Weinhandl, R., Mayerhofer, M., Houghton, T., Lavicza, Z., Eichmair, M., & Hohenwarter, M.
Correspondence to: Martin Mayerhofer, Department of Mathematics, Faculty of Mathematics, University of Vienna, Vienna, Austria, martin.mayerhofer@univie.ac.at

Johannes Friedrich

16 years

Johannes is in 10th grade in a private preparatory school. His parents, a nurse and a project supervisor in the IT sector, don't have a regular working schedule. Johannes is an only child and takes on household chores when his parents are at work. His parents expect him to finish his homework on his own in a responsible way. In his spare time, Johannes has several hobbies related to science and engineering: He has picked up basic coding skills by himself and uses them to work on projects of increasing complexity. Johannes frequently uses sources such as science magazines that go above and beyond what he is taught in school. He hardly misses an opportunity to learn about math. Johannes is far ahead in maths and usually bored in class. Johannes uses the time gained to support the teacher by helping students who lag behind or by working on challenging problems to prepare for national maths competitions in which he is doing well. Johannes has already made up his mind that he will pursue studies in the field of mathematics, science, or engineering at university.

Goals

- as much knowledge in maths as possible
- understanding of mathematical concepts
- applying maths in out-of-school and interdisciplinary contexts

Needs

- opportunities to discuss maths, also beyond the curriculum
- opportunities to show his math skills
- access to materials that go beyond the curriculum
- extra challenges in and outside of school

Challenges & Problems

- lack of opportunities in class to go beyond the curriculum
- presentation of new mathematical concepts with little or no proof in class

Joys

- to learn something new when discussing math
- to solve challenging problems
- to discover connections between different problems or areas
- to feel his mathematical prowess and to show it off
- to help others

Fears

- to fall short of others' expectations
- to lose his status
- to fail publicly
- to lose interest in mathematics on account of superficial lessons

Feelings & Emotions

- enjoying math
- disappointment by superficial presentations of concepts
- pride in his skills
- appreciation by peers and teachers

Strategies

- independent study
- actively searches for additional resources
- engages in extracurricular activities related to maths
- approaches his teachers with advanced questions after class

Weinhandl, R., Mayerhofer, M., Houghton, T., Lavicza, Z., Eichmair, M., & Hohenwarter, M.
Correspondence to: Martin Mayerhofer, Department of Mathematics, Faculty of Mathematics, University of Vienna, Vienna, Austria, martin.mayerhofer@univie.ac.at

Aurelia Höfinger

17 years

Aurelia is in 11th grade at a preparatory school. Her focus is already on studying medicine. She has already started to prepare for the entrance exam to study medicine. If she shouldn't pass at the first go, she plans to enrol for psychology for one year and then retake the entrance exam. Her goal, however, is to pass at her first attempt and also to finish school with straight A's. She is aware of the fact that maths play an important role in the exam, which explains her interest in the subject. Aurelia works hard for school and tries to stand out by doing extra work. Outside school she tries to hone her math skills by solving the same exercises over and over again to prevent lapsing in an exam.

Aurelia's parents and her sister, who is three years older and already studying at university, are supportive of Aurelia and her plan.

Goals

- straight A's
- solving all exercises requested by teachers

Needs

- large supply of practice problems
- additional support from people other than the teachers
- reassurance
- extra credit

Challenges & Problems

- impatience with open, unclear, tricky, or unfamiliar problems
- stress in exams

Joys

- to receive positive feedback from her teachers
- to successfully apply familiar strategies
- to excel in exams

Fears

- to not excel in exams
- to have a mental block in exams

Feelings & Emotions

- thrill when being rewarded
- pressure to perform well
- impatience

Strategies

- treats maths as a means to her future studies
- practises the same problems many times over
- uses external sources to find additional practice problems
- elicits positive feedback from her teachers

Weinhandl, R., Mayerhofer, M., Houghton, T., Lavicza, Z., Eichmair, M., & Hohenwarter, M.
Correspondence to: Martin Mayerhofer, Department of Mathematics, Faculty of Mathematics, University of Vienna, Vienna, Austria, martin.mayerhofer@univie.ac.at

Manuel Winkler

16 years

Manuel is in 10th grade at a preparatory school. He lives with his parents, a full-time shop assistant and a cleaning person working part-time. They consider Manuel to be responsible for his school work and are generally supportive. He plans to go to university after school. Finishing high school is what matters most to Manuel right now. He is not willing to put in more effort into school than absolutely necessary. Manuel is willing to adopt *any* strategy – permitted or not – that helps him pass his exams and save time and effort. He tries to anticipate the minimal amount of effort necessary to pass exams. Manuel wants his teachers to specify in detail what needs to be done to pass the class. Up to 8th grade, Manuel did very well at maths. Since then the number of topics that interest him in maths class have decreased and his performance got poorer. Manuel looks for materials that present rules and recipes that help him cram for exams. Overall, Manuel approaches his school work unemotionally and quite indifferently. He prefers to play video games for many hours on end. He doesn't spend much thought on school-related issues. Manuel is pleased when he passes exams or tasks with as little effort as possible.

