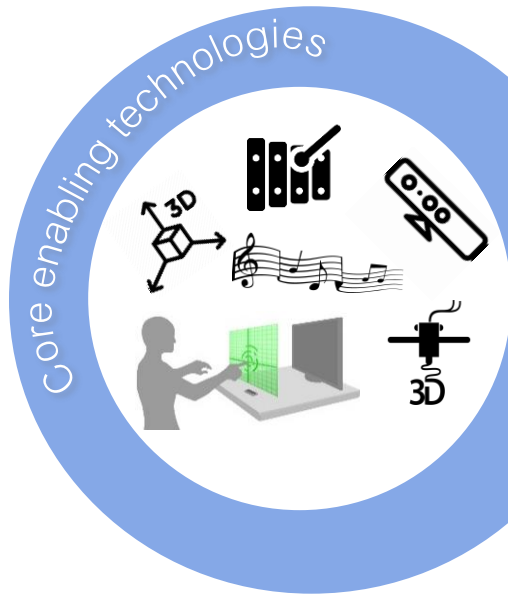


Tracking learner's activity/behaviour

Vassilis Katsouros (Athena RC, Greece)
**Foteini Simistira (University of Fribourg,
Switzerland)**



Develop and explore **original and innovative enabling technologies** for open co-creation tools in music activities to support **STEAM learning** fostering **creativity and innovation** through art and science.

- [drawme v0](#)

Learner's behaviour using biometric sensorial data

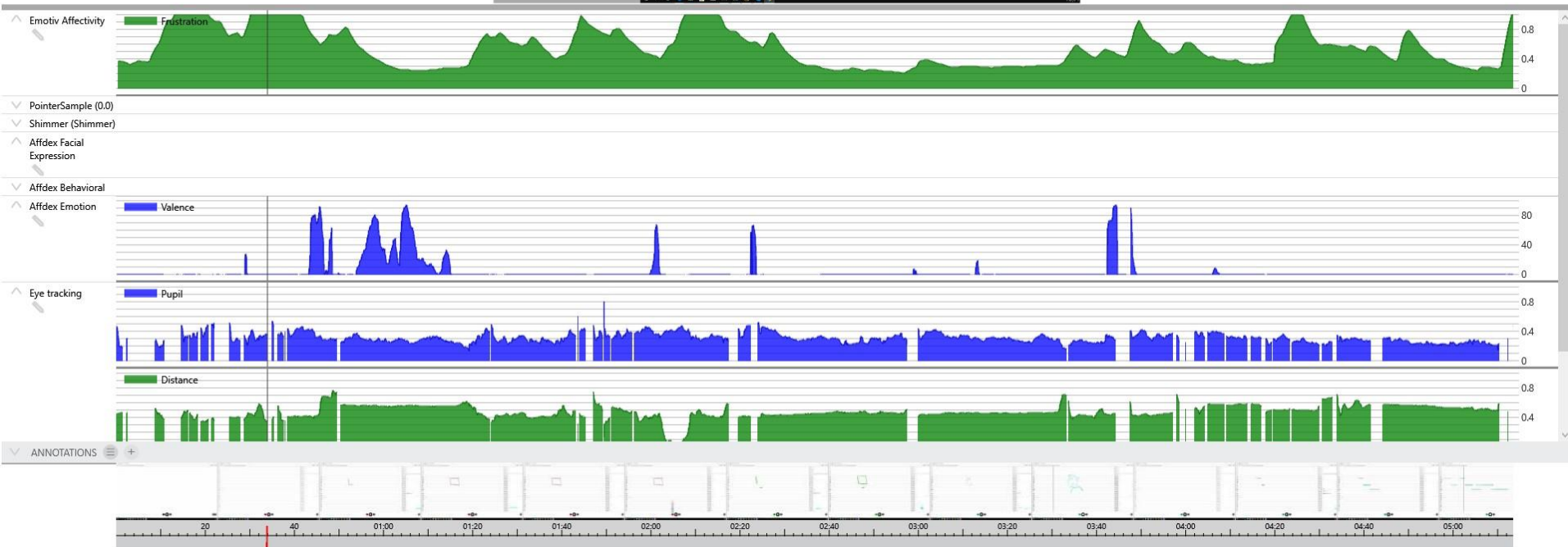
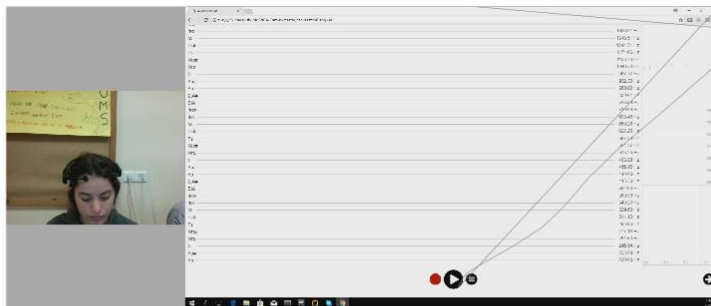
Student participants

