DRUGS WITHIN A CONTEXT OF CHEMISTRY TEACHING

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INITIAL SITUATION

Due to the increasing prominence of the substance class of amphetamines, the primary goal of drug prevention is to provide young people with sufficient education and information. In Germany recent efforts show that the importance of addiction prevention has increased, that a large number of measures are implemented and that a wide variety of players are involved [1].

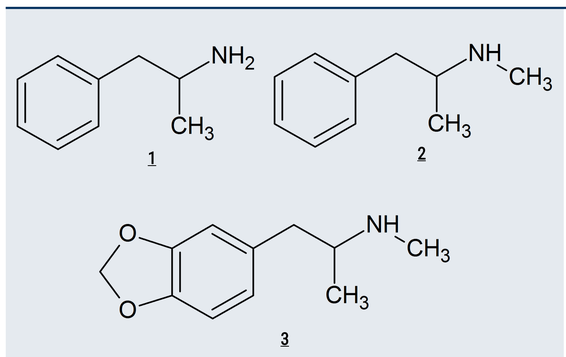

Figure 1:
Molecular structures of the drugs in focus: amphetamine (**1**), methamphetamine (**2**) and MDMA (methylenedioxy-*N*-methylamphetamine (**3**)

THE LEARNING SET

A total of ten stations was constructed according to certain criteria and can be assigned to different learning occasions (theoretical, experimental, creative, digital, playful). In addition to aspects of health education, the development is based on concepts of organic chemistry. Thus, basic chemical concepts such as the substance-particle concept, the structure-property principle and the concept of chemical reaction are focused on [2]. New knowledge about the structures, historical aspects, production possibilities, physiological effects and detection reactions of the substances can be acquired through methodically diversely prepared stations.

MODEL EXPERIMENTS

Stations 5 and 6 have a significant role, as they generate novel experimental approaches to rapid drug tests in the form of model experiments. In particular, at station 5, a carbenium ion as a key chemical structure which can stimulate process thinking based on reaction mechanisms is created (Fig. 3) [4].

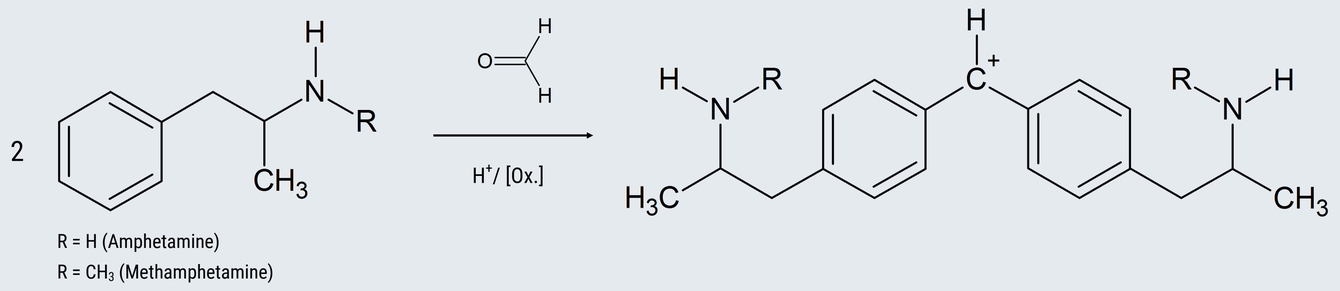

Figure 3:
Marquis reaction

When amphetamines react with a drop of Marquis reagent, which is composed of concentrated sulfuric acid and 40% formaldehyde solution and is located at the bottom of the glass vial, it becomes clear, that the produced carbenium ion is the cause of the color due to the newly formed conjugated system [5]. As a result of the color reaction, new possibilities are created to make the submicroscopic level tangible. In addition, the students gain insight into the police work involved in handling the rapid test from ESA-TEST GmbH of Eisenach in Thuringia (Fig. 4).

While amphetamine and methamphetamine produce a red-brown color reaction (Fig. 4), MDMA turns purple-black when mixed with the Marquis reagent. With the aid of freely available drugs in station 5 (here: Aspirin Complex with the active ingredients acetylsalicylic acid and pseudoephedrine hydrochloride), similar color reactions can be generated based on structural similarities. Station 6 is also based on the structure-property concept and enables desired color reactions through structure-like compounds. Here, primary amines (amphetamine) can be distinguished from secondary amines (methamphetamine, MDMA) using Simon's reagent [6, 7].

