



TOMSK
POLYTECHNIC
UNIVERSITY



DIGITAL EDUCATION TECHNOLOGIES IN UNIVERSITIES

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Vice Rector for Digital Affairs

2018

- Digital technology brought the availability of knowledge for everyone, at any time and in any place
- Universities have lost a monopoly on knowledge
- The Internet contains 90-95% of false knowledge
- Universities are not ready for open sharing of their educational materials

- What knowledge needs to be studied and what can always be found on the Internet?
- Is it possible to acquire skills and competences alongside knowledge on the Internet?
- How to distinguish false knowledge from the true one on the Internet?
- **Why should a student attend lectures if he can find any information on the Internet?**



- **Involvement**
 - Children are not involved in a learning process.
 - But they are 100% involved in computer games: they are focused, learn, acquire skills and do not get distracted ...
- **Individuality**
 - Each child has individual abilities and inclinations. You can not treat different diseases of the same pills.
 - Student centered model
- **Adaptability**
 - The speed of mastering the same material in school, in the same class, can differ by 5 times, in the country - by 60 times.

■ Analytics

- In the digital environment, each student and teacher leaves traces when performing any action. This information is much more important than the teacher's subjective assessment, and it cannot be faked

■ Digital measurement of learning outcomes

- If the child has reached the end of the game - no one has any doubt that he has completed all the tasks of the game and learned what the author required of him. Nobody requires an exam at the end of the game
- Test tasks kill the ability to solve problems

■ Digital portfolio instead of diplomas

■ VR & AR

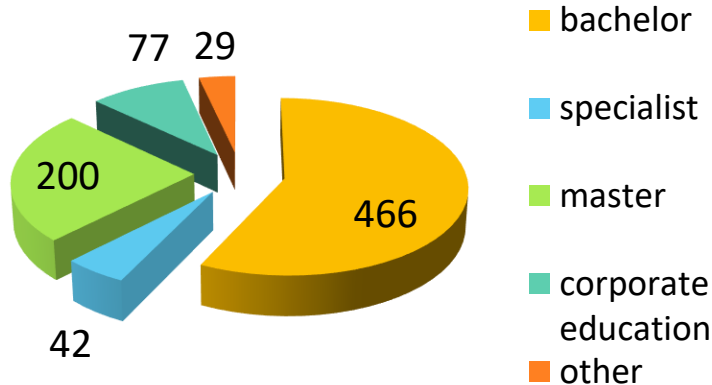
ONLINE-COURSE IS NOT THE E-BOOK

- The learning process is designed for self-study.
- Video lectures with embedded presentations, graphics, text, interactive questions and tasks
- Tasks: different types of tests, peer-to-peer assessment, personal tasks
- Online Interaction:
 - student - LMS
 - student - teacher
 - student - student
- New content formats: time tapes, mental maps, virtual buddies, interactive infographics
- Teamwork, collaborative work on projects, crowdsourcing projects (wikis), forums, communities, mutual evaluation of work and assignments
- Virtual Labs, Game Simulators and Gamification
- Online proctoring

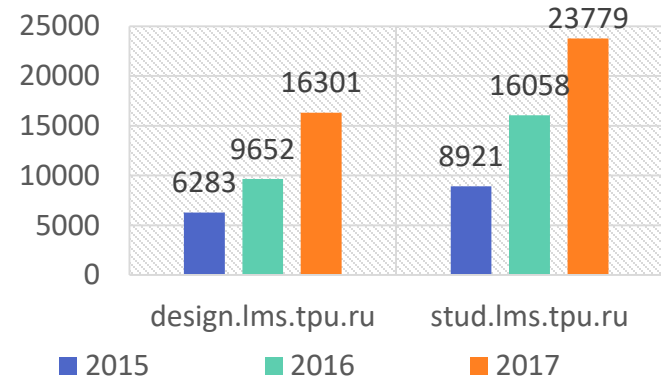
ON-CAMPUS ONLINE COURSES

- Developed online courses, total – 920
- Developed online courses in 2017 – 183+
- Online courses for distance learning – 200
- Online courses in use – 896