- 15 years old
- Female (7)
- Male (9)

Research question

- How do students perform in a newly introduced learning environment
- Are there differences between male and female students?

Student performing the usability scenario for drawme in Greece



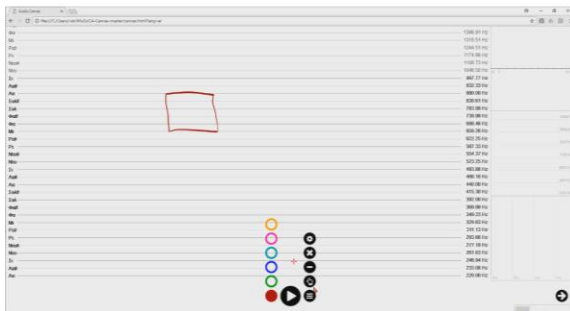
Stimulus: Drawing canvas for music creation | Exposure time: 04:10 | 15 Anonymous 22-11-17 12h27m | 00:34:038 Speed 1x

Tasks

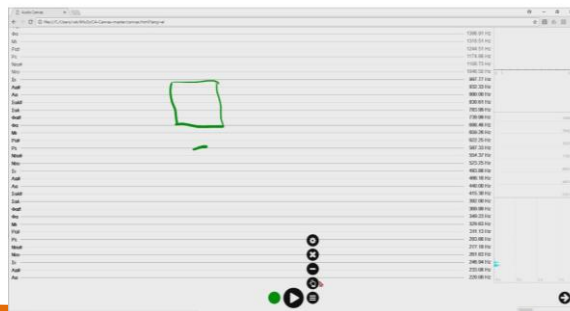
1. Use the dark red colour ink to draw a rectangle. Press the play button to hear it. Observe the graphs on the right.



2. Clear the canvas.



3. Change the colour of the ink into green perform steps 1-2.



5. Select the lock to grid (dash) and use different colours to write a melody with notes A, E and C#.



4. Choose the ink of your preference and use the canvas to make your own drawing. Clear the canvas.



Time required for each task

Task	Average (sec)		StdDev (sec)		Min (sec)		Max (sec)	
	Female	Male	Female	Male	Female	Male	Female	Male
Q1	42.60	33.62	17.91	10.15	22.49	24.30	68.58	58.68
Q2	19.35	18.28	10.09	9.51	7.56	10.16	37.17	35.77
Q3	33.22	36.41	9.21	11.39	21.89	25.19	49.32	56.18
Q4	51.83	43.99	8.73	22.32	34.67	25.32	59.96	90.16
Q5	76.97	62.99	28.49	26.39	41.51	40.02	121.84	115.55

- Male students are faster in all tasks but one (Q3)
- Female students were faster in task Q3 but slower in all other

Q1. Use the dark red colour ink to draw a rectangle.

Press the play button to hear it. Observe the graphs on the right.

Q2. Clear the canvas.

