STEM PD Net
European STEM Professional Development Centre Network

Modeller för kompetensutvecklingscentra: sammanhang, uppgift, struktur och aktiviteter.

En översikt över modeller, utmaningar och framgångsfaktorer som kan bidra till utveckling av kompetensutveckling för STEM-lärare

ISE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

STEM PD Net
European STEM Professional Development Centre Network

Information about the report/IO
IO N° 5
Publication date: 25/06/2018
Report/IO title: PD centre models: context, mission, structure and activities. A review of models, challenges and success factors to lead improvements in STEM teacher professional development.

Project Information
Grant no. 2016-1-DE03-KA201-023103
Project title: European Network of STEM Professional Development Centres
Project acronym: STEM PD Net
Start date of project: 01/09/2016
Duration: 36 months
Program: Erasmus+, Key Action 2 (KA2) – Strategic Partnerships

Contact Information
Coordinating Institution: University of Education Freiburg, International Centre for STEM Education (ICSE)
Coordinator: Prof. Dr. Katja Maaß
Project Manager: Elena Schäfer
Lead partner for this report/IO: Prof. Dr. Günter Törner, Joyce Peters-Dasdemir
Website: http://stem-pd-net.eu/

Svensk översättning och bearbetning
Peter Nyström, Nationellt centrum för matematikutbildning, Göteborgs universitet

The project European Network of STEM Professional Development Centres (STEM PD Net) has received co-funding by the Erasmus+ programme of the European Union.

The creation of these resources has been co-funded by the Erasmus+ programme of the European Union under grant no. 2016-1-DE03-KA201-023103. Neither the European Union/European Commission nor the project's national funding agency PAD are responsible for the content or liable for any losses or damage resulting of the use of these resources.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

Innehållsförteckning

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

1 Inledning

Som en del av ERASMUS-projektet European STEM Professional Development (PD) Centre Network (STEM PD Net) har vi arbetat med modeller för kompetensutvecklingscentra. Det vi huvudsakligen fokuserat på är en översikt över modeller, utmaningar och framgångsfaktorer som kan bidra till utveckling av kompetensutveckling för lärare på STEM-området. Vi har försökt mäta och förstå skillnader och likheter mellan STEM-centra.

Alla projektpartners samt alla ytterligare medlemmar i det europeiska nätverket för kompetensutvecklingcentra inom STEM har bidragit till en omfattande informationsbas genom att svara på en enkät. Analysen av enkätsvaren gav djupa insikter i de olika modeller för kompetensutvecklingscentra och angreppssätt de länder som representeras av institutionerna i nätverket.

Dessutom illustrerar analysen på ett imponerande sätt skillnader mellan olika centras grundläggande uppgifter, till exempel förbättra STEM-utbildning, förbättra kompetensutveckling för lärare och lärarutbildare, bredda aktiviteter och expertis i forskning om undervisning, fokusera utveckling av klassrumsundervisning och skolor, och bidra till en sammanhållen lärarutbildning. Genom att besvara enkäten och reflektera över de olika kategorierna kan också centra ha fått en klarare bild av vilken modell de själva tillhör och på detta sätt också stödja den organisatoriska utvecklingen av den egna organisationen. Hela konsortiet kan också lära av de bästa exemplen.

Vårt kompendium är utformat för att göra våra resultat tillgängliga för dig och hjälpa dig förstå vad som kännetecknar framgångsrika kompetensutvecklingscentra inom STEM. Det är särskilt viktigt att beskriva de olika möjligheter som står till buds när ett kompetensutvecklingscentrum på STEM-området ska skapas. Kompendiet innehåller en strukturerad översikt över möjligheter när det gäller kompetensutvecklingscentras organisation och aktiviteter, beskrivningar av ett urval centra med såväl exempel på deras aktiviteter som analys av deras svagheter, styrkor och utmaningar, och en översikt över utmaningar och rekommendationer vid utveckling av inflytelserika kompetensutvecklingscentra och möjligheter att ta sig an utmaningar.

För att förstärka dessa översikter har vi lagt till fallstudier av några centra som du också kan ta del av på webbplatsen för nätverket (http://stem-pd-net.eu/en). Dessa fallstuder ger oss “best practice examples” som kan vara riktningsgivare för framgångsrika centra. De fem centra som presenteras representerar och konkretiserar de fyra typer av centra som utgör övergripande kategorier. När vi skrev om fallstudierna fick vi ytterligare insikter vilket ledde fram till ytterligare en enkät, och nya insikter från nya enkätsvar. Vi beskriver dessa nya insikter i slutet av dokumentet tillsammans med några rekommendationer.

Den här svenska versionen av kompendiet innehåller följande delar:

- Sammanfattning
- Struktur för kompetensutvecklingscentra och situation i olika länder
- Uppgifterna för centrumen och deras viktigaste utmaningar
- Slutsatser och rekommendationer: Nya insikter om kompetensutvecklingscentra
- Bilagor: Fallstudier och enkäter

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

2 Kompetensutvecklingscentra

2.1 Olika typer av centra

Sett över flera årtionden har de flesta europeiska länder etablerat statliga kompetensutvecklingscentra för vissa skolämnen. Dessa centra måste uppfattas som centrala utbildningsinstitutioner och deras huvuduppgift var och är att stödja och stödja ländernas officiella utbildningspolitik. Tidigare krävde nya läroplaner nya initiativ till utbildning för lärare som måste implementera den nya läroplanen. Denna uppgift var den dominerande funktionen för dessa kompetensutvecklingscentra. Men baserat på forskning har funktionen för dessa centra vidgats.

Som tur är har många europeiska regeringar under de senaste tjugo åren insett att kontinuerlig kompetensutveckling av lärare är en viktig fråga, alldeles oberoende av förändringar I läro- och kursplaner. Denna utveckling fick sällskap på forskningssidan då "lärares förändrade praktik" och "kompetensutveckling" allteftersom tagit plats som viktiga nyckelord som kräver uppmärksamhet. Därför kom en ny beteckning för de traditionella centrumen gradvis i bruk: Kompetensutvecklingscentra ("Professional Development (PD) centres). En del av de centra som ingår i det europeiska nätverks för STEM kommer från de gamla statliga institutioner som var ansvariga för implementering av läroplaner.

En annan typ av kompetensutvecklingscentra har sin grund i universitetsvärlden och finns även de representerade bland medlemmarna i nätverket. I alla europeiska länder har universiteten I någon grad ansvar för lärarutbildning. Ibland har till exempel tekniska universitet och högskolor ingen fakultet för lärarutbildning och inget programansvar för lärarutbildning, men de kan ändå vara inblandade på något sätt. Om en fakultet ansvarar för lärarutbildningen är det inte förvånande att lärarutbildarna också bedriver forskning om processer i klassrummen och om lärarnas roll, t.ex. lärarnas professionella utveckling.

Det är också ganska självklart att lärarutbildarna därmed engagerar sig i kompetensutveckling för aktiva lärare och inte bara undervisning av lärarstudenter. Några av forskarna hanterar denna uppgift på eget initiativ, för andra ingår det i tjänsten, och det finns olika modeller i olika europeiska länder för att tillskapa detta möte mellan akademi och praktik. Vi känner inte till någon undersökning om kopplingen mellan universitetsforskning och implementering i daglig praxis på skolor, med fokus på lärare och elever. Det ligger alltså ganska nära till hands för universitet och högskolor att inrätta institutioner som kallar sig kompetensutvecklingscentra, och denna typ av centra har andra förutsättningar och kännetecken än de statligt inrättade som beskrivits ovan.

En tredje typ av kompetensutvecklingscentra har inrättats på initiativ från företag som har intresse av att bidra till utbildningssystemet som en marknad. Ett exempel är Texas instruments som initierat och driver det viktiga kompetensutvecklingsprogrammet T3 ("Teachers Teaching Technology").

Den fjärde och sista typen av kompetensutvecklingscentra utgörs av icke-statliga organisationer. De bygger på olika typer av finansiering på områden där exporter har identifierat brister i utbildningssystemet. Det nationella institutet för lärarutbildning inom matematik i Tyskland (Deutsches Zentrum für Lehrerbildung Mathematik, DZLM), kan fungera som ett typexempel. Utbildningspolitiken i Tyskland är fragmenterat eftersom de sexton provinserna (så kallade "Bundesländer") kan besluta om läro- och kursplaner. Stiftelsen Telekom Deutschland beslutade att inrätta och finansiera detta nationella centrum.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

2.2 Sammanfattning av våra observationer

I Europa finns fyra olika typer av kompetensutvecklingscentra för lärare:

Typ 1) Kompetensutvecklingscentra som drivs av **utbildningsinstitutioner** på regeringens uppdrag. Regeringen eller närstående institutioner står för finansieringen. Regeringen reglerar också vad centrumen ska arbeta med och har rätt att utse personer som arbetar där.

Typ 2) **Universitet** har intressen i lärarutbildningen Medarbetare hävdar därför själva sin expertis eller åläggs att göra det, och genomför därför kompetensutvecklingsinsatser för aktiva lärare. Dessa aktiviteter har lett till upprättandet av universitetsbaserade kompetensutvecklingscentra.