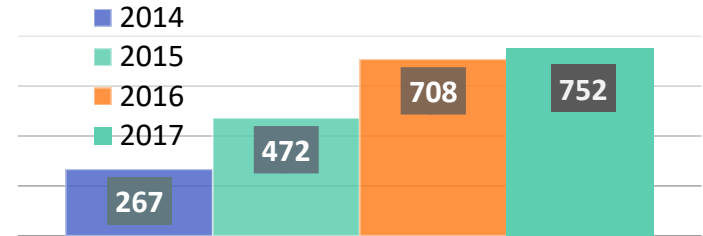
Number of online courses in TPU



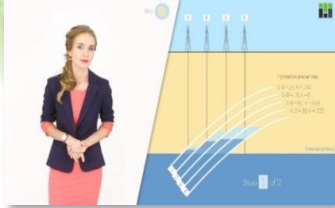
Number of online users total



Number of teachers



MASSIVE OPEN ONLINE COURSES OF TPU



Introduction to Petroleum Engineering

- **3373 learners** / > 16 countries
- **355 certificates**
- liversity.org, edx.tpu.ru



Myths and Facts about Rocks

- **4600 learners** / > 16 countries
- **155 certificates**
- liversity.org, lektorium.tv, edx.tpu.ru



Engineering of the Future

- **7000 learners** / > 10 countries
- **445 certificates**
- lektorium.tv, stepik.org, edx.tpu.ru

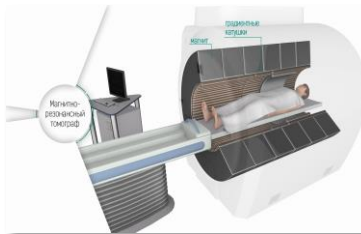


Logistics and Entrepreneurship

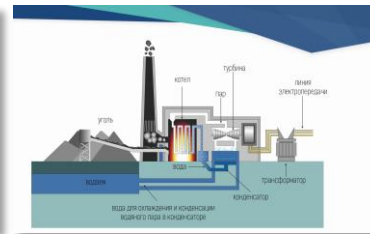
- **4500 learners** / > 10 countries
- **200 certificates**
- lektorium.tv, edx.tpu.ru