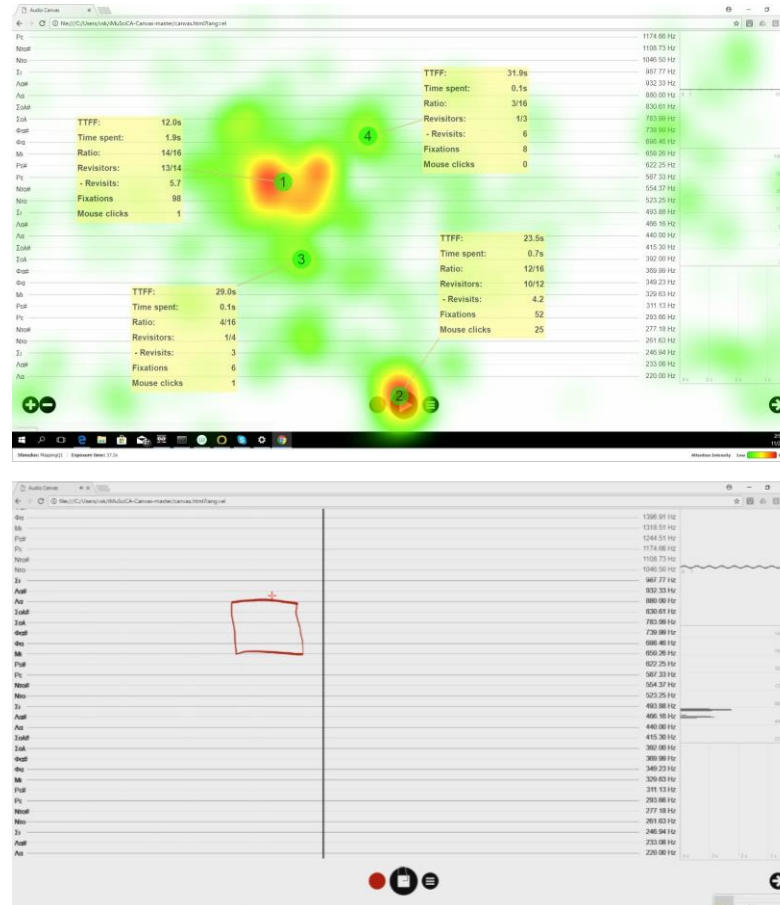
Q3. Change the colour of the ink into green perform steps 1-2.

Q4. Choose the ink of your preference and use the canvas to make your own drawing. Clear the canvas.

Q5. Select the lock to grid (dash) and use different colours to write a melody with notes A, E and C#.

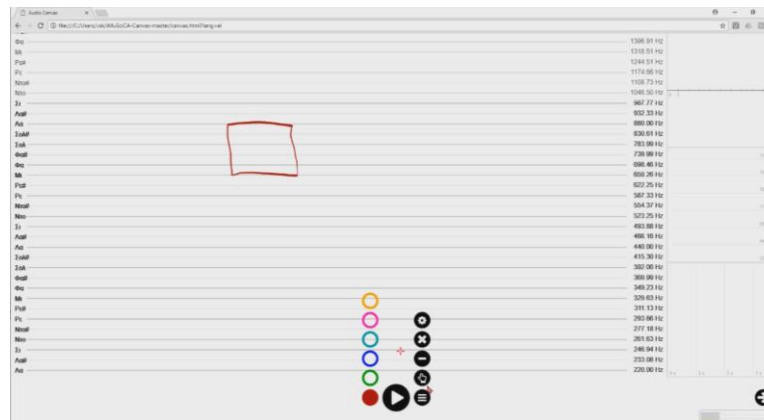
Heatmap

- **Q1.** Use the dark red colour ink to draw a rectangle. Press the play button to hear it. Observe the graphs on the right.