Typ 3) Utbildning kan också ses som en **marknad.** Bland annat har förlag och företag som producerar programvara eller material intresse av att verka i denna marknad och har därför inrättat egna kompetensutvecklingsorganisationer.

Typ 4) Det är inte förvånande att **icke-statliga organisationer** har intresse av att bidra med expertis. Ofta kan de agera där officiella institutioner möts av hinder. I Tyskland har till exempel var och en av 16 provinserna (så kallade "Bundesländer") sin egen utbildningspolitik. Därför är det inte så lätt att inrätta en nationell institution som alla kan enas kring.

I de fallstudier som redovisas i bilagan finns detaljerade beskrivningar av fem institutioner som är av olika typ:

- DZLM (Berlin, Tyskland) - Deutsches Zentrum für Lehrerbildung Mathematik (typ 4)
- NCM (Göteborg, Sverige) - Nationellt centrum för matematikutbildning (typ 1)
- T3 Europe - Teachers Teaching Technology (typ 3)
- Verbund LEHRERiNNENBILDUNG WEST (Innsbruck, Österrike) - RECC Biologie, RECC Mathematik (Type 2)
- UPC (Vilnius, Litauen) - Center for Education Development (EDC) (Typ 1)

Det är uppenbart att de fyra typerna skiljer sig enormt med avseende på variablerna.

- Centrumets identitet och medarbetarnas självuppfattning
- Grundläggande filosofier för sitt agerande
- Intern flexibilitet
  - Att balansera teori och praktik för att stödja lärares lärande.
  - Att hantera många och olika aspekter av lärarnas kompetenser och erfarenheter.
  - Att vara kontextuell och flexibel (t.ex. ta itu med behoven hos lärare, elever, branscher och företag).
- Grad av inflytande på politiken
- Beroende resp. oberoende med avseende på åtaganden gentemot staten
- Professionalitet i interna ledningsprocesser
- Närhet resp. avstånd till forskning; forskningens roll för centrets arbete
- Internationell synlighet
- Intensitet och typ av samarbete med andra intressenter; vikten av tvärvetenskap
- Ekonomiska resurser

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

Skillnaden beror också på olika motiv för att etableringen av centra, bland annat

- förbättra STEM- utbildning
- förbättra den professionella utvecklingen av lärare, lärarutbildare och lärarutbildning
- stödja fysikundervisning på alla nivåer
- bredda aktiviteter och expertis inom forskning i pedagogik
- fokus på undervisnings- och skolutveckling
- implementera skolämnenas innehåll, undersökande arbetssätt i matematik och dataveten-skap, utveckling av lärarkompetens
- stärka en sammanhängande lärarutbildning

3 Uppgifter och utmaningar

3.1 Förändringsprocesser

Vi måste acceptera att traditioner (för dessa centra i europeiska lände) är mycket beständiga. Naturligtvis finns det drömmar och rekommendationer om hur centra kan och ska fungera, men vi måste vara realist-iska och först och främst tacksamma för det som finns och fungerar. Vi vet att det inte är möjligt att tillskapa resurser för att etablera nya institutioner som vi skulle önska.

I synnerhet är kompetensutvecklingscentra av typ 1 mycket beständiga eftersom det ytterst är landets politiska ledning som har makt att reglera alla processer. Det är mycket lättare att påverka kollegor i uni-versitetscentra (typ 2) med nya idéer och att försöka något nytt. Även centra av typ 3 och 4 verkar vara mer flexibla.

Vi vill också deklarera att vad som ska uppfattas som ett kompetensutvecklingscentrum beror till stor del på föreställningar hos inblandade parter. Med andra ord: Det är inte enkelt att förändra något inom de centra som ingår I nätverket. Vi måste acceptera att processen är långsam.

3.2 Dilemmat med STEM

Ytterligare ett problem som vi måste enas kring är att landskapet som betecknas STEM är mycket hetero-gent. Det finns inte något enskilt och unikt skolämne som kallas STEM. STEM-undervisning sker ofta via en bunt av olika aspekter från fyra olika självständiga ämnesområden (eller fler eftersom naturvetenskap de-las upp på flera skolämnen).

Hur som helst är alla projektmedlemmar (de som medverkat I skrivandet av den här rapporten) mycket öppna för STEM. Om du väljer vilken kombination som helst av bokstäverna S, T, E och M kommer du att hitta ett centrum som arbetar inom de skolämnen som representeras av bokstäverna.

3.3 Framgångsfaktorer

Kvalitetskriterier för kompetensutvecklingscentra handlar om filosofin bakom kompetensutvecklingspro-gram, resurser, samarbete och utvärdering. Dessa kvalitetskriterier är viktiga framgångsfaktorer för dessa kompetensutvecklingscentra och beskrivs närmare i en annan rapport från samma projekt (se http://stem-pd-net.eu/wp-content/uploads/2019/10/Ready_to_use_guide_final_22Oct2018-1_SWE_final.pdf). Kvali-tetskriterierna sammanfattas kortfattat nedan.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

Filosofi

Väl fungerande kompetensutvecklingscentra kan påverka professionalisering och praktik när det gäller undervisning inom STEM. Därför behöver de presentera utgångspunkterna för arbetet explicit. En tydlig och transparent information om filosofin bakom utgår från centrala frågor, till exempel:

- Vad är centrumets STEM-identitet? Kännetecknas den till exempel av ämnesöverskridande, undersökande arbetssätt eller koppling till vardagsliv?
- Vad vill centrumet åstadkomma när det gäller kompetensutveckling för lärare. Är det till exempel att lärare ska bli experter på den undervisning de genomför dagligen?
- Vilka utbildningsmässiga mål och krav uppfyller centrumet? Går dessa till exempel i linje med nationella krav på lärares utbildning och kompetensutveckling?
- Vilken typ av lärares professionalisering fokuseras? Till exempel kan det handla om att lärare behöver utveckla kompetens att undervisa inom STEM genom förändrade synsätt, utvecklade färdigheter och bredare kunskap.

Filosofin hos kompetensutvecklingscentra av hög kvalitet är synlig i de program och aktiviteter som de driver. Det handlar bland annat om att:

- Balansera teori och praktik för att stödja lärare lärande
- Ta fasta på många och olika aspekter av lärares kompetenser och erfarenheter.
- Vara flexibel och kontextnära (till exempel genom att möta uttryckta behov hos lärare, elever och industri).
- Erbjuda strukturerat och progressivt innehåll.
- Möte olika förväntningar från målgrupper (till exempel elever, lärare, kompetensutvecklingsanordnare)
- Ha en forskningsbaserad bakgrund.
- Använda olika lärandestrategier (till exempel lärande från erfarenhet och lärande av experter)

Lärande organisationer

Väl fungerande kompetensutvecklingscentra reflektera och utvecklar sitt arbetssätt hela tiden. De agerar som lärande organisationer som är öppna för innovationer, ständigt lärande och utveckling. Sådana kompetensutvecklingscentra strävar efter en bra balans mellan att erbjuda relevant kunskap och att själva ägna sig åt ett öppet och flexibelt lärande. Som lärande organisationer analyserar och reagerar kompetensutvecklingscentra på lärares och skolors behov och utmaningar. De anpassar sig till ett kontinuerligt föränderligt sammanhang. Utvecklingen av högkvalitativa kompetensutvecklingscentra är evidensbaserad och utgår från nationell och internationell utveckling och praktik. Kommunikation och samarbete med relevanta miljöer är avgörande för att säkerställa kompetensutveckling av hög kvalitet.

Som lärande organisationer kännetecknas väl fungerande kompetensutvecklingscentra av att de:

- Avsätter resurser för kritisk reflektion kring sin egen utveckling.
- Löser problem systematiskt (till exempel gällande organisatoriska frågor)
- Experimenterar med nya upplägg
- Lär sig från erfarenheter
- Lär sig från andra (samarbetspartners och målgrupper)
- Överför och kommunicerar kunskap.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

Resurser

För att ett kompetensutvecklingscentrum ska hålla hög kvalitet är det avgörande att centrumet har relevanta resurser. I synnerhet visar professionella lärarutbildare positiva attityder till sitt arbete, har sociala och känslomässiga färdigheter och hög nivå av professionell etik. Expertis i STEM, både ämnesmässigt och undervisningsmässigt, samt utbildning av vuxna är mycket viktigt. Lärarutbildarna har en tydlig vision för sitt arbete och använder vision som utgångspunkt för reflektioner över resultatet av sitt arbete och identifierar behoven för vidare kompetensutveckling. Kompetensutvecklingscentra stödjer en kultur präglad av reflexivt lärande.

Hög-kvalitativa kompetensutvecklingscentra kan bland annat erbjuda STEM-specifika material och miljöer som:

- Guidelines (till exempel generell information om struktur, innehåll och syfte med kompetensutvecklingsprogram eller material).
- Lärandemiljöer (Till exempel för lärare, inklusive information om vad materialet tillför, målgrupp, didaktiska kommentarer, eller för kompetensutvecklingsanordnare, inklusive information om teoretiska modeller, empirisk bakgrund, etc.)
- Verktyg och utrustning (till exempel teknisk utrustning, rum, mjukvara, etc.)