Produced in 2017/18

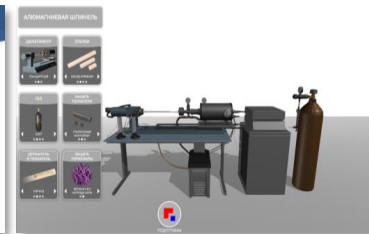
Tomography: see the invisible



Clean Energy on Solid Fuels is Real



Nanostructured Ceramics

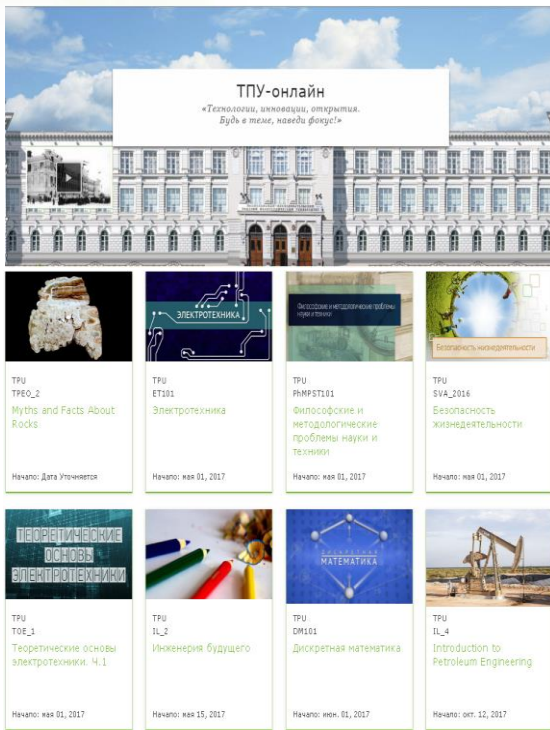


Russian history



INTEGRATING MOOCS IN TRADITIONAL EDUCATION

■ <http://edx.tpu.ru>



1. Own open learning platform “TPU Online”
2. Certificates of completion for the successful completion of online courses from TPU
3. Using MOOCs “Introduction to Petroleum Engineering” and “Myths and Facts about Rocks” to teach Professional English:
 - Spring semester 2016/2017:
126 students, 90 Certificates
 - Autumn semester 2016/2017:
133 students, 125 Certificates
 - Autumn semester 2017/2018:
54 students, 51 Certificates
4. Using MOOC “Introduction to Petroleum Engineering” to select students for the programs delivered by Heriot-Watt Petroleum Engineering Approved Support Center:
 - Spring 2017 – **487 students, 72 Certificates**
5. Using MOOC “Engineering of the Future” to train schoolchildren and university entrants of the Russian Federation and CIS countries:
 - Spring 2018 – **1500 students, 331 Certificates**


- Reliable, quality material
- High quality of speech, appearance, content
- Strict match time
- The ability to show real processes
- Visual representation of complex technological objects (graphics, animation)
- Ability to view at a convenient time, the required number of times

График предложения

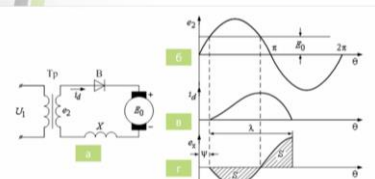


P – цена
Q – количество
S – предложение

Изменение предложения



Неуправляемые выпрямители



Работа однофазного однополупериодного выпрямителя на двигательную нагрузку

$$\sqrt{2}E_2 \sin(\theta + \psi) - X \frac{dI_d}{dt} = E_0 \quad I_d = \frac{\sqrt{2}E_2}{X} [\cos \psi - \cos(\theta + \psi)] - \frac{E_0}{X} \theta$$

$$I_d = \frac{1}{2\pi} \int_0^{\lambda} I_d d\theta = \frac{\sqrt{2}E_2}{2\pi X} [\lambda \cos \psi - \sin(\lambda + \psi) + \sin \psi] - \frac{E_0 \delta^2 \pi}{X}$$


INTERACTIVE SIMULATORS

ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ
ЦЕНТР ЭЛЕКТРОННЫХ ОБРАЗОВАТЕЛЬНЫХ РЕСУРСОВ

БЕЗОПАСНОСТЬ ЖИЗНЕДЕЯТЕЛЬНОСТИ
Исследование вибрации и способов защиты от нее

Измерение параметров вибрации

ЭТАП 1
0 1 2

ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ
ЦЕНТР ЭЛЕКТРОННЫХ ОБРАЗОВАТЕЛЬНЫХ РЕСУРСОВ

ГИДРОГАЗОДИНАМИКА
Определение коэффициента местного сопротивления

ЭТАП 1
Выполнение эксперимента

0 1 2

Исследование автономной системы электроснабжения на базе ветрогенератора АВ-3

ОБЩАЯ ЭНЕРГЕТИКА

ЭТАП 1
Выполнение работы (50 КВ)

0 1 2 3

КОЛЛОИДНАЯ ХИМИЯ
Определение поверхностности на примере
Расчет молекулярных характеристик исследуемого ПАВ

ЭТАП 1
Проведение эксперимента

0 1 2 3 4

VR SIMULATORS



VR IN ENGINEERING EDUCATION

In 2018, we created a **virtual reality studio**:

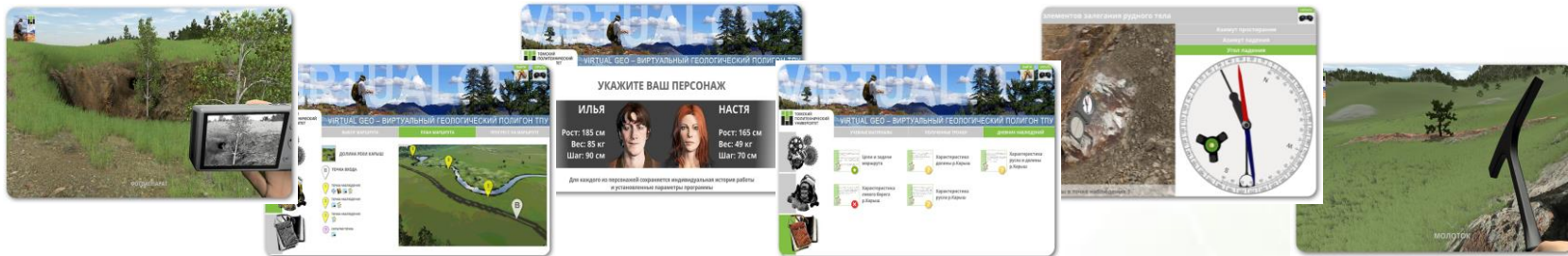
- Virtual laboratory in 2.5D to be used in distance and full-time education
- Simulators in 3D to be used as practical modules in MOOCs
- Computer simulators in the VR format to be used in full-time education



VIRTUAL GEO

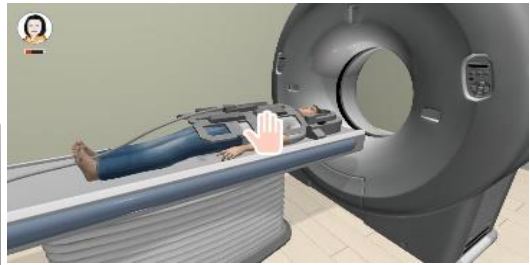
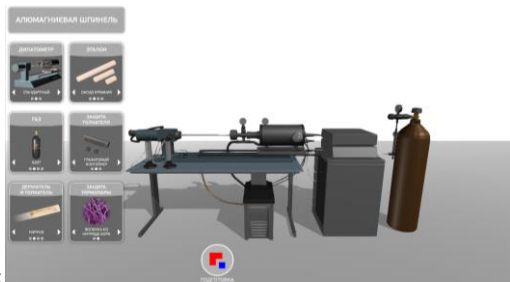
VIRTUAL GEOLOGICAL POLYGON OF TPU

Local landscape, soil landforms, outcrops modeled as in the geological training range located in Khakasia

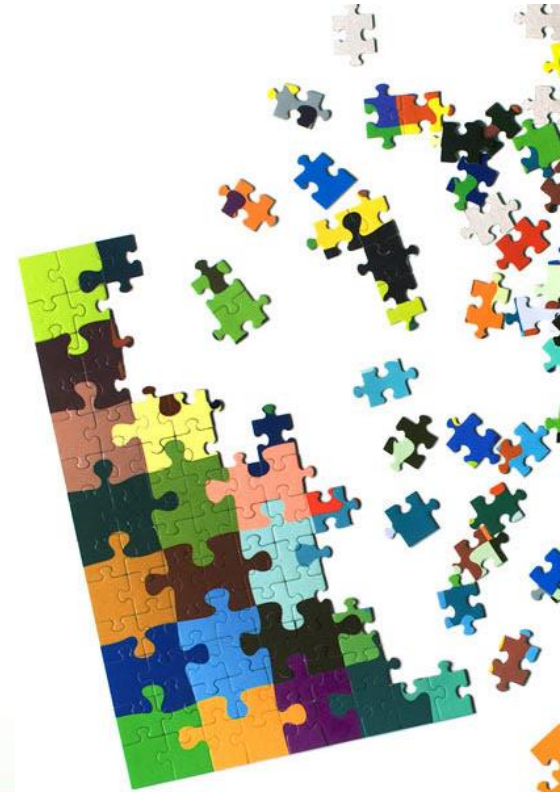


VIRTUAL REALITY (VR), AUGMENTED REALITY (AR)

- skills through practice
- saved financial resources
- no exposure to risks and damage factors.