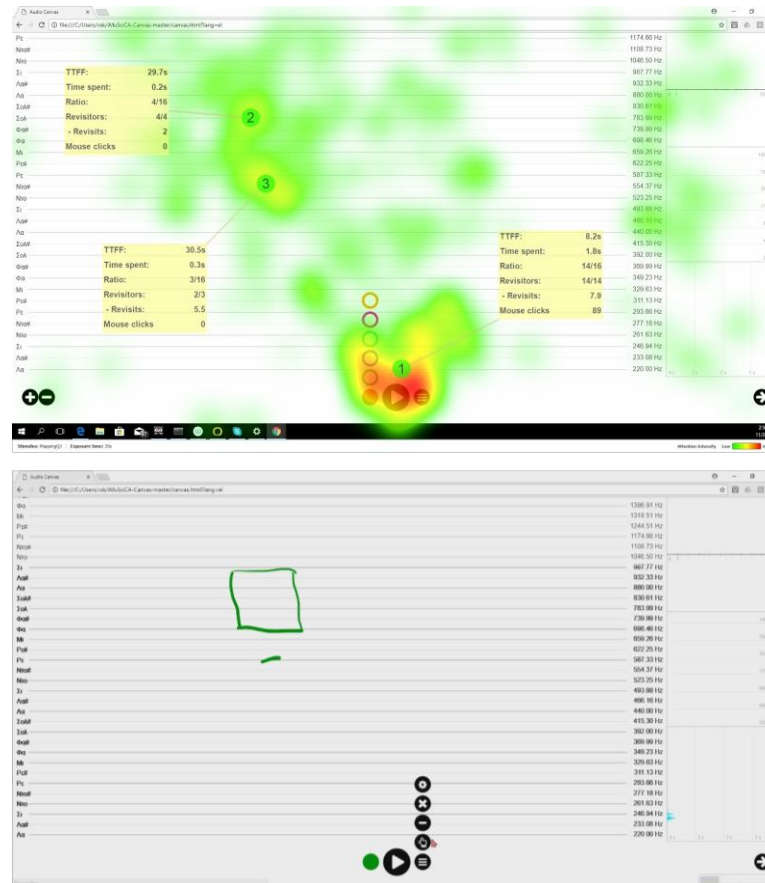
Heatmap

- Q2. Clear the canvas.



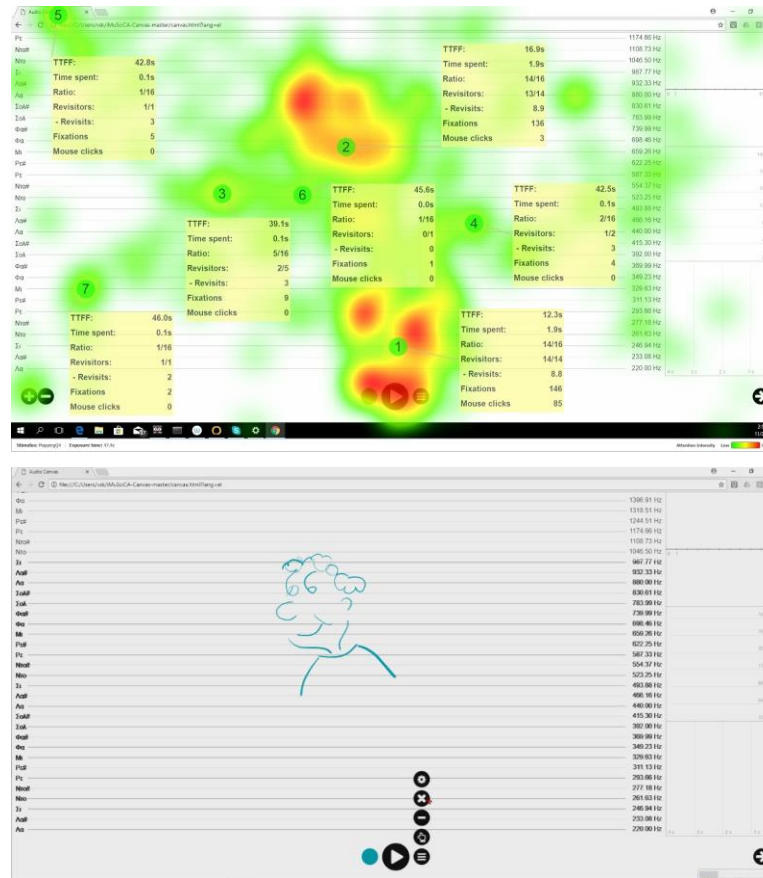
Heatmap

- **Q3.** Change the colour of the ink into green perform steps 1-2.



