“ENERGETIK OBYEKT QURILMALARI” FANINI O‘QITISHDA VIRTUAL LABORATORIYALARDAN FOYDALANISH IMKONIYATLARI

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Annotatsiya. Tezisda “Energetik obyekt qurilmalari” fanining modullari va virtual laboratoriya turlari (simulyatsion, masofaviy, 3D/VR trenajyor, raqamli egizak) o‘rtasidagi moslik tahlil qilingan. Har bir modul uchun eng maqbul virtual laboratoriya turi tanlangan, shuningdek, ko‘nikmalar virtual va real laboratoriya o‘rtasida taqsimlangan. Virtual laboratoriya real laboratoriyaning o‘rnini bosmasligi, balki unga tayyorlov va kengaytiruvchi bosqich bo‘lishi asoslangan.

Kalit so‘zlar: virtual laboratoriya, masofaviy laboratoriya, raqamli egizak, VR trenajyor, energetik obyekt qurilmalari, laboratoriyaga kirish shakli.

“Energetik obyekt qurilmalari” fani kuch transformatorlari, kommutatsiya apparatlari, rele himoyasi, o‘lchash transformatorlari va elektr dvigatellar kabi qurilmalarni o‘z ichiga oladi. Ularning ko‘pchiligi yuqori kuchlanishda ishlaydi va qimmat turadi. Shu sababli ular bilan o‘quv laboratoriyasida erkin tajriba o‘tkazish deyarli mumkin emas. I.U.Raxmonov va hammualliflar yuqori kuchlanishli podstansiya uchun yaratilgan VR-trenajyorlarni tahlil qilib, ulardagi asosiy kamchiliklarni ko‘rsatgan: elementlarning bir-birini to‘sib qolishi, ko‘rsatmalarning ekranni egallab olishi va sxemalarning kichik o‘lchamda berilishi [1]. Demak, virtual laboratoriyadan foydalanish imkoniyati faqat dasturning mavjudligiga emas, balki uning qanday loyihalanganiga ham bog‘liq.

O.B.Yusupov masofaviy ta’lim platformalarini virtual laboratoriyalar bilan birlashtirish real jihozlar cheklangan sharoitda ham amaliy ko‘nikmalarni rivojlantirishini va an’anaviy hamda virtual o‘qitishni uyg‘unlashtirgan gibrid yondashuv maqsadga muvofiqligini ta’kidlagan [2]. M.H.Avezova va Sh.Sh.Muyidinova esa ayrim laboratoriya ishlarini real sharoitda bajarish sog‘liq uchun xavfli bo‘lishi mumkinligini ko‘rsatgan [3]. Energetika uchun bu xavf yanada yuqori. Ushbu tezisning maqsadi – fan modullari kesimida virtual laboratoriyadan foydalanish imkoniyatlarini aniqlash va virtual hamda real laboratoriya o‘rtasidagi vazifalar taqsimotini asoslash.

Virtual laboratoriya turlari. N.Ertugrul LabVIEW asosidagi o‘quv vositalarini tahlil qilib, muhandislik ta’limida virtual laboratoriyalarning simulyatsiya, masofadan boshqariladigan real jihoz va ularning aralash shakllari kabi turlarini ajratgan [4]. Bugungi kunda ularga 3D/VR trenajyorlar va raqamli egizaklar ham qo‘shildi. Har bir turning imkoniyati turlicha. *Simulyatsion laboratoriya* jarayonning matematik

modeliga asoslanadi va parametrlarni erkin o‘zgartirish imkonini beradi. *Masofaviy laboratoriya* real jihozni internet orqali boshqarishga imkon beradi, natijada talaba haqiqiy o‘lchov ma’lumotini oladi. *3D/VR trenajyor* qurilmaning tashqi ko‘rinishi, tuzilishi va xizmat ko‘rsatish amallarini o‘rgatadi. *Raqamli egizak* esa muayyan real obyektning holatini uzluksiz aks ettiradi.

E.Lindsay va M.Gud laboratoriyaga kirish shakli (bevosita, masofaviy yoki simulyatsion) o‘quv natijalariga turlicha ta’sir ko‘rsatishini aniqlagan [5]. Bundan kelib chiqadiki, “qaysi virtual laboratoriya yaxshiroq?” degan savolga umumiy javob yo‘q. Javob o‘rganilayotgan qurilmaga va ko‘zlangan natijaga bog‘liq. Shu asosda fan modullari va virtual laboratoriya turlarining mosligi baholandi (1-rasm).