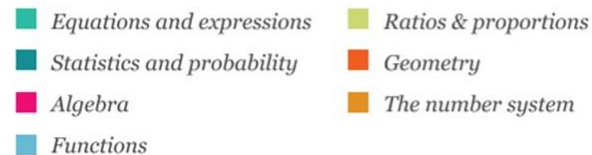
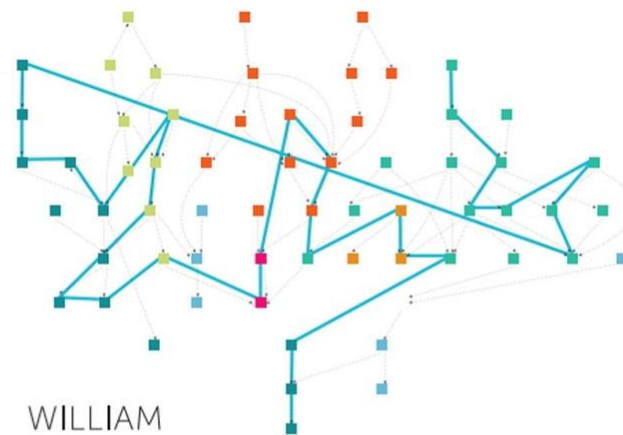
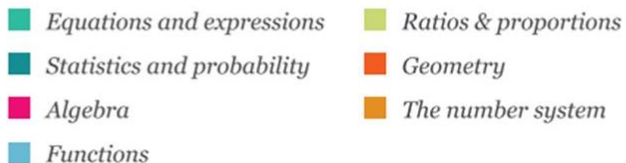
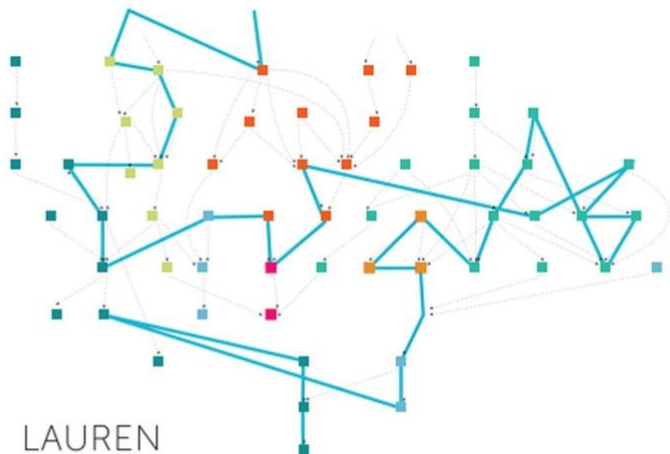


- **Microlearning deals with relatively small learning units and short-term learning activities**
 - **study of educational material in small portions**
 - **crushing a large specialty or course into smaller ones**
 - **issuing certificates upon completion of the mini-program (Coursera and micro-credentials)**

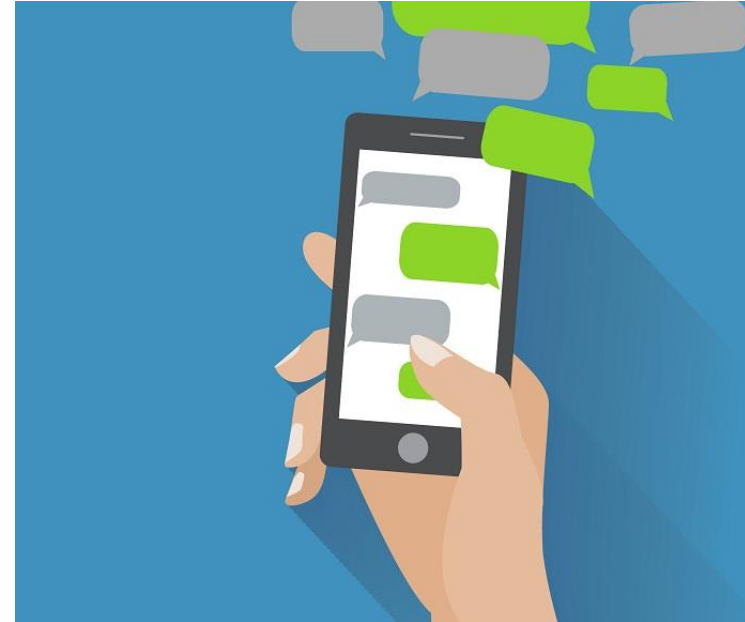


ADAPTIVE LEARNING

Adaptive learning (adaptive teaching), is an educational method which uses computer algorithms to orchestrate the interaction with the learner and deliver customized resources and learning activities to address the unique needs of each learner.