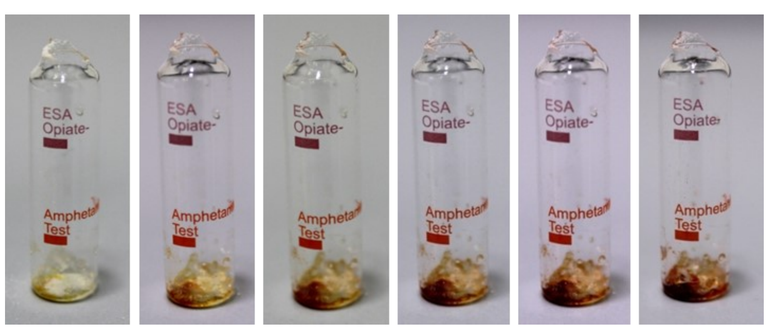

Figure 4: Course of the color reaction when adding amphetamine or methamphetamine to the Marquis reagent (from left to right: after 10, 30, 60, 120, 180 and 240 seconds); own photography (taken on 20.12.2017)

PARTICIPATIVE DIDACTIC ACTION RESEARCH

In order to transform the modern topic of amphetamines into teaching materials, teachers, students, non-university institutions (Eisenach Substance Analytics) and university disciplines from Jena (e.g. Institute of Macromolecular Chemistry and Organic Chemistry) were involved in the conception and optimization.

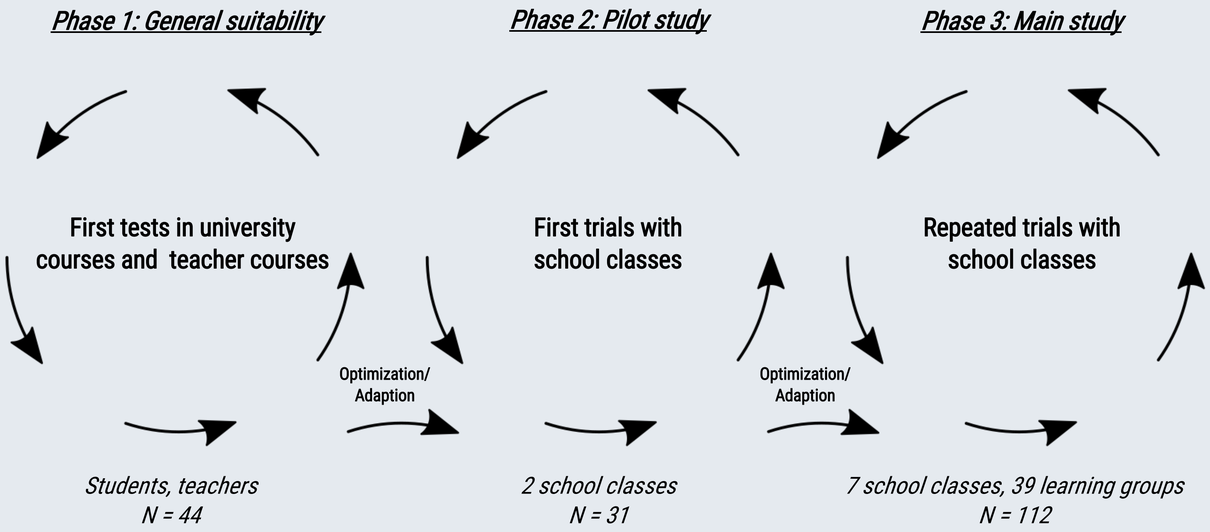

Figure 2:
Three phases of the own research process (own representation based on [3])

Other concepts such as didactic reconstruction, didactic transfer research, and curricular innovation research are incorporated into the development process. The goal was to conduct the developed stations with students aged 16 to 18 as part of a main study, to determine process-related competencies, and to identify program effects.

RESULTS & OUTLOOK

The materials have already been tested and evaluated several times with students and teachers. Initial results of a pilot study yielded positive feedback of the program and individual stations. In order to be able to make a contribution to drug prevention in Germany, the materials will be made available to students and teachers. The data evaluation of the main investigation will show whether this is an acceptance-oriented attractive learning arrangement.

Figure 5:
Teacher training in June 2019; own photography (taken on 20.06.2019)

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