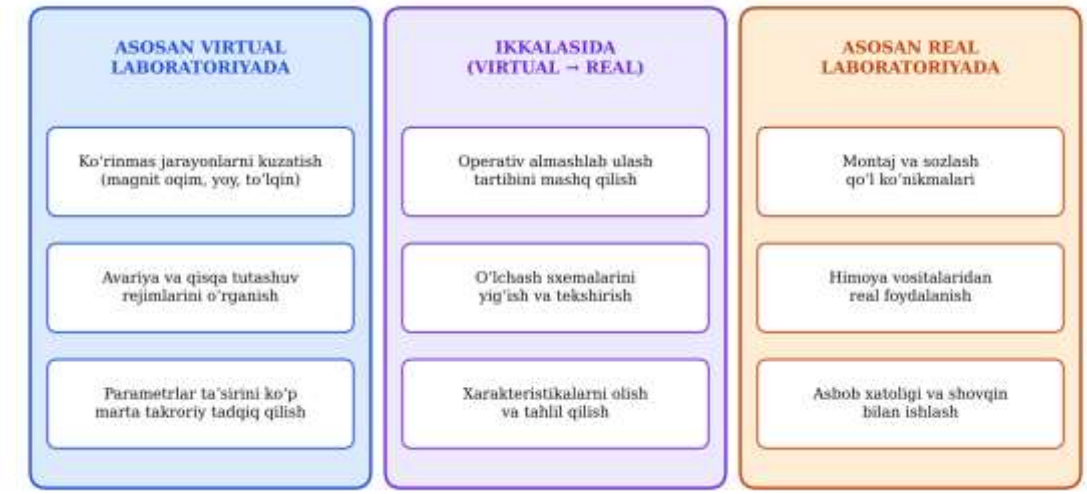
	Simulyatsion laboratoriya	Masofaviy laboratoriya	3D / VR trenajyor	Raqamli egizak
Kuch transformatorlari	juda mos	mos	mos	juda mos
Kommutatsiya apparatlari	mos	qisman	juda mos	mos
Rele himoyasi va avtomatika	juda mos	mos	qisman	juda mos
Podstansiya sxemalari	mos	qisman	juda mos	juda mos
Elektr dvigatellar	juda mos	juda mos	qisman	mos
O'lchash transformatorlari	juda mos	mos	mos	qisman

1-rasm. Fan modullari va virtual laboratoriya turlarining mosligi (muallif bahosi)

Matritsadan ko‘rinadiki, kuch transformatorlari va rele himoyasi kabi modullarda asosiy e’tibor jarayon va rejimlarga qaratiladi. Shuning uchun ularda simulyatsion laboratoriya va raqamli egizak eng ko‘p imkoniyat beradi. Kommutatsiya apparatlari va podstansiya sxemalarida esa qurilmaning fazoviy tuzilishi va operativ amallar ketma-ketligi muhim. Bu yerda 3D/VR trenajyor ustunlikka ega. Elektr dvigatellarni masofaviy laboratoriyada o‘rganish ham qulay, chunki ularning past kuchlanishli stendlari arzon va masofadan xavfsiz boshqariladi.

Virtual va real laboratoriya o‘rtasidagi taqsimot. N.Finkelstein va hammualliflar elektr zanjirlarini o‘rganishda simulyatsiyadan foydalangan talabalar konseptual savollarda ham, keyinchalik real zanjirni yig‘ishda ham real jihozda ishlaganlardan yaxshiroq natija ko‘rsatganini aniqlagan [6]. T.Yaakkola va hammualliflar esa simulyatsiya va real laboratoriyani birga qo‘llash faqat simulyatsiyadan foydalanishga qaraganda chuqurroq tushunishga olib kelishini

ko‘rsatgan [7]. Bu ikki natija bir-birini to‘ldiradi: virtual laboratoriya tushunish uchun kuchli vosita, lekin real tajriba bilan birga qo‘llanganda samaradorroq. Shunga ko‘ra, fan bo‘yicha ko‘nikmalar uch guruhga ajratildi (2-rasm).



2-rasm. Ko‘nikmalarning virtual va real laboratoriya o‘rtasida taqsimlanishi

Birinchi guruh ko‘nikmalari, masalan, ko‘rinmas jarayonlarni kuzatish va avariya rejimlarini o‘rganish, faqat yoki asosan virtual muhitda shakllanadi. Ikkinchi guruh ko‘nikmalari, masalan, operativ almashlab ulash tartibi, avval virtual muhitda xatosiz bajarilguncha mashq qilinadi, so‘ngra real stendga o‘tkaziladi. Uchinchi guruh esa montaj, himoya vositalaridan foydalanish va asbob xatoligi bilan ishlash kabi ko‘nikmalardan iborat. Ular faqat real laboratoriyada to‘liq shakllanadi.

“Energetik obyekt qurilmalari” fanida virtual laboratoriyadan foydalanish imkoniyatlari modulga qarab farqlanadi. Jarayon va rejimlarni o‘rganishda simulyatsion laboratoriya va raqamli egizak, qurilma tuzilishi va operativ amallarni o‘rganishda esa 3D/VR trenajyor eng ko‘p samara beradi. Virtual laboratoriya xavfli va qimmat tajribalarni hammaga ochiq qiladi, biroq qo‘l ko‘nikmalari va real xavfsizlik amallarini shakllantirmaydi. Shuning uchun uni real laboratoriyaning o‘rnini bosuvchi emas, balki unga tayyorlov va uni kengaytiruvchi bosqich sifatida loyihalash lozim. Taklif etilgan moslik matritsasi fan bo‘yicha virtual laboratoriya resurslarini tanlash va xarid qilishda asos bo‘lishi mumkin.

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