluster 3: 0.5872830413899245  
 Cluster 4: 1.3888775262296416

**BetweenClusterVariation:** 6.655191490714171

**Partition Coefficient:** 0.48142639455446073

**Partition Entropy:** -1.0386568558964013

**XieBeni Index:** 1.1980653722668537

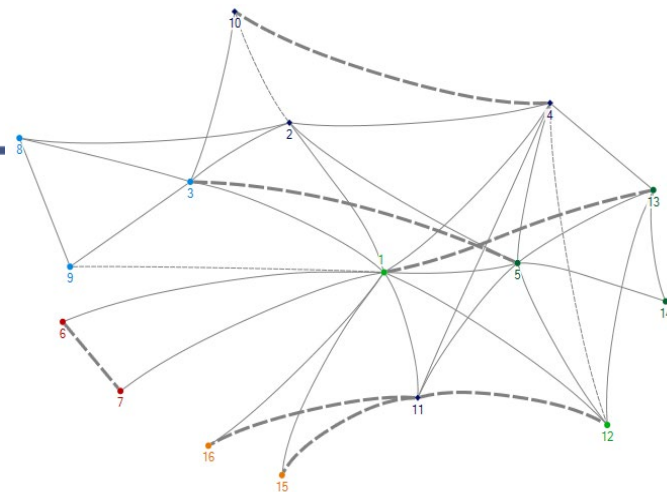
**Fuzzy Hypervolumes:** Cluster 0: 7.725830168991048E-5,  
 Cluster 1: 8.200383407488844E-4, Cluster 2: 4.336906922537835E-4,  
 Cluster 3: 1.2494421266961216E-4, Cluster 4: 8.485699640513354E-4

# Network Modeling of Blended Communications in the Community of Project Teams of Students

It is effective to maintain university communities of interacting project teams to develop the vocational and soft skills of students. Lecturers can organize communities at longitude creative workshops, but monitoring of agile students' teams with high structural dynamics is very time-consuming. A significant contribution can be the integration of the following technologies: pedagogical (collaboration based on social constructivism), communicative (hybrid practices in knowledge and information flows), managerial (horizontal and vertical connections in agile teams), informational (cloud services).

For solving these problems, social network analysis and modeling can be applied. Ties types are Formal or Informal. Vertical or Horizontal. Knowledge or Information based. Blended or Distant, and Stable or Unstable. Communicating sequential processes is considered as a model of formal joint activities in projects.

The issues are the identification and dynamic construction of a didactically stable network, transformation of weak and Unstable ties into Stable strong ones, monitoring, and creation of new Knowledge-based ties in formal and informal communications. We discovered that Formal Distant Information-based ties led to unstable connections and then focused on the formation of Stable ties in triads where they are absent or Unstable.

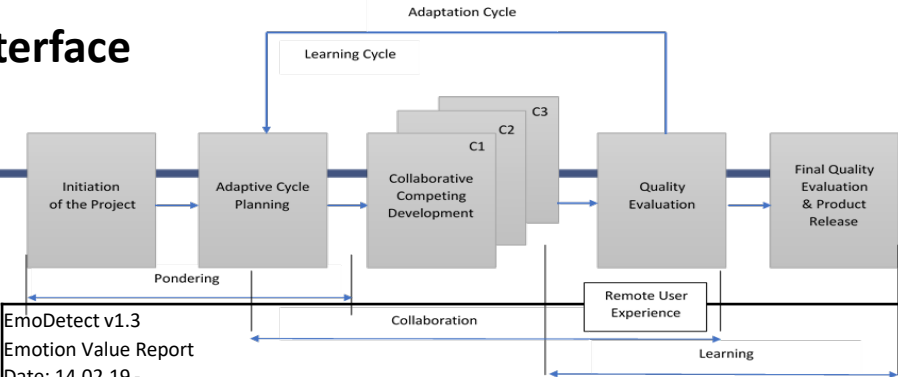


| Vertex | Degree | Betweenness Centrality | Main team | Formal vertical functions | Unstable ties |
|--------|--------|------------------------|-----------|---------------------------|---------------|
| 1      | 12     | 52.33                  | 0         | Yes (Head)                | 2             |
| 2      | 6      | 8.00                   | 2         | Yes (Coordinator)         | -             |
| 3      | 6      | 8.42                   | 1         | Yes (Leader)              | -             |
| 4      | 7      | 7.58                   | 2         | Yes (Leader)              | 1             |
| 5      | 8      | 13.25                  | 3         | Yes (Leader)              | -             |
| 6      | 2      | 0.00                   | 4         | Yes (Leader)              | 1             |
| 7      | 2      | 0.00                   | 4         | No                        | 1             |
| 10     | 3      | 0.25                   | 2         | No                        | -             |
| 13     | 5      | 3.75                   | 3         | No                        | -             |
| 8      | 3      | 0.33                   | 1         | No                        | 1             |
| 9      | 3      | 2.17                   | 1         | No                        | 3             |
| 11     | 6      | 4.67                   | 2         | At times (tutor)          | 1             |
| 12     | 5      | 0.25                   | 0         | Yes (Expert)              | 1             |
| 14     | 2      | 0.00                   | 3         | No                        | 1             |
| 15     | 2      | 0.00                   | 5         | No                        | 1             |
| 16     | 2      | 0.00                   | 5         | No                        | 1             |