Samarbete

Kompetensutvecklingscentra av hög kvalitet upprätthåller samarbeten och möjligheter till lärande både inom och bortom den egna organisationen. De samarbetar med olika partners (universitet, myndigheter, industri, affärsvärlden, etc.) för att öka medvetenheten om STEM-områdets utmaningar. Nätverkande med andra kompetensutvecklingscentra inom STEM (internationellt och nationellt) visar på centrumens öppenhet för olika perspektiv och innovationer. I synnerhet erbjuder utbytet av kunskap och erfarenheter mellan kompetensutvecklingscentra möjlighet till lärande för varje deltagande centrum, och främjar fortsatt utveckling.

Högkvalitativa kompetensutvecklingscentra stimulerar och främjar samarbete mellan deltagare (till exempel lärare, rektorer, osv.). Dessutom stöder och uppmuntrar de deltagarna till professionellt nätverkande i relevanta miljöer. Genom att erbjuda rika möjligheter till reflektion och diskussion tillsammans med andra (till exempel om lärares arbete i klassrummet, elevlösningar till problem, eller andra artefakter), bemyndigas och uppmuntras deltagare att samarbeta i sitt lärande, vilket representerar ett centralt kännetecken på effektiva lärande- och utvecklingsprocesser.

Högkvalitativa kompetensutvecklingscentra skapar möjligheter för relevanta målgrupper (skolledare, beslutsfattare, lärare, forskare, m.fl.) kan mötas och utbyta kunskap och expertis.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

Utvärdering

Utvärdering är kopplat till förbättringsprocesser. Högkvalitativa kompetensutvecklingscentra undersöker systematiskt resultat och effekter av sitt arbete, med hjälp av olika verktyg för utvärdering och genom att rikta sig mot olika nivåer, till exempel:

- Specifik feedback: Kompetensutvecklingscentra får detaljerad feedback kopplad till specifika kompetensutvecklingsinsatser genom att använda praktiska instrument och metoder (till exempel enkäter eller intervjuer). Resultat och slutsatser används för utveckling av specifika kompetensutvecklingsinsatser.
- Generell feedback: Kompetensutvecklingscentra får kvalificerad feedback om sitt generella utbud. Sådan utvärdering inkluderar vanligen både kvalitativa och kvantitativa metoder liksom triangulering (till exempel under konferenser och mässor) för att få reliabla och valida data.

För att stödja utvärderingsprocesser utvecklar och erbjuder väl fungerande kompetensutvecklingscentra olika användbara instrument och metoder som fokuserar olika aspekter. Eftersom högkvalitativa kompetensutvecklingscentra är intresserade av att fortsätta utveckla sitt arbete har de en inneboende motivation att utvärdera arbetet. Utvärdering ger värdefulla insikter för en systematisk förbättring av de positiva effekterna av kompetensutvecklingsinsatser.

I tillägg till dessa kvalitetskriterier finns det ytterligare aspekter som är relevanta för framgångsrika centra:

- Presentationer på internationell konferenser, synlighet på den internationella scenen
- Stöd från utbildningsadministrationen I landet
- Framstående forskningsartiklar
- Attraktiva för lärare och lärarutbildare
- Garantera kvalitetskriterier och konstant granskning
- Innovation och tillämpbarhet

3.4 Ytterligare uppgifter och aktiviteter

Policy-beslut spelar också mycket stor roll för kompetensutvecklingscentra. Med utgångspunkt i de enkäter som kompetensutvecklingscentra besvarat kunde vi se olika riktningar, beroende på var centrat ligger och hur det finansieras. En grov uppdelning i tre kategorier är

1. Materiell strategi: pressen, tidningar, förlag
2. Personlig strategi: samarbeten med personer som kan bidra till uppskalning, professionella lärandegemenskaper, olika sammanslutningar för lärare
3. Systemstrategi: vetenskapliga sällskap, fackföreningar, utbildningsförvaltning och administration

Vi har också lyckats identifiera olika mål för vår påverkan på policynivån, som att ha goda kontaktermed landets utbildningsförvaltning men även industri och handel, och ha representanter i centrala kommittéer och styrelser eller ha kunskap och insikt I EU-perspektiv.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

4 Slutsatser och rekommendationer

Eftersom det ERASMUS-projekt som bland annat resulterat I denna rapport successivt inneburit ett djupare och kontinuerligt samarbete, har nya insikter tillkommit om de olika aktiviteter som sker vid alla kompetensutvecklingscentra. Nya, och tidigare okända, variabler blir gradvisa synliga.

Därför bestämde vi oss för att lägga till några fler frågor en kompletterande enkät och skicka den till de kompetensutvecklingscentra som ingår i gruppen som arbetat fram rapporten. Denna enkät återfinns I bilaga.

4.1 Samarbete med vetenskapliga sällskap

Som forskare vet vi att vetenskapliga sällskap (Fachgesellschaften) är viktiga intressenter i det här sammanhanget. De står I direkt kontakt med många forskare och utbildare. Vetenskapliga sällskap representerar viktiga perspektiv på de virtuella landskap som utgörs av forskare, av ämnets utveckling och av centrala nya internationella utvecklingsriktningar.

Till exempel är the American Mathematical Society och the London Mathematical Society mycket inflytelserika I sina länder och ingen debatt kan avslutas utan omfattande kommentarer från dessa lärda sällskap. Men inte alla lärda sällskap är I direkt kontakt med aktörerna på vår scen. Så här långt finns inga lärda sällskap som är dedikerade till STEM.

REKOMMENDATION: Kompetensutvecklingscentra bör inleda eller intensifiera samarbetet med lärda sällskap, det skulle gynna båda parter.

4.2 Professionell ledning av kompetensutvecklingscentra

Naturligtvis har många kompetensutvecklingscentra vuxit fram successivt, drivna av individer från STEM-scenen. Nästan ingen av de engagerade kollegorna har utbildning I hur man driver och organiserar ledningen av ett center på ett professionellt sätt. Vi känner inte till något exempel där exporter konsulterats vid administration av ett centrum.

Vi bortser inte från engagemanget från många medarbetare, men vi måste understryka att det finns stora skillnader i effektivitet mellan centra. Naturligtvis behövs personella resurser för att kontinuerligt och framgångsrikt organisera:

- tidningsmaterial för allmänheten
- finansiering och sponsorer
- årsplaner
- föreläsningar
- kontakter på den internationella nivån

REKOMMENDATION: Vi rekommenderar kontakter med organisationskonsulter.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

4.3 Hur kan behovet av insatser identifieras?

Kompetensutvecklingscentra tillämpar många olika processer för identifikation och beslut om vilka insatser som ska erbjudas till lärare och skolor. Ibland bestäms detta av landets utbildningsadministration, vissa kurser föreslås av inflytelserika utbildare och I några fall kan de bygga på ett initiativ från lärare som efterfrågar särskilda insatser.

Vi menar att framgången för en kompetensutvecklingsinsats delvis påverkas av denna process.

Men det beror också på vilken typ av centrum det handlar om. Centra som står nära regeringen agerar vanligen “top-down”, medan andra typer av centra domineras av efterfrågan på klassrums- och skolnivå, dvs. "bottom-up”.

REKOMMENDATION: Vi rekommenderar att kompetensutvecklingscentra reflekterar över om utbudet av aktiviteter är balanserat och inte primärt tillkommit I en “top-down”-process.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

5 Bilagor

5.1 Fallstudier

DZLM

GERMAN CENTRE FOR MATHEMATICS TEACHER EDUCATION (DZLM)

We refer to the presentation of DZLM on its website (https://dzlm.de/dzlm/international- visitors). Parts of the following text are cited from an English version of its homepage and modified according to our categories:

I The DZLM as a German Institution

I.I The Starting Point

The DZLM was initiated and is funded by the Deutsche Telekom Stiftung (www.telekom-stiftung.de), a corporate foundation centred on improving STEM-education. On the recommendation of a panel of experts for Mathematics across the Educational Chain, the foundation created the DZLM in 2011 as a nationwide centre aiming at general quality standards for teacher training. The idea of such an institution was mainly influenced by the characteristics of National Centre for Excellence in the Teaching of Mathematics (NCETM) in London which was run by the prominent mathematics educator Celia Hoyles at that time. In a country where each state has its own politically driven philosophy on professional development, this was a totally new approach.

I.II DZLM Embedded into the Heterogeneous Educational System of Germany

Thus, the centre is an institution completely independent within the highly complex framework of the German educational system. It should be annotated that Germany consists of 16 federal states which are responsible for the educational-policy in their state. Federal state laws regulate education in general, as well as teacher education in Germany. This autonomy results in a heterogeneity in the systems of further qualification of teachers and educators. The differences between federal states are challenging for DZLM, but DZLM also considers them to be a chance: The great variety of successful formats and rich content in continuous professional development courses is thus bundled by the German Centre for Mathematics Teacher Education. To disseminate the concepts, materials and courses at a large scale and to ensure their practicability for the target group, the DZLM cooperates closely with the education authorities in the different federal states, strengthened by the help of specific local coordinators and federal delegates from education policy. As a consequence, DZLM can draw on the experience of the partners in teaching and research, in the didactics of mathematics and in pedagogy.