Goals

- passing with as little effort and commitment as necessary

Needs

- needs to know exactly the passing requirements
- mathematical recipes

Challenges & Problems

- lack of motivation unless his teachers or parents set goals
- cramming just before the exam
- no incentive to study maths other than to pass

Joys

- to apply rules that are easy to understand and help him solve the required tasks
- to pass exams no matter the grade
- to reach his goals with the least amount of time and effort

Fears

- having to put in more effort to pass
- having to work on exercises that cannot be solved following a familiar recipe or rule

Feelings & Emotions

- indifference

Strategies

- tries to anticipate exam questions
- tries to find out exactly the passing requirements
- prepares for exams just in time
- cheats

Weinhandl, R., Mayerhofer, M., Houghton, T., Lavicza, Z., Eichmair, M., & Hohenwarter, M.
Correspondence to: Martin Mayerhofer, Department of Mathematics, Faculty of Mathematics, University of Vienna, Vienna, Austria, martin.mayerhofer@univie.ac.at

Diana Markovic

15 years

Diana is in 9th grade in an upper secondary school specialised on STEM subjects and is thinking of quitting school and taking up training as a caregiver or transferring to school that specialises in social work. She moved to Austria with her parents at the age of seven. At school, Diana considers some subjects very important and others as not important at all. She considers maths important, even though she faces challenges. Her main goal is to pass, however, she always wishes to do better in the future. Compared to her sociable and talkative nature when she is with her friends, she is rather quiet and doesn't want to draw attention in class. Even when she is following well, she doesn't usually volunteer her answer or ideas to questions the teacher asks to the class. Occasionally, Diana receives private tutoring and uses additional outside materials to help her study. She is diligent and takes sufficient time to prepare for exams, so she can be relaxed before exams and doesn't have to worry about poor grades.

Goals

- to pass and do better next time
- to not be called on by teachers in class

Needs

- additional study materials
- visualisations for concepts
- sufficient time to prepare for exams
- step-by-step explanations

Challenges & Problems

- applying acquired skills in unfamiliar contexts
- having to use materials that do not fit her visual learning style
- organising help and additional materials by herself

Joys

- little joy in maths
- to solve routine problems
- to study without pressure

Fears

- test anxiety
- causing embarrassment by asking for help on supposedly easy problems

Feelings & Emotions

- respect for maths and for people who are good at maths
- anxiety and pressure
- considers maths difficult and important
- frustration when her efforts do not pay off

Strategies

- plans ahead to have sufficient time for studying
- uses additional materials to prepare for exams
- uses multiple means of support (private tutoring, internet resources, etc.)

Weinhandl, R., Mayerhofer, M., Houghton, T., Lavicza, Z., Eichmair, M., & Hohenwarter, M.
Correspondence to: Martin Mayerhofer, Department of Mathematics, Faculty of Mathematics, University of Vienna, Vienna, Austria, martin.mayerhofer@univie.ac.at

Dominik Ghali

15 years

Dominik is in the 9th grade of a preparatory school. He has not yet decided what to do after finishing high school: He has considered both a career as a craftsman or to study for an engineering degree at university. His parents and his brother, who is three years younger, support Dominik and are proud of their family. Dominik pays much attention to his appearance, confidently applying gel to his hair and, as of recently, works out at a gym. He keeps his friends up to date on his progress in the gym and his appearances on his football team by regular posts in social networks.

His performance in school is average. Maths is especially challenging for Dominik, which he usually masters quite well. He wants to prove to his maths teacher, his colleagues, and his parents that he has talent for maths. Therefore he works hard as exams draw closer and commits solutions to practise problems to heart, sometimes assisted by a private tutor. Dominik is anxious at the thought of performing worse than people who are important to him would expect.

Goals

- passing exams with grades that reflect the effort he has put in
- doing a reasonable job on his homework

Needs

- large amount of study materials
- clear understanding of what is required to get a reasonable grade
- model solutions and problem solving strategies
- visualisations of concepts
- additional support within reach at all times

Challenges & Problems

- new and unfamiliar contexts
- time management
- organising support on his own
- motivating himself to study
- tasks that are structured differently from what he is used to

Joys

- finding a pattern that frequently leads to a solution
- solving an exercise using an internalised strategy
- positive grades

Fears

- to fail in exams
- to fail to connect with completely new topics

Feelings & Emotions

- intimidated by new concepts
- relieved when passing exams
- not confident that effort will pay off
- anxious before exams
- resilience

Strategies

- to commit solutions of practice problems and solution patterns to heart
- to prepare for exams just enough
- to prepare for together with friends or a private tutor
- to use *any* means promising a better result (also cheating)