Heatmap

- **Q4.** Choose the ink of your preference and use the canvas to make your own drawing. Clear the canvas.




Heatmap

- **Q5.** Select the lock to grid (dash) and use different colours to write a melody with notes A, E and C#.



Eye tracking measures



All		
Task Labels	Pupil Dilation	Distance
Q1	0.540	0.360
Q2	0.470	0.585
Q3	0.404	0.505
Q4	0.473	0.424
Q5	0.438	0.613
Grand Total	0.463	0.500

- Q1 maximum pupil dilation / minimum distance -> high cognitive overload
- The values are normalized according to mean and standard deviation to [0,1]
- The average distance is: 671 mm and the average pupil dilation is: 19.57 mm

Q1. Use the dark red colour ink to draw a rectangle.

Press the play button to hear it. Observe the graphs on the right.






Q2. Clear the canvas.

Q3. Change the colour of the ink into green perform steps 1-2.

Q4. Choose the ink of your preference and use the canvas to make your own drawing. Clear the canvas.

Q5. Select the lock to grid (dash) and use different colours to write a melody with notes A, E and C#.

Eye tracking measures

Pupil Dilation								
	Average		StdDev		Min		Max	
Task	Female	Male	Female	Male	Female	Male	Female	Male
 Q1	0.555	0.539	0.116	0.227	0.314	0.022	0.807	1.000
 Q2	0.571	0.468	0.164	0.242	0.304	0.034	0.869	1.000
 Q3	0.536	0.401	0.178	0.200	0.223	0.040	0.937	0.988
 Q4	0.552	0.471	0.164	0.206	0.204	0.036	0.932	1.000
 Q5	0.501	0.436	0.162	0.211	0.114	0.029	0.872	1.000

- Q1.** Use the dark red colour ink to draw a rectangle.
Press the play button to hear it. Observe the graphs on the right.
- Q2.** Clear the canvas.
- Q3.** Change the colour of the ink into green perform steps 1-2.
- Q4.** Choose the ink of your preference and use the canvas to make your own drawing. Clear the canvas.
- Q5.** Select the lock to grid (dash) and use different colours to write a melody with notes A, E and C#.

Eye tracking measures

Distance								
Task	Average		StdDev		Min		Max	
	Female	Male	Female	Male	Female	Male	Female	Male
Q1	0.199	0.364	0.169	0.245	0.008	0.001	0.683	0.993
Q2	0.207	0.593	0.250	0.312	0.003	0.028	0.682	0.989
Q3	0.142	0.516	0.165	0.287	0.007	0.034	0.679	0.992
Q4	0.179	0.430	0.194	0.280	0.004	0.000	0.721	0.990
Q5	0.157	0.626	0.139	0.305	0.004	0.000	0.727	0.999

- Q1.** Use the dark red colour ink to draw a rectangle.
Press the play button to hear it. Observe the graphs on the right.
- Q2.** Clear the canvas.
- Q3.** Change the colour of the ink into green perform steps 1-2.
- Q4.** Choose the ink of your preference and use the canvas to make your own drawing. Clear the canvas.
- Q5.** Select the lock to grid (dash) and use different colours to write a melody with notes A, E and C#.