Further, *the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany (KMK)* takes over a coordinating role.

DZLM is successfully in establishing in the landscape of professional development in Germany and it is well-known to all stakeholders. However, DZLM has not reached a permanent status. It is not a trivial question how to anchor and finance an institution like DZLM in the Federal Republic Germany in the future. At the moment, various negations are underway to reach a compromise in 2019. The problems are described in Section 8.

I.III The Constitutive Partners, the Personnel and the Budget

At the moment members of eight universities are involved in the consortium: Humboldt-University Berlin, Free University Berlin, Ruhr-University Bochum, Technical University Dortmund, University Duisburg-Essen, University of Education Freiburg, Paderborn University and University of Potsdam. The main office resides at the Humboldt- University. DZLM succeeded in having contracts with these universities regulating the cooperation.

On the basis of such a construction, DZLM owns a wide panel of various experts in professional development, from primary schools to secondary schools, from mathematics to education theory at the different residences of their universities in Germany with many different research interests. Since the professors are further engaged at their universities on the basis of their regular contracts, the work is divided between them and many young scientists or seconded teachers. Most of them are PhD candidates…, often researching issues of professional development.

Only travel expenses of the professors and the expenses for courses are paid by DZLM, thus round about 60 % of 1.2 million euros per year is used for internal financing.

It is self-evident, that DZLM cooperates with further partners in the fields of mathematics, mathematics education and educational research as well as the educational institutes of the different federal states.

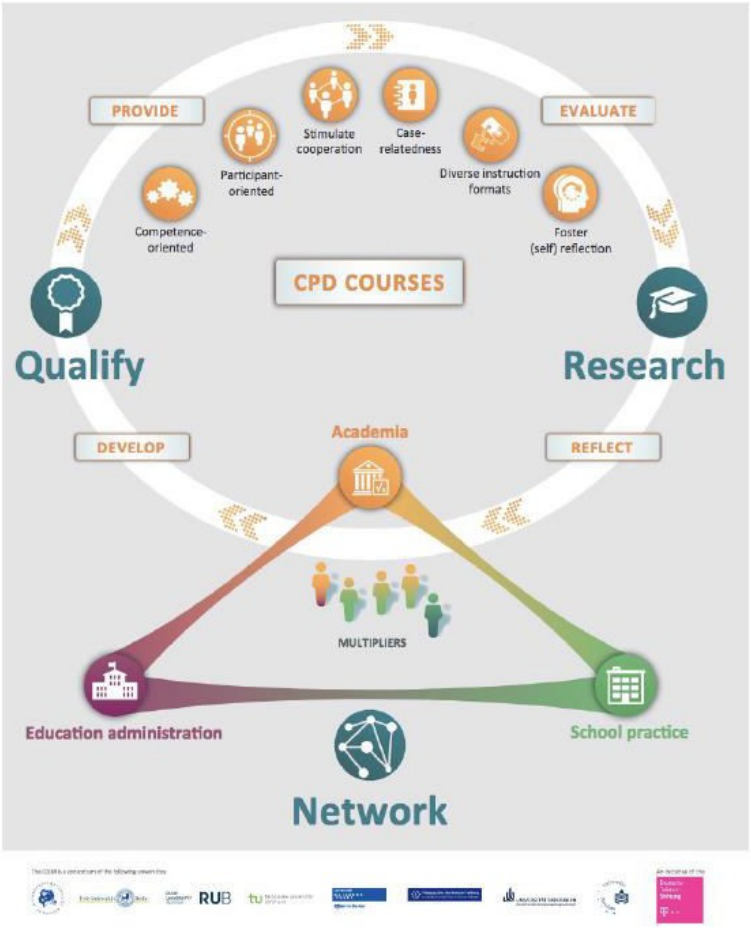


Figure 1: The embedding of DZLM [https://www.dzlm.de/files/uploads/DZLM_Flyer_English-2016_12-07%20DRUCK.pdf]

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

II Philosophy, Mission and Networking

II.I Traditions of PD Centres in Germany

It is easy to provide an answer: There is no tradition of mathematics PD centres: however, over many decades, various cooperation (of different insensitivities) have been developed regionally with institutions of the educational systems, but none has ever reached a global (a country-wide) `charisma'.

This maybe explained by the federal structure of the German educational systems with authority in the specific `Bundesländer'. Next, we would like to annotate that the learned societies of physics and chemistry have a lot of resources to pay for professional development and they are doing it since companies and firms are existing; this is not true for mathematics since there does not exist a mathematical industry and last not least there was no tradition built up by the German mathematical society. Note that only a small percentage of teachers are members of mathematical society, differently to the situation in the former Eastern bloc.

II.II Philosophy and Mission

It was decisive that a `neutral' stakeholder, namely the Deutsche Telekom foundation affine to mathematics, has taken over the responsibility. And again the Deutsche Telekom Stiftung set the specific well-defined objectives for the centre for which it was willing to pay. Both, the universities and all other partners involved in the German Centre for Mathematics Teacher Education have a common mission:

- To accompany the professional development of mathematics teachers during their whole career.

Since it is impossible to address each mathematics teachers in a country with more than 80 million inhabitants and more than 100.000 mathematics teachers, we have to restrict our mission to teacher instructors (multipliers). DZLM follows a trend that was formerly accentuated by the group of Katja Maas at Freiburg, namely Educating the Educators.

The continuous professional development (CPD) courses, concepts and materials follow a competence framework and design guidelines according to the latest research results in teacher education. Also, comparable concepts for the support and the securing of early education in mathematics are developed. These concepts result in CPD courses for kindergarten and elementary educators.

II.III Networking as a Crucial Issue of a PD Centre

It is an important objective to create networks between many different types of partners: teachers, colleagues, institutions and societies wherever possible. Thus, we network on a national and international scale through conferences, institutional cooperation and the creation of regional branches:

- Cooperation between educational and government institutions or ministries from different German federal states
- Creation of a web portal offering information, material for professional development and interactive teaching environments
- Inclusion of further education offerings from other people, projects or institutions through integration or linking

Research reports in literature prove that isolated initiatives are in general not successful, mathematics educators need various partners in different systems, they need friends. DZLM knows that networking between various levels promotes professionality (see the figure on page 2). These initiatives are indispensable. DZLM does not like to be regarded as a competitor. In a governmental system we would not have a chance to win.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

DZLM's activities are in line with a coherent concept of mathematics education from kindergarten and elementary education to upper secondary level that includes diagnosis and advancement of students' learning processes in mathematics.

The DZLM is interested in being a prominent member of the European Network of STEM Professional
Development Centres.

III Activities

The DZLM's fields of action are:

- topic-specific (mathematics) and practice-oriented;
- research-based, and seek to gain and share insights;
- networked throughout school levels.

The activities of the German Centre for Mathematics Teacher Education can be structured in three main strands:

Certified Qualification Measures:

- Creation of a nationwide master course for teacher educators
- Subject-specific and didactical qualification of teacher educators particularly for professional development
- Further qualification of out-of-field teachers
- Qualification events and courses for teachers and elementary educators Research in Teacher

Research in Teacher Education and Professionalization:

- Evaluation of activities of the German Centre for Mathematics Teacher Education and of other agencies
- Research in the effectivity of professional development courses and publication of the results on an international level
- Research-based design of the quality framework (theoretical basis, design guidelines and competence framework)
- Initiation and financial support of professional learning communities (PLC) for peer coaching and competence development

Development of Material and Concepts:

- Development of material used by teacher educators in CPD courses
- Development of material used by teachers and elementary educators for self- teaching
- Development of information material, videos and flyers
- Joint development of concepts with teacher education institutes and ministries in the German federal states

IV The Theoretical Framework

The theoretical framework constitutes the foundation of its activities and builds upon theory and is evidence based.

- A competence model,
- a research and development agenda and
- design guidelines

have been derived from this and serve as a basis for the actual continuous professional development courses. All activities are monitored for quality with a systematic evaluation by means of transparent criteria. A subdivision within the centres is responsible for coordinating and monitoring design-based research around the courses.

Research on professional development is a central part of the agenda of DZLM, especially the PhD-graduation and qualification of young scientists providing also an international auditorium.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

Specific Aspects

V Political Dependency

Since DZLM is actually not a part of the German educational system and is not paid by government, it is of course politically independent. Using a metaphor, DZLM is thus a further provider – and not to be ignored – a further competitor in the market of professional development. Thus, DZLM is free to set up its own norms.

On the one hand, this independence can be seen as an advantage: DZLM may experiment, may generate its own patterns and may follow new tracks.

On the other hand, having no political power behind it, independence is also a disadvantage. So the institution knows that it has to downplay its role and should seek for cooperation. Meanwhile, this role has been practised and accepted. Many courses are run beyond a label DZLM & xy or xy & DZLM.

VI Interdependence of Initial Teacher Education and DZLM Activities

The German Teacher education system consists of three consecutive levels. Firstly, there is the teacher education at university and in the most `Bundesländer' the university curricula are being subordinate to different ministries, the ministry for academic and sciences on one hand, the ministry for education and schools on the opposite side.

After graduating from university the prospectives have to go into a preparatory service for 18 months. Actually, there is almost no cooperation between the persons in these virtual institutions and the faculties at university.