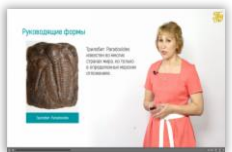
- **Personal training through the smartphone messenger**
 - Usual environment
 - Personal content delivery
 - Notification and reminder system
 - Test knowledge system and control responses
 - Maximum availability



221 virtual laboratories



95 video lectures



101 state recognized certificates



813 online courses



35 thousand learners



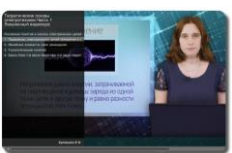
41 registered PC applications



25 smartphone applications



26 educational films



19 awards



12 MOOCs on Edx.tpu.ru



859 students or thousand Edx.tpu.ru trainees



26 teachers



11 VR modules



50 software units



159 academic certificates



9 MOOCs on external platforms



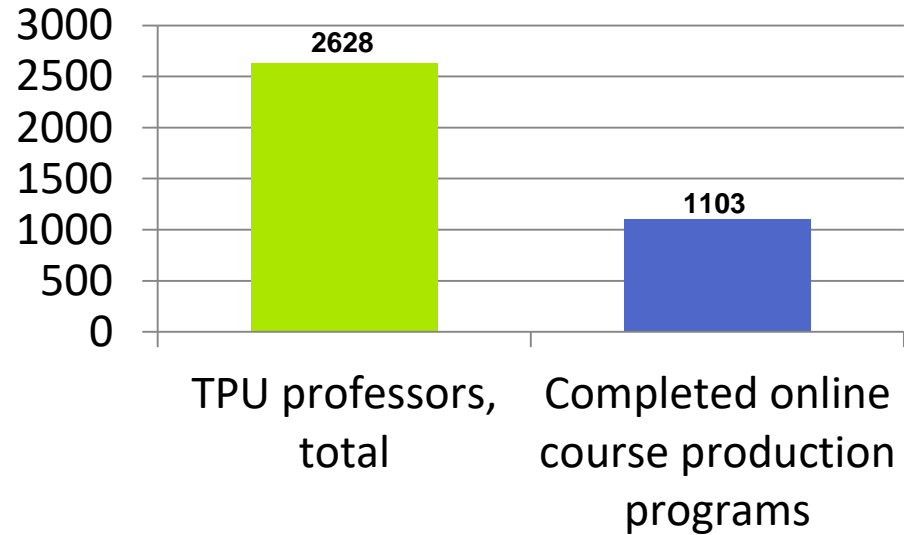
13.7 thousand MOOC learners



80% teachers use online courses



- TPU online courses are developed by teachers themselves
- If teachers are not involved, most course advantages are neglected or used incorrectly
- All online courses are developed with expert support



46 special programs for teachers targeted at nuances of digital technologies for online course production

After studying

- use online courses - **80%**
- develop own online course - **40%**

The main mission is

- **transformation of knowledge into** modern digital educational products and dissemination of this knowledge in all available and applicable ways
- creation of a new ecosystem on production and delivery of digital educational technologies to a customer



OPEN ELECTRONIC ARCHIVE

- <http://earchive.tpu.ru> (*DSpace software*)

Электронный архив ТПУ

Communities in DSpace

Choose a community to browse its collections.

- Science** 37086
- Education** 9679
- Other activities** 1088

Discover

Author

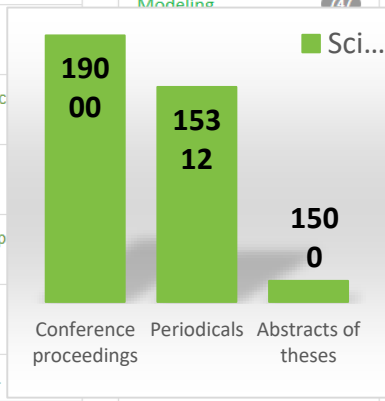
- Смольянинов, Станислав Иванович 140
- Витюгин, Виктор Моисеевич 122
- Лопатинский, Вадим Петрович
- Скороспешкин, Александр Иванович

