DIDACTICALLY CORRECT SENSORS FOR DIGITAL LABS

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Recent decade digital labs became wide-spread in chemical education. They introduce and visualize concepts that used to be abstract (such as pH) and introduce quantitative laws and patterns. However the sensors are developed rather by engineers than by teachers. Some of them are habitual technically but are not the best solution for didactics. Developing our digital labs Nau-Ra we based on learning tasks and developed sensors for them. As a result our system differs from the majority of other systems in several issues.

For quantitative characterisation of reactions with gas release we use a sensor of gas volume instead of gas pressure that is used in many labs. It is more visual, because students observe volume change. It is easier to process the results, because to calculate amount of a substance one needs to know only temperature (at 20°C amount (mol) = 24 χ volume (litre)), whereas using pressure – also gas volume in a vessel that. It is more safe because does not require excessive pressure in reaction vessels.

Another sensor that was developed basing on tasks is optical density sensors. Conventional sensors employ 3 ml cuvette that is put into a covered container. Students do not observe what is happening in the cuvette and they don’t form links between observable effect (colour) and its digital characteristics. They also can not add anything to a cuvette to see how the optical density changes. Our sensor is a gate that is put on an open 100 ml cuvette. The students can see what is happening in the cuvette and add to it whatever he wants. Sensor with immersion probe holder would be even better but expensive solution.

We also developed automatic burette based on syringe with plug shift measurement. It is more precise than conventional drop counters and allows varying rate of titrant adding from one drop per minutes to millilitres per second.

There are also problems that are not solved yet: water sensor for organic liquids (to research equilibrium of esterification), high-temperature sensors of combustible gases and its products (to research process of combustion), cheap polarimeters (to investigate optically active substances and reactions with them), *in situ* refractometers (to investigate organic reactions) cheap thermogravimetric system etc. So, developing sensors starting from learning task is still up-to-date problem.