Having obtained a teacher position at school, the (novice) teachers are now in front of their classrooms. That is the first time that DZLM might address these teachers within the complicated role as novice teachers. One may regard this process as new and substantial, whereas in older times professional development has been seen as an upgrade after several years of service.

Thus, DZLM propagate that professional development initiatives should start as early as possible. Next, we would like to make professional development initiatives also as self-evident as possible. Thus cooperation at the moment highly depends on the program offered by DZLM.

VII Quality Assurance

As mentioned before using design-based research, DZLM is trying to influence the design of any course in advance. DZLM-members conduct the courses themselves or work together with experienced partners in the federal states, with whom they develop the courses together or make sure their concepts are in line with DZLM- standards and goals.

Next, after intensive discussions DZLM has set up specific position papers, namely

- a competence model and
- design guidelines.

These documents serve as a basis for the actual continuous professional development courses and are continuously revised according to new research and practice experiences. All activities are monitored for quality with a systematic evaluation by means of transparent criteria.

VIII Interdependence of Research and Practice – a Balance Act

Nevertheless, having accompanied the development of DZLM for many years and being at the same time also involved in the international research domain of professional development, the author has often posed the question of what is really sustainable. We should not ignore: DZLM consists of highly qualified persons from

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

universities and only partly experienced teacher instructors.

To be honest, it is not easy to guarantee that professional development is successful. Firstly, we should accept that teachers, their classrooms and their students live in a world which is disjoint from our field of experiences, the world of universities, the world of research projects. Next, we should reflect how we can bridge between these two strands. For the author, it is extremely difficult to balance between research and practice and that is an actual (hidden) struggle at DZLM.

To run courses for teachers and teacher instructors is not very deserving in the university world, a professor will not be honoured through such initiatives when he/she applies for a new position. Persons at a university will be measured by the amount of research money which they have achieved in the past. Numbers of publications in referred journals are decisive; however, teachers normally have no access to this literature and no time to study them.

On the other hand, teachers at schools are in most cases reserved towards what is offered as the latest research results by university teachers. They have often experienced that the worldviews of researchers about classroom are far beyond from being adequate. Thus, we need solutions balancing between practice and research while serving for the DZLM.

What was described for the individuals is also valid for the ranking of the whole institution DZLM. Is DZLM an institution for research or for generating materials and course? Yes and no, DZLM has to play both roles, but also sees this as one of its unique characteristics compared to other institutions.

Miscellaneous

IX Conclusions and Recommendations

IX.I The Role of Learned Societies

Since DZLM only addresses mathematics teachers, there are only two learned societies which should cooperate. The centre has strong relations to the

- German Mathematical Society (DMV) as well as to the
- German Mathematics Education Society (GDM) and
- Verband zur Förderung des MINT-Unterrichts (MNU; http://www.mnu.de/index.php).

DZLM is usually present at their annual conferences and supports in particular any activity which is run on the `Teachers' day'. Some members of DZLM also work within joint commissions.

IX.II Networking; Informal Education

Since DZLM does not address the individual teacher, but teacher educators, the link links are not very strong to *informal activities* of the communities of teachers. However, if there are requests DZLM would not refuse its collaboration,
e.g. seeking for experts accompanying professional learning groups (PLG).

IX.III Diversity of PD Centres: Culture, International Relations

DZLM is so far not a permanent institution, thus its highest priority is actually given to efforts which guarantee the permanent existence. Thus, the STEM initiative in general plays a minor role since resources are limited.

IX.IV Visions

The predominant vision: DZLM will become a permanent institution, financed by a governmental system and will contribute to a development of mathematics all over the German teachers' culture.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

IX.V Publications

Here you can find international publications by DZLM members. A complete list of publications in German and English is available https://dzlm.de/dzlm/international- visitors/publications

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

NATIONAL CENTRE FOR MATHEMATICS EDUCATION (NCM)

We refer to the presentation of NCM within on its website (https://http://ncm.gu.se/node/203).

Parts of the following text are cited from an English version of its homepage and modified according to our categories. Also by the help of Peter Nyström:

I The NCM as a Swedish Institution

I.I The Beginning

In 1999 the Swedish government decided to establish a National Resource Centre for Mathematics Education at Göteborg University (UGOT) and reserved some funding for that purpose. The centre would coordinate, support, develop and implement the contributions which promote Swedish mathematics education from pre-school to university college.

The centre also utilizes the experiences and the knowledge base evolving within the framework of the Nämnaren project which started as a journal for mathematics education in 1974. After years of planning, the first issue of a second journal, Nordic Journal for Research in Mathematics Education, NOMAD, was launched in the fall of 1993.

Thus, the centre was developed based on a long tradition of in-service training of mathematics teachers in Sweden.

I.II The Embeddedness

NCM is the Swedish National Resource Centre for Mathematics. Its main task is to support the development of Swedish mathematics education. It is one of a number of centres for different school subjects established by the government over the last 15 years. NCM does not come under the auspices of any state authority, but is an independent body at Göteborg University.

University of Göteborg is a large higher education institution in Sweden. One of many profile areas is knowledge formation and learning, where teacher education plays an important part. The university offers the broadest range of teacher education in Sweden in terms of available programmes and subjects.

I.III The Constitutive Partners, the Personal and Budget

UGOT hosts the Swedish National Centre for Mathematics Education. The centre is commissioned and financed by the Swedish government with the mission to coordinate, support, develop, carry out and follow up initiatives promoting Swedish mathematics education in pre-school, school and adult education. NCM is also specifically expected to stimulate and disseminate research in mathematics education in Sweden.

It is self-evident, that NCM cooperates with further partners in the fields of mathematics, mathematics education and educational research as well as the ministry of education.

The most important cooperation and collaboration is with the Swedish Agency of Education (the governmental authority responsible for school

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

development, curricula etc. in Sweden.) NCM also collaborates with other PD-Centres, including the Norwegian Centre for Mathematics Education. Not to forget with several universities in Sweden, to some extent through their specific centres for in- service training of teachers.

NCM employs six academics as facilitator and one as researcher, three non-academics as well as another employee (75% of full employed). The research is done individual and play a minor role for the NCM.

What is the money spend for?	Rough percentage
Staff	60%
Materials (development)	13%
Other	27%

Half of the funding comes from the third party funding. The other half comes from the educational ministries as well as centre's intake (publishing, ...).

Thus, the centre has a budget of more than 1 million euros per year.

II Philosophy, Mission and Networking

II.I Target Group of NCM

Nursery school and in-service teacher with a University degree use local and regional conferences as a PD. Those conferences are mostly one day, working in professional learning communities and regular courses. NCM reaches by year about 500 nursery schools and 1000 in- service teachers. However, through the website and materials developed at the centre, they reach a much larger group.
Pre-service training of teachers is not a goal for NCM. The materials are however widely used in pre-service training of teachers and they facilitate a yearly conference for pre-service teacher educators in mathematics. 2017 approximately 60 educators participated in the conference.

Also school-leaders (which need a university- degree and school-leader program) are not a primary target group for the centre. In some development projects school-leaders are included. During the large scale national PD-project for mathematics education 2012-2016, NCM was responsible for a program for school-leaders. Over the whole period they reached almost 3000 school-leaders.

Varying, in-service training is done by universities, but also by a variety of private initiatives. Thus, this group isn't a goal for NCM.

II.II Philosophy and Mission

The mission of the centre is to coordinate, support, develop, carry out and follow up initiatives promoting Swedish mathematics education in pre-school, school and adult education. Specifically, NCM is commissioned to stimulate and disseminate research in mathematics education in Sweden.

Specific Aspects

III Characteristics of NCM Activities

III.I Main Ideas

The NCM is working on all sorts of ideas related to teaching and learning mathematics in school, and it is difficult to pinpoint the most important ones. However, trying to list the activities of NCM results in three main strands:

Teaching Number and Problem Solving:

They have over the years had a fairly strong focus on the teaching of number from pre-school all through compulsory school. This is based on the fundamental role of understanding number in order to learn mathematics. Problem solving is another important theme (of course). One example of the efforts in this area is the work with Cangarou sans Frontiers/Kangaroos without

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

borders, which is an international competition distributing challenging problems to all students. The project has a number of different `classes' for students of different ages. Approximately 150000 students participate in Sweden each year.

Courses, conferences and other PD activities:

Another important idea is to give teachers concrete suggestions for activities in the classroom, which are based on fundamental goals and principles for mathematics teaching and learning. This idea influences strongly the efforts to produce materials that are published in their books and journals, and the rich material published on the website of NCM. This idea also influences their planning of courses, conferences and other direct PD activities. NCM finds it important that teacher try out activities and that they gain experience using different approaches in the classroom. This is an important key to effective professional development. One particular area which the centre has been promoting is the use of hands-on materials in the teaching and learning of mathematics.

Research in Teacher Education and Professionalization:

A third important idea that highly influences the priorities of the centre is the spreading of relevant research in mathematics education, transformed into a useful form for teachers. But also (and equally important) spreading of best-practice and praxis-related knowledge developed by teachers. Many of NCM-publications are characterized by a mixture of voices, both researchers and practitioners, presenting important and interesting lessons learned about teaching mathematics which are relevant to teachers.