Subject

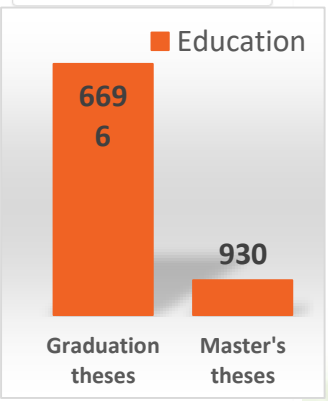
- Electronic resources 1999
- PhD theses 1213
- Modeling 747

Date issued

- 2000 - 2018 39232
- 1900 - 1999 8615
- 1895 - 1899 2



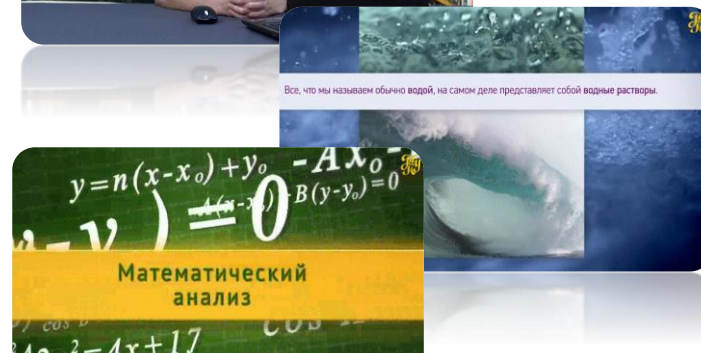
| Document Type | Count |
|------------------------|-------|
| Conference proceedings | 19000 |
| Periodicals | 15312 |
| Abstracts of theses | 1500 |



| Document Type | Count |
|-------------------|-------|
| Graduation theses | 6696 |
| Master's theses | 930 |

| | |
|----------------------------------|----------------------|
| Date of creation | November 2015 |
| Number of documents | 44 627 |
| Indexed in Google Scholar | 25 600 |

- **Open educational online platform “TPU Lectorium”**
 - The aim is **to upload and share all ever developed learning materials**
- **Video materials in TPU-affiliated groups in social networks**
 - Information search on the Internet is not connected directly with a certain information supplier
 - A student does a search through popular global search engines, such as Google, Yandex, Yahoo, Bing and etc. or through a social network, for example, YouTube.
 - Content placed **on an institution’s website** has lower chances to appear in the search result than the content of popular social networks



Все, что мы называем обычно водой, на самом деле представляет собой водные растворы.