# Unstable Teams: Management of Remote User Interface Evaluation in Adaptive Software Development

The purpose is to discuss the modified model of Adaptive Software Development (ASD) complemented with interface evaluation procedures in the conditions of development by unstable development teams with remote participation and the possibilities of experimental implementation of the model. We propose to add each iteration of the ASD model with autonomous tasks for remote evaluation of the user interface, which are carried out by remotely involved performers. Methods may include behavioral and psychophysiological metrics based on eye-tracking and emotion detection in remote user experience.

We justify the effectiveness of experimental verification of the model for remote teams of students undergoing software development training using modified ASD methodology. As a result, the additional problem of ensuring sufficient selection of qualified users for evaluating professional projects interface with behavioral and psychophysiological methods can be solved: the possible way is to involve students undergoing software development training and performing remote autonomous tasks within unstable professional teams.



EmoDetect v1.3  
Emotion Value Report  
Date: 14.02.19-13:08:19.599  
Video File: 2019.02.14-12.42.20.avi  
Video frame rate: 24  
Video duration: 13000ms  
Gender: male  
0,20

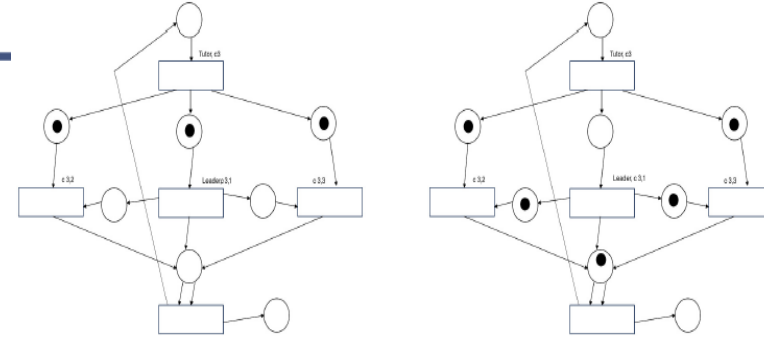
| #      | time | neutral | happy  | sadness | anger  | disgust | surprise | fear   |                |
|--------|------|---------|--------|---------|--------|---------|----------|--------|----------------|
| 00     |      | 0.814   | -0.052 | 0.037   | -0.121 | -0.079  | 0.009    | 0.002  | neutral        |
| 141    |      | 0.814   | -0.052 | 0.037   | -0.121 | -0.079  | 0.009    | 0.002  | neutral        |
| 283    |      | 0.814   | -0.052 | 0.037   | -0.121 | -0.079  | 0.009    | 0.002  | neutral        |
| 3125   |      | 0.601   | 0.164  | 0.012   | -0.008 | -0.203  | 0.067    | 0.000  | neutral        |
| 4166   |      | 0.601   | 0.164  | 0.012   | -0.008 | -0.203  | 0.067    | 0.000  | neutral        |
| 5208   |      | 0.490   | 0.273  | -0.034  | -0.178 | 0.002   | 0.073    | 0.039  | neutral        |
| 6250   |      | 0.507   | 0.235  | -0.055  | -0.231 | -0.222  | 0.075    | 0.027  | neutral        |
| 7291   |      | 0.507   | 0.235  | -0.055  | -0.231 | -0.222  | 0.075    | 0.027  | neutral        |
| 8333   |      | 0.468   | 0.302  | -0.017  | -0.267 | -0.168  | 0.047    | 0.000  | happy          |
| 471958 |      | 0.555   | 0.128  | 0.060   | -0.235 | 0.006   | 0.023    | -0.033 | neutral        |
| 482000 |      | 0.485   | 0.329  | -0.057  | -0.250 | -0.145  | 0.030    | 0.006  | happy          |
| 492041 |      | 0.485   | 0.329  | -0.057  | -0.250 | -0.145  | 0.030    | 0.006  | happy          |
| 502083 |      | 0.179   | 0.380  | -0.241  | -0.513 | -0.360  | 0.226    | 0.134  | surprise happy |
| 512125 |      | 0.179   | 0.380  | -0.241  | -0.513 | -0.360  | 0.226    | 0.134  | surprise happy |
| 522166 |      | 0.347   | 0.217  | -0.049  | -0.401 | -0.156  | 0.110    | 0.034  | neutral        |
| 532208 |      | 0.347   | 0.217  | -0.049  | -0.401 | -0.156  | 0.110    | 0.034  | neutral        |
| 542250 |      | 0.347   | 0.217  | -0.049  | -0.401 | -0.156  | 0.110    | 0.034  | neutral        |

# Communicating Processes Simulation in Agile Management for Student Teams Projects of Software Development

The implementation of projects with structural dynamics by student teams, as unstable professional teams, requires agile management of blended interactions in conducting tasks timely by participants. The mechanism of communicating sequential processes (CSP) is one of the ways to model concurrent and distributed processes. The experimental work on student projects management in software development showed that CSP model can be applied rather effectively in the management of individual and group project tasks. Parallelism in this model is manifested in the possibility of simultaneous execution of distributed tasks by different participants. The disadvantage of CSP model is difficulty to conduct global analysis and monitoring in the practical management of several projects.