The PD-offers are 100% focused on the pedagogical content knowledge (PCK).

III.II NCM Activities

The typical activities of the Swedish National Centre for Mathematics Education fall into the follow areas:

- Half-day course for teachers about hands-on activities in mathematics:

Groups of teachers come to the mathematics workshop and are given an introduction to ideas behind using manipulatives and are offered the opportunity to test some activities.

- Municipalities arranging a series of half- day or whole day meetings for their teachers, asking NCM to contribute in planning and executing.
- Conferences (mostly half day) for teachers explaining, exemplifying and encouraging the use of materials produced by NCM.

IV Quality Assurance

Among those working at NCM, there are people with experience from the national school curriculum, syllabus and test development work, national and international assessment and conference activities, national and local research and competence development projects. Also people with knowledge of Information Communication Technology (ICT) and distance learning, teacher training and supplementary education, text book production for both teachers and students, work in pre-school, preschool classes, all levels of the nine-year compulsory school, upper secondary school and as remedial teachers. In addition, there are researchers in mathematics and mathematics education.

They are responsible for and participate in various activities and projects such as

- Publication of the magazines Nämnaren and NOMAD
- Publication literature for teacher training
- Participation and organization of seminars, courses and conferences

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

- Operation and development of several websites.

All activities are monitored for quality with a systematic evaluation by means of transparent criteria.

V Best-Practice Examples

Three examples of best-practice that the NCM-Centre has been working with:

Important aspects of learning numbers:
They have produced a book together with the Australian researcher Alistair McIntosh which describes important aspects of learning about number in grades 1-10, including diagnostic tests for each year. They also give short courses in how to use the book and how to lead others in using the book. The book is frequently used in many schools in Sweden and has been a huge success.

Teaching material for pre-school class:
NCM has also developed a teaching material for pre-school class, i.e. school for six-year old children in Sweden which is a bridge between pre-school and school. For this they have material met with many
teachers to introduce the ideas in the material and also leading a network of teachers who use the material and who lead colleagues in using the material.

The pre-school project they are working with was thoroughly investigated in the developmental phase and they are currently working on a book describing the project more deeply. This book will only be published in Swedish. There is however one publication in English about this project (http://ncm.egu.se/media/smdf/Published/No10_Madif9/159168-Sterner_Helenius.pdf).

The boost for mathematics:
The centre has been deeply involved in the large-scale national professional development project for all teachers of mathematics (`The boost for mathematics'), which reached a majority of Swedish mathematics teachers in 2012-2016. The project continues and new modules are developed and publish on a web-portal run by the Swedish National Agency of Education.

The `Boost for mathematics' project has been extensively evaluated and there seem to be a lot of positive effects so far. The long-term effects remain to be investigated. The publications are in Swedish, and there is very little published in other languages. One of the Swedish publications (https://www.skolverket.se/publikationer?id=3706) is an evaluation made by researchers in mathematics education at Ume University.

A more local study of the effects of the project (and another local project) on student learning was recently published:

Lindvall, J. (2017). Two large-scale professional development programs for mathematics teachers and their impact on student achievement. International Journal of Science and Mathematics Education, 15, 1281.1301.

Currently NCM is developing modules for Coding and mathematics and Special education and mathematics.

VI Interdependence of Research

Research has had an important role in the centre as individual projects and as a foundation for activities and projects at the centre, but not so much as a commitment for the centre as a whole. Reviews of research have of course played a significant role, but not so much empirical research first hand. However, recently the centre has been engaged in developmental projects with a clear research agenda.

VII Conclusions and Recommendations

VII.I Major Challenges

There are different ways of looking at challenges. One type of challenge concerns factors that limit our possibilities to make a difference for the

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

teaching and learning of mathematics. One such factor concerns the often short-term character of projects. NCM wish to engage in more long-term, sustainable efforts of professional development. Another factor is the financial situation, which makes it difficult to initiate and run the kind of projects that could make a difference.

Another type of challenges concern the areas where professional development is most needed and perhaps most hard to achieve. NCM is currently involved in planning for a project that will address two of these challenges: developing the confidence and knowledge in mathematics for teachers in primary school (which is a pre-requisite for doing a lot of the teaching that we know can make a difference) and developing structures where teachers efforts of developing mathematics education is supported by school-leaders and policy makers in a sustainable way.

VII.II Diversity of PD Centres in Sweden

In Sweden are further STEM Centres next to NCM. But not with the specific focus for mathematics education. To name but a few: (We refer to the presentation of the Centres within on their website.)

The National Resource Centre for Chemistry Teachers (KRC)
[http://www.krc.su.se/page.php?pid=140]

In June 1994 Kemilärarnas Resurscentrum, KRC got an assignment from the Swedish government to start a Centre supporting activities of chemistry teachers in Swedish compulsory and upper- secondary schools. The general aim of the Centre is to promote and stimulate interesting and up-to-date teaching of chemistry in Swedish schools. The Centre is supported by Stockholm University.

Centre for School Technology Education (CETIS)
[https://liu.se/cetis/english/index_eng.shtml]

The Swedish National Centre for School Technology Education, CETIS, at Linköping University started in 1993. In 1996, the government made CETIS a national centre. The main aim of the Centre is, in collaboration with teachers, teacher-trainers, and representatives for industry etc., to develop technology education in schools.

National Resource Centre for Physics Education (NRCF) [http://www.fysik.org/english/]

The National Resource Centre for Physics Education located at Lund university is aimed at being a resource for teachers from preschool to upper secondary school (high school). The aim is to inspire and stimulate the development of physics education and to give teachers the opportunity to further studies of physics.

National Centre for Science and Technology's Didactic (NATDID)
[https://liu.se/forskning/natdid]
One of the new Centres is the national Centre for science and technology didactic. The aim of this is that teachers should be able to translate subject didactic research into practice and thereby let the school rest on a scientific basis. NATDID was established after a government decision in February 2014 and is located at Linköping University.

As can be seen, the founding is usually associated with the decision of the Swedish government. But it suggets itself that there is a need for networking and exchange.

VII.III Publications

Some highlighted publications are

- *Matematikundervisning i praktiken* [Mathematics teaching in practice]. A collection of essays about

different aspects of teaching mathematics in compulsory school (470 pages).

- *Förstå och använda tal* [Understand and use numbers]. A guide through teaching about number throughout compulsory

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

school, including diagnostic tests intended for formative use in each school year.

- *Blå strävor* [Blue aspirations]. A collection of activities specifically designed for use in mathematics

education for students with learning disabilities.

Here you can find publications by NCM members http://ncm.gu.se/publikationer

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

T³ EUROPE

T3 EUROPE – Teachers Teaching with Technology

This case study has been written in collaboration with Oliver Wagener and Ian Galloway.

I Philosophy

Frank Demanna and Bert Waits started T³, Teachers Teaching with Technology, in 1986. The T³ philosophy is exemplified by a quote from Bert Waits in 2000,

- Some Knowledge and Skills become more important because technology requires it.
- Some Knowledge and Skills become less important because technology replaces it.
- Some Knowledge and Skills become possible because technology allows it.

II Traditions of STEM PD centres

T³ has arisen from a grass roots drive to find better ways to teach mathematics. Its vision statement being:

> *Technology has changed the mathematics and science classroom, and its impact will continue to grow. Technology provides the opportunity for all students to be active learners as they are afforded the chance to explore and investigate what they have learned in the classroom. When used effectively by a well-trained teacher, technology supports the learning of mathematics and science students, enhancing rather than degrading their skills. Technology provides value as an efficient means of analysing data and instantly seeing the results. It provides opportunities for further exploration. These activities allow insight and understanding which is not available without the use of technology.*

T³ refers to this bridge to learning and understanding as *The Power of Visualisation*. This has evolved to encompass science as well as mathematics. T³ today regularly brings mathematics and science teachers to discuss content and pedagogy. T3 Europe is part of this tradition.

III A survey of STEM PD centres

T³ Europe is composed of 12 countries each with its own website and all linked to the umbrella site of T³ Europe. Funding for all the activities is derived from Texas Instruments (TI) who as owns the T³ logo.
The result is a symbiotic relationship between T³ and TI in which TI consults T³ to better understand how to reach policy makers and T³ consults TI during product development. The common language when meeting as T³ Europe is English. Each country is self-regulated and devises its own programme of activity. Every two years T³ Europe organises a conference by invitation, Sharing Inspiration, held in a European capital city.

IV Foci and activities of STEM PD centres: consultancy, PD provision, curriculum and content development.

Sharing Inspiration is about

- providing quality professional development that enables the mathematics and science educator to

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

be successful in the classroom through the appropriate use of technology;
• developing state-of-the art classroom pedagogy or didactics and sharing it with our peers both nationally, within our T³ country organization and internationally as T³ Europe
• sharing expertise in training, educational curricula and exam development;
• sharing this expertise with Ministries of Education, curriculum development and exam bodies, public and private pre- and in-service professional development organisations, pedagogical research institutions, textbook publishers and other content providers

we seek

• to identify common elements across European STEM curricula and teaching methodologies.
• to promote inquiry-based learning through the use of real-world applications and data collection devices for students aged 10-19.
• to encourage a balanced approach combining the use of graphing and other technologies along with mental skills and paper and pencil skills to support STEM curricula.
• to inuence the content of STEM curricula and students' skills through demonstrating the power of technology to accelerate student cognition.