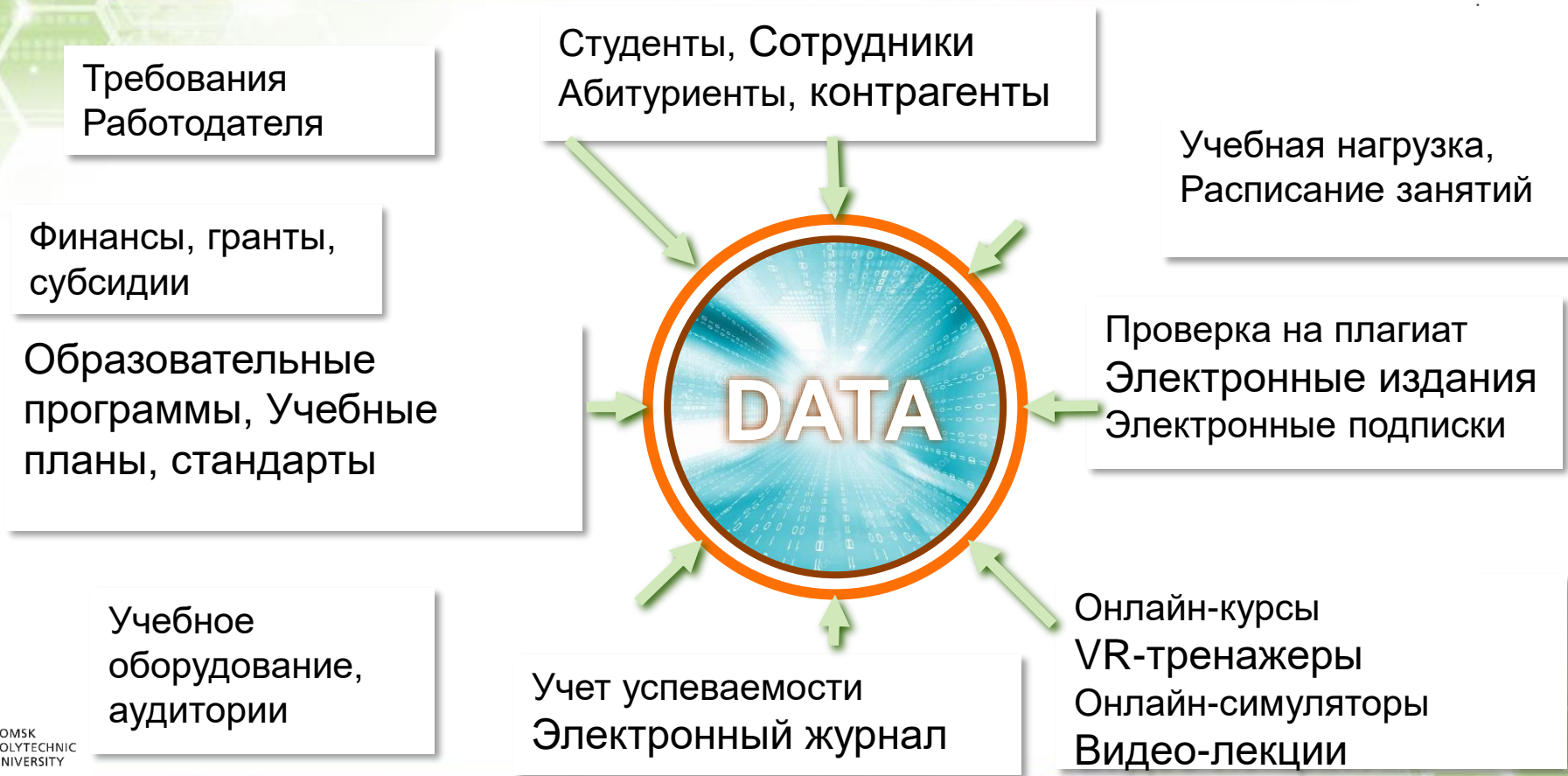
Определение функции нескольких переменных

Пусть множество $D \subset \mathbb{R}^n$.
Если каждой точке $M(x_1, x_2, \dots, x_n) \in D$ поставить в соответствие число $U \in \mathbb{R}$, то говорят, что на множестве D задана функция n переменных.
Обозначают: $U = f(M)$ или $U = f(x_1, x_2, \dots, x_n)$.



D – множество точек области определения.
 U – множество значений функции $f(M)$.
 x_1, x_2, \dots, x_n – независимые переменные (аргументы).
 U_0 – частное значение $f(M)$ в

DATA ECONOMY AT UNIVERSITY



DATA ECONOMY AT UNIVERSITY

Электронная
зачетная книжка
Цифровое портфолио

Учет востребованности
ресурсов и сотрудников

Личные кабинеты онлайн,
Сайты сотрудников,
Онлайн-справочники

Аналитика, прогнозы,
тренды

Сопровождение
обучения,
Тьюторская работа

Учет успеваемости и
электронная зачетная
книжка



Экспорт данных в
отчеты по требованию
контролирующих
органов

Индивидуальное и адаптивное
образование

Аналитика
больших
данных





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ЦИФРОВОЕ ПОРТФОЛИО

ДОПОЛНИТЕЛЬНОЕ
ОБРАЗОВАНИЕ

5

УЧАСТИЕ
В ПРОЕКТАХ

4

ДОСТИЖЕНИЯ

110

КОМПЕТЕНЦИИ

30

РЕКОМЕНДАЦИИ

2

THANK YOU!

DIGITAL EDUCATION TECHNOLOGIES IN UNIVERSITIES

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