CSP model allows transformation into Petri nets, which can also be used to manage student teams' work. The disadvantage of Petri nets for team projects, on the contrary, is the impossibility of delimiting the tasks of the personal responsibility of the participants.

The possibility of combining two formalisms permits both to control and analyze the interaction of participants in joint project activities. In addition, software development learning with process modeling makes it possible to illustrate students' dynamic model application in social system automation.



$$P = ((c_1 \rightarrow c_2 \rightarrow P_1) ; ((c_6 | 0) \rightarrow P_2 \parallel (c_7 | 0) \rightarrow P_2) ; P_3 ; ((c_{14} | 0) \rightarrow c_{15} \rightarrow (c_{16} | 0) \rightarrow c_{17} \rightarrow c_{18} \rightarrow P_4 ; c_{24} \rightarrow (c_{25} | 0) \rightarrow c_{27} \rightarrow P_5 ; \text{Stop})$$

$$P_1 = (c_3 \rightarrow c_4 \rightarrow P_1 \parallel c_4 \rightarrow c_5 \rightarrow P_1)$$

$$P_2 = (c_8 \rightarrow c_9 \rightarrow (c_{10} \rightarrow (c_{11} | 0) | 0) \rightarrow P_2)$$

$$P_3 = (c_{12} \rightarrow c_{13} \rightarrow P_3)$$

$$P_4 = (c_{19} \rightarrow P_4 \parallel c_{20} \rightarrow P_4 \parallel (c_{21} | 0) \rightarrow P_4 \parallel c_{22} \rightarrow P_4 \parallel c_{23} \rightarrow P_4)$$

$$P_5 = (c_{27} \rightarrow P_5)$$

$P_i$  – stages of the main project  $P$ ;  $c_i$  – project tasks;  
'0' – empty process; 'Stop' – stopping; ';' – the sub-process composition;

' $\rightarrow$ ' – sequential execution; ' $\parallel$ ' – parallel execution; ' $|$ ' – alternative

# Thank you for the attention!

- Dudysheva E., and Solnyshkova O. Network modeling of blended communications in the community of project teams of students. *Lecture Notes in Networks and Systems*. Vol. 181. 2021. Pp. 347-364.
- Dudysheva E., and Zakharov P. The use of virtual and mixed reality environments in students' study of crystal models in solid body physics. *The Academic Journal of Moscow City University, Series "Informatics and Informatization of Education"*. Vol. 2 (52). 2020. Pp. 67-74. (in Russian).
- Solnyshkova, O., and Dudysheva E. Mobile technologies in blended learning of engineering students in digital measurements on geodetic. *2020 5th International Conference on Information Technologies in Engineering Education, Inforino 2020 - Conference Proceedings* : 5. Moscow, 2020. P. 9111810.
- Dudysheva E., and Solnyshkova O. The potential of universities as resource centers in the agile teacher training for organizing STEM projects for school students. *AIP Conference Proceedings : Proceedings of the II International Scientific Conference on Advances in Science, Engineering and Digital Education: (ASEDU-II 2021)*. Vol. 2647. Krasnoyarsk: AIP PUBLISHING, 2022. P. 030027.
- Dudysheva E., and Lopatkin N. Practice-oriented modules in physics and informatics teachers training in educational technopark environment. *AIP Conference Proceedings : Proceedings of the III International Scientific Conference on Advances in Science, Engineering and Digital Education: (ASEDU-III 2022)*. Krasnoyarsk: AIP PUBLISHING, 2023. (in press).
- Dudysheva E., and Skopin I. Unstable teams: Management of remote user interface evaluation in Adaptive Software Development. *2023 3rd International Conference on Technology Enhanced Learning in Higher Education (TELE)*. Lipetsk, Russian Federation, 2023. Pp. 104-108.
- Dudysheva E. About network parameters of learning community sustainability for project teams in professional training. *ABSTRACTS of the VII World Congress of Turkic World Mathematicians (TWMS Congress-2023)*. Turkestan, Kazakhstan, 2023. P. 357.
- Dudysheva E. Communicating processes simulation in agile management for student teams projects of software development. *ABSTRACTS of the VII World Congress of Turkic World Mathematicians (TWMS Congress-2023)*. Turkestan, Kazakhstan, 2023. P. 358.
- Dudysheva E., and Solnyshkova O. Ethical using issues of digital intellectual support technologies in professional training. *Scientific Journal "Modern High Technologies"*. Vol. 10. 2023. (in Russian, in press).