Each national T³ organisation supports these aims but will use its own networks and methods of working to achieve them.

Specific Aspects

V Political dependency

T³ Europe is politically independent but seeks the ability to cooperate with political administrations. By its very nature the use of technology within the classroom and the examination system is often rejected, not only by politicians but by society at large. By sharing expertise with Ministries of Education, curriculum development and exam bodies, public and private pre- and in-service professional development organisations, pedagogical research institutions, textbook publishers and other content providers, T³ Europe is working towards a more equitable landscape.

VI Interdependence of initial Teacher Education and STEM centre PD activity

Activity is frequently integrated into ITE programmes, and in some institutions this is systematic. In general there is no interdependence and any activity only serves to make trainee teachers aware that such technology exists and has the potential to be useful in the classroom.

VII Quality assurance

T³ Europe has no formal process of assuring quality. This does not mean that it is ignored, quite the contrary, the organisation is always examining its own protocols and content with a view to improving.

All website content for example is peer-reviewed, PD providers themselves have undergone extensive peer observation and this information is fed back to organisers and website managers.

T³ trainers do use evaluation sheets and the whole network of T³ members is looking at impact back in the classroom on an ongoing basis. This never stops and is formally recorded through the use of focus groups conducted by Texas Instruments developers at international conferences. In this way the hardware, firmware and software is continually updated through teacher feedback ensuring that it is of the highest possible quality and efficacy for teaching and learning.

VIII Interdependence of research and practice

There is cooperation within T³ between researchers and practitioners who are both using the technology to improve learning. Researchers and practitioners meet with each other at conferences, particularly *Sharing Inspiration*, and exchange views and ideas.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

As well as funding T^3 activities, Texas Instruments also funds research and some university teaching. The interdependence is then a triangular one!

IX Conclusions and recommendations

IX.I The role of learned societies

Many T^3 Instructors belong to learned societies, and this helps to connect the pedagogical use of technology to committees and working parties within these groups who may be working on educational projects.

IX.II Networking; informal education

Networking is a principle aim of the T3 organisation. Sharing Inspiration is the highlight of the T3 Europe calendar and brings together teachers from many countries including the USA and Australia. Considerable effort is made to include educational administrators and researchers to ensure that networking is vertical as well as horizontal.

IX.III Diversity of PD centres: culture, international relations

Composed of 12 different countries T^3 Europe is already very diverse in terms of culture and language.

Networking is supporting other countries wishing to become a partner of T^3 Europe. Members themselves are engaged with many different examination systems, Germany alone has 16 different federal states. Not only are our exam systems different but curricula vary widely. The one feature we have in common is how best to use technology for the learning of students.
In identifying common elements across European STEM curricula and teaching methodologies we are helping to improve international relations.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

LEHRERiNNENBILDUNG WEST
RECC Biolgie, RECC Mathematik & Geometrie

LEHRERiNNENBILDUNG WEST

I The cluster LEHRERiNNENBILDUNG WEST

I.I The "Birth" . . .

The cluster LEHRERiNNENBILDUNG WEST (LB-West) was launched by the cooperation agreement „Sekundarstufe (Allgemeinbildung)" between five institutions in 2016. In 2014 already, the subjects „Mathematik & Geometrie", „Physik" and „Biologie" were accredited with the RECC- label (regional educational competence centre). In 2015, „Geographie & Wirtschaftskunde" and „Deutsch & Mehrsprachigkeit" were also accredited with the same label [3].

I.II LB-West embedded into the Heterogeneous Educational System of Austria

In 2012, after the approval of a new law [2] concerning the teacher's education system, four cluster across Austria were installed in order to design the new teacher education programme. As a consequence of the new law, the pedagogical colleges and the universities have to collaborate and are responsible for the whole teacher education. The collaboration may also offer a stronger involvement of the universities regarding the PD courses, especially in the STEM subjects. In Western Austria this clusters has been renamed to LB-West.

I.III The Constitutive Partners, the „Personnel" . . . and the Budget

The LB-West comprises two universities (University of Innsbruck and University Mozarteum) and three pedagogical colleges (PH Tirol, PH Vorarlberg and KPH Edith Stein). Two regional competence centres (RECC Biologie, RECC Mathematik & Geometrie) – collaborations within the LB-West – are partner of the STEM PD Net-Project. The universities are mostly autonomous and related to the Federal Ministry of Science, Research and Economy; the pedagogical colleges are under the supervision of the Federal Ministry of Education. The LB-West is run by the heads of the participating institutions and has not an own budget.

II Philosophy, Mission and Networking

II.I Traditions of PD centres in Austria

In Austria, the so called pedagogical institutes (Pädagogische Institute) were responsible for teachers' PD courses till the foundation of the pedagogical colleges (Pädagogischen Hochschulen) in 2007. In 2004/5, the Federal Ministry of Education set up six Austrian Educational Competence Centres (AECC) to support the teacher education (pre-service and in-service). Five centres for the subjects biology, chemistry, physics, german, mathematics, and the institute of instructional and school development.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

II.II Philosophy and Mission

The main aim of LB-West is to implement the „PädagogInnenbildung Neu" [1] in Western Austria, but it offers also the chance to reshape the PD courses especially in the STEM subjects under the RECC labels.

II.III Networking as a Crucial Issue of a PD Centre

Since the LB-West comprises several institutions and collaborates intensively with the school authorities in Tirol, Vorarlberg and Südtirol, networking is a core mission of the LB-West.

III Activities

The main focus at the moment is to implement (we are starting the third year) the new teacher education programme. Especially in science education and mathematics education new courses were designed.

IV Specific Aspects

IV.I Political dependency

The origin of LB-West was in 2013 when a new law was released in order to reform the teacher education in Austria [2] Part of the new law was that pedagogical colleges and universities plan and implement the new teacher education in a close cooperation. From a political point of view, the pedagogical colleagues are depended of the Federal Ministry of Education meanwhile the universities are in the competence of the Federal Ministry of Science, Research and Economy, but act autonomously. Before the new law in 2013, only the pedagogical colleges were allowed to offer PD courses, although many researchers from the university gave the courses. With the new law, this restriction was softened and therefore it is reasonable that at least the subjects under the RECC-label will plan and offer PD courses together.

IV.II Interdependence of initial Teacher Education and STEM PD activities

The new structure of the teacher education in Western Austria allows a close connection between the initial teacher education and future PD courses in the LB-West. In the new teacher education programme all secondary teachers (upper and lower, academic and vocational) graduate from the same study. Before the new teacher education programme, the pedagogical colleges only educated the teachers for the lower secondary (part of it), but offered PD courses for all teachers. In the pedagogical colleges, we have now the chance to employ the same teacher educators for the initial teacher education and the PD courses, especially in the subjects under the RECC label.

IV.III Quality assurance

Quality assurance with respect to PD courses is still an open topic within the LB-West. In 2015/16, the RECC Mathematik & Geometrie under the lead of the pedagogical college Tyrol tested a new PD format, with face-to-face meetings and an implementation phase between those meetings. A modest monitoring showed that the acceptance by the teachers was quite low. Therefore, new PD course structures are recently discussed. An alternative approach may arise from the initial teacher education itself. The curricula of the new teacher education foresees a closer collaboration with in-service teachers and emphasises the exchange between researchers and practitioners in specially designed courses. We hope to extend such collaborations also for the PD courses in a few years.

At the moment, no certificate is needed for a successful graduation of a PD courses, only the attendance counts.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

IV.IV Interdependence of research and practice

Subject-specific education in Western Austria got only recently – within the context of the new law concerning the teacher education – an institutional framework. At the University of Innsbruck a new institute – at the new faculty School of Education – was founded and at the pedagogical college Tirol the „Fachdidaktikzentrum" was initiated. In biology, research on conceptual change with focus on learning outside the classroom is implemented directly in PD courses already for several years. In mathematics, subject-specific education is at the very beginning, but gathered some experiences in the field of inquiry-based learning within the EU- project mascil and conducts actual a survey on the natural number bias. For the next year, we plan PD courses together with practitioners with a focus on topics from pedagogical content knowledge.

V Conclusions and recommendations

V.I The role of learned societies

Due to the early stage of the LB-West, the relations to learned societies in Austria are in still in an initial phase.

V.II Networking; informal education

Due to the early stage of the LB-West, there not yet links to informal activities of the communities of teachers.

V.III Diversity of PD centres: culture, international relations

Due to the early stage of the LB-West, international collaborations in the field of PD are not yet established. The RECC Biologie and RECC Mathematik & Geometrie are partner in the STEM PD Net project.

V.IV Visions

LB-West is going to be responsible for the teacher education in Western Austria.