Facial expression analysis



Female												
Task	Anger	Sadness	Disgust	Joy	Surprise	Fear	Contempt	Engagement	Attention	Positive	Negative	Neutral
Q1	0.00	0.00	0.28	7.49	0.00	0.00	0.29	18.97	86.26	6.64	2.17	81.02
Q2	0.00	0.00	0.60	4.08	0.60	0.00	1.04	9.71	93.73	3.37	4.96	87.34
Q3	0.00	0.00	0.00	1.52	0.04	0.00	0.01	9.37	88.41	1.53	0.27	87.11
Q4	0.00	0.00	0.04	7.00	0.63	0.00	0.00	22.33	85.61	4.98	0.67	82.79
Q5	0.00	0.00	0.00	1.07	0.57	0.00	0.10	13.30	70.98	1.13	0.88	84.30



Male												
Task	Anger	Sadness	Disgust	Joy	Surprise	Fear	Contempt	Engagement	Attention	Positive	Negative	Neutral
Q1	0.00	0.00	0.03	4.09	0.00	0.00	0.74	9.18	95.93	4.07	2.46	89.76
Q2	0.00	0.00	0.00	0.00	3.23	0.00	1.47	9.69	98.52	0.00	10.64	89.26
Q3	0.00	0.00	0.01	2.05	0.30	0.00	0.92	7.39	92.86	1.89	4.93	87.17
Q4	0.00	0.00	0.03	1.43	0.24	0.00	1.73	10.08	93.46	1.47	2.09	92.92
Q5	0.00	0.05	0.02	0.57	1.07	0.00	2.25	6.00	78.78	0.53	0.36	83.15

- Overall, attention is high. The highest value encountered in task Q2 for both groups.
- Engagement is not strong
- Mostly neutral attitude

Galvanic Skin Response (GSR) summary scores

Task Labels	Average of Peaks/Min		
	Female	Male	All
Q1	8.81	9.42	9.15
Q2	13.32	9.27	11.04
Q3	10.3	7.21	8.56
Q4	13.96	6.96	10.02
Q5	15.68	7.61	11.14
Grand Total	12.41	8.09	9.98

- Male students are sweating emotionally less than the Female students in all tasks but the first one (Q1).
- Tasks Q4, Q5 are the most stressful for the Female students, where they show almost double value than the Male students.
- On the contrary tasks Q1 and Q2 are the most stressful for Male students, where the most stressful one task Q1 is the least stressful for the Female students.

Electroencephalography (EEG) measures


The frontal asymmetry index is calculated as the natural logarithm of the ratio of the alpha power on the right (F4) over the alpha power on the left (F3).



[Hagemann, Naumann, Thayer, & Bartussek, 2002](#)

[Harmon-Jones et al., 2010](#)

Electroencephalography (EEG) measures



	Frontal Asymmetry Index for electrodes AF4, AF3		
Task Labels	Female	Male	All
Q1	6.17	-1.04	2.11
Q2	5.49	-5.44	-0.66
Q3	5.21	-0.76	1.85
Q4	3.88	-0.62	1.35
Q5	3.78	-0.30	1.48
Grand Total	4.90	-1.63	1.23

- Female students show a more positive attitude and a motivation approach than male students
- Male students have an increased right frontal activity that corresponds to a negative attitude and a withdrawal approach, especially for task Q2. (They were faster and less stressed, though)

Summary

- This study:
 - Female students are more stressed
 - Female students have a more positive attitude
 - Clear button was difficult to find
 - Therefore: new version [drawme](#)
- Other study:
 - Students with music background are less stressed
 - Science students show a more positive attitude and a motivation approach than music students
- General
 - Good to use eye-tracking, time measure, and GSR
 - EEG was cumbersome, simple EEG would be enough
 - Pen did not give more insights

Follow up projects

- <https://ec.europa.eu/research/participants/porta/desktop/en/opportunities/h2020/topics/dt-transformations-07-2019.html>
 - The impact of technological transformations on children and youth
 - Focus on behavioral analysis
 - Idea: RIA on distance learning from home
 - Analyze them with **eye tracking**, **GSR**, face, maybe mobile EEG (educational partners and industrial partners really liked the knowledge gained with eye-trackers and GSR)
 - Team up? Olivier, Koichi, Andreas?

Thank you 😊