V.V Publications

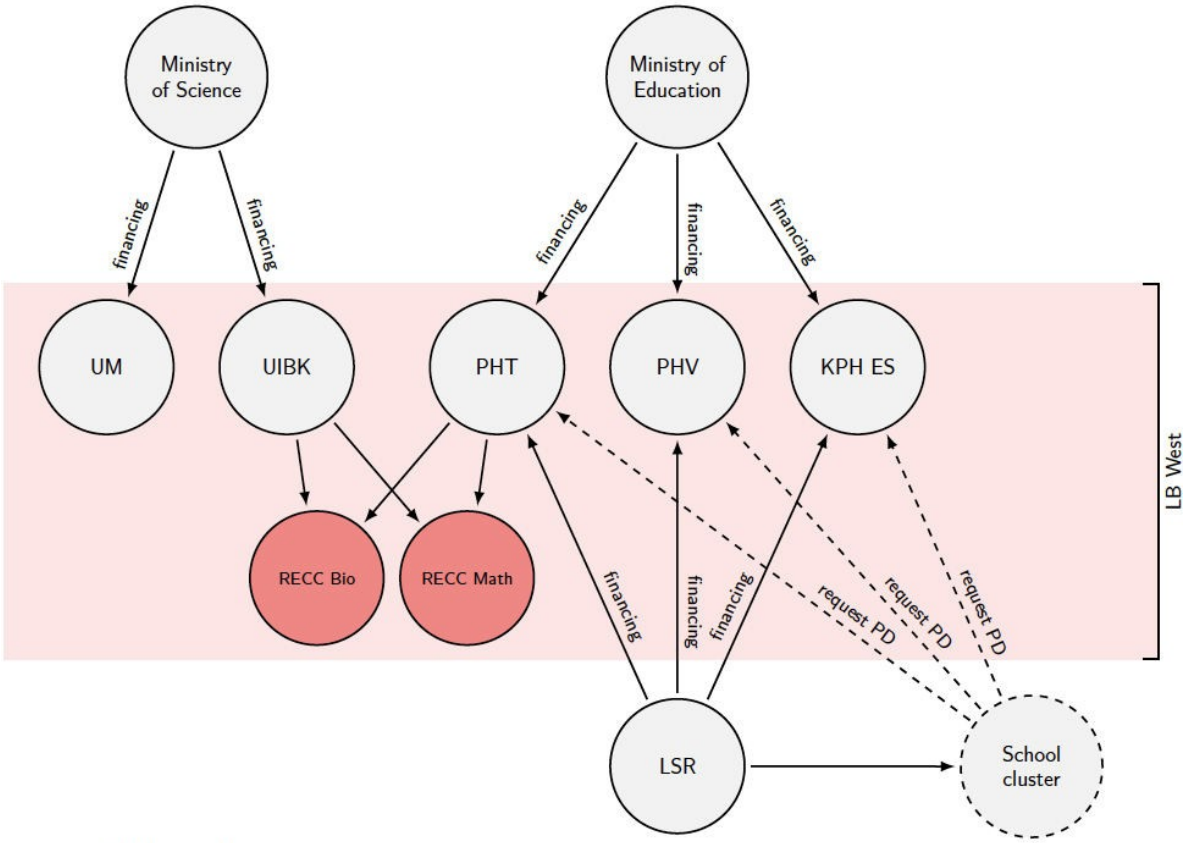
The LB-Wes WEST exists since 2016, publication within the cluster are in preparation but not yet published [1].

[1] Bundesministerium für Bildung (BMB) (2017). PädagogInnenbildung Neu. url: https://www.bmb.gv.at/schulen/pbneu/index.html (visited on 11/10/2017)

[2] Bundesministerium für Unterricht, Kunst und Kultur (BMUKK) (2013). Bundesrahmengesetz zur Einführung einer neuen Ausbildung für Pädagoginnen und Pädagogen. url: http://www.parlament.gv.at/PAKT/VHG/XXIV/I/I_02348/index.shtml (visited on 11/10/2017).

[3] Universität Innsbruck and Pädagogische Hochschule Tirol (2017). Regional Educational Competence Centre | Regional Educational Competence Centre. url: http://recc.tsn.at/ (visited on 11/10/2017).

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union



Abbrevations:

UM Universität Mozarteum
UIBK Universität Innsbruck
PHT Pädagogische Hochschule Tirol
PHV Pädagogische Hochschule Vorarlberg
KPH ES Kirchliche pädagogische Hochschule – Edith Stein
RECC B Regional Educational Competence Center – Biologie
RECC M Regional Educational Competence Center – Mathematik & Geometrie
LSR Landesschulrat Tirol

Figure 2: Map of the political dependencies of LB-West [https://www.upc.smm.lt/projektai/stempdnet/naujienos/diskusija/3-LEHRERiNNENBILDUNG-WEST-LB-West-klasterio-kurimas.pdf; p. 7]

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

UGDYMO PLĖTOTĖS CENTRAS

EDUCATION DEVELOPMENT CENTRE (EDC)

We refer to the presentation of UPC on its website[1]. Parts of the following text are cited from an English version of its homepage and modified according to our categories, the rest is collected internally. This case study has been written by Ruta Mazgelyté & Vytautas Andrékus.

I EDC as a Lithuanian Institution

I.I The Founding

The Education Development Centre (EDC) was established on the 1st September, 2009 after the reorganization of Teacher Professional Development Centre (TPDC), Education Development Centre (EDC), Teacher Competence Centre (TCC), Lithuanian Adult Education and Information Centre (LAEIC) and it is the largest institution under the direct authority of the Ministry of Education and Science.

In 1945 the Republican Pedagogical Cabinet at the Ministry of Education was founded. In 1950 the cabinet was transformed into Republican Teacher Qualification Improvement Institute which had the main function of teacher qualification improvement and teacher training. In 1990, after the independence of our country had been restored, the institute was rearranged into the Lithuanian In-Service Teacher Training Institute. In 1999, the institute was reorganized into Teacher Professional Development Centre (TPDC). The main goals of this institute were: dissemination of education reform ideas and innovations, implementation of strategic in-service training projects and programmes, preparation of consultants for regions, organization and coordination of methodological activity, preparation of methodological tools for teachers.

In 1958 the Scientific School Research Institute was established; it was reorganized into the Pedagogical Scientific Research Institute and later into Institute of Pedagogy. In 1991, the Education Development Centre was established after the restructuring of the Institute of Pedagogy. The main EDC tasks were: the preparation and introduction of the documents which determine the curriculum and methodological material for teachers, organization and implementation of education system monitoring, preparation of education development models.

In 2003, the Teacher Competence Centre (TCC) was established. This institution organized the supervision of in-service teacher training quality, accreditation of in-service teacher training institutions and their programmes, and provision of methodological support. TCC has been coordinating the attestation of pedagogues and school administrators, implementing expert in- service teacher training evaluation and participating in expertise of teacher training programmes.

In 2005 after the reorganization of Distance (Extramural) Education Centre, Lithuanian Adult Education and Information Centre (LAEIC) started its activity. The Centre had been providing support for continuing adult education, gathering and

[1] https://www.upc.smm.lt/veikla/about.php

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

storing data on adult education possibilities, on employs 65 persons with pedagogical degrees and institutions which provide adult education and 39 specialists; thus it makes it a large institution. their programmes, disseminating information,
testing adult education status and needs, implementing different projects in adult education development.

What is the money spend for?	Rough percentage
Staff	50 %
PD Initiatives	24 %
Materials development	1,06 %
Other:	25,94 %

I.II The Embeddedness and Institutional Dependencies

The Education Development Centre (EDC) is a national level institution affiliate to the Ministry of Education and Science of the Republic of Lithunia. It provides educational support in the field of preschool, primary and general education. Due to centre establishment peculiarities, the centre carries various tasks, which require close cooperation and collaboration with other institutions – and particularly in the field of in- service teacher training.
In the field of in-service teacher training EDC cooperates with 5 institutions affiliate to the Ministry of Education and Science of the Republic of Lithuania (Lithuanian Centre of Non-formal Youth Education, National Agency for School Evaluation, The Lithuanian Children and Youth Centre, Special Pedagogy and Psychology Centre, Centre for the Development of Qualifications and Vocational Training), professional development centres in 8 institutions of continuing education at universities and 62 regional teacher' training centres, 63 subject associations. The institutional dependencies by financial and accreditation aspects are shown in the graph 'Lithuanian teacher professional development system and institutional dependencies'.
EDC has 5 divisions: Education Content Division, In- Service Training Division, School Performance Development Division, Education Content Quality Assurance Division, Information and Communication Division and 3 supporting departments: Law, Human Resources and Public procurement department, Accounting department, Administration and Maintenance department. EDC
In addition to allocated budget, EDC has got additional funding from international projects 0.3 mln. Euro, EU structural funds project 1.4 mln. Euro.

II Philosophy, Mission and Networking

II.I Traditions of PD Centres in Lithuania

PD centres in Lithuania can be classified into two categories according to their scope:

- national level and
- regional level PD centres.

National level centres focus on CPD, which corresponds to national in-service teacher training needs and key-education policy trends.
These institutions are the Education Development Centre, institutions of continuing education at universities, the Lithuanian Centre of Non-formal Youth Education and the Lithuanian Children and Youth Centre. Their operational activities are funded by Ministry of Education and Science and Teacher PD voucher. The slight exceptions are institutions of continuing education at universities – they are funded by universities (but again: universities get funding from the Ministry of Education and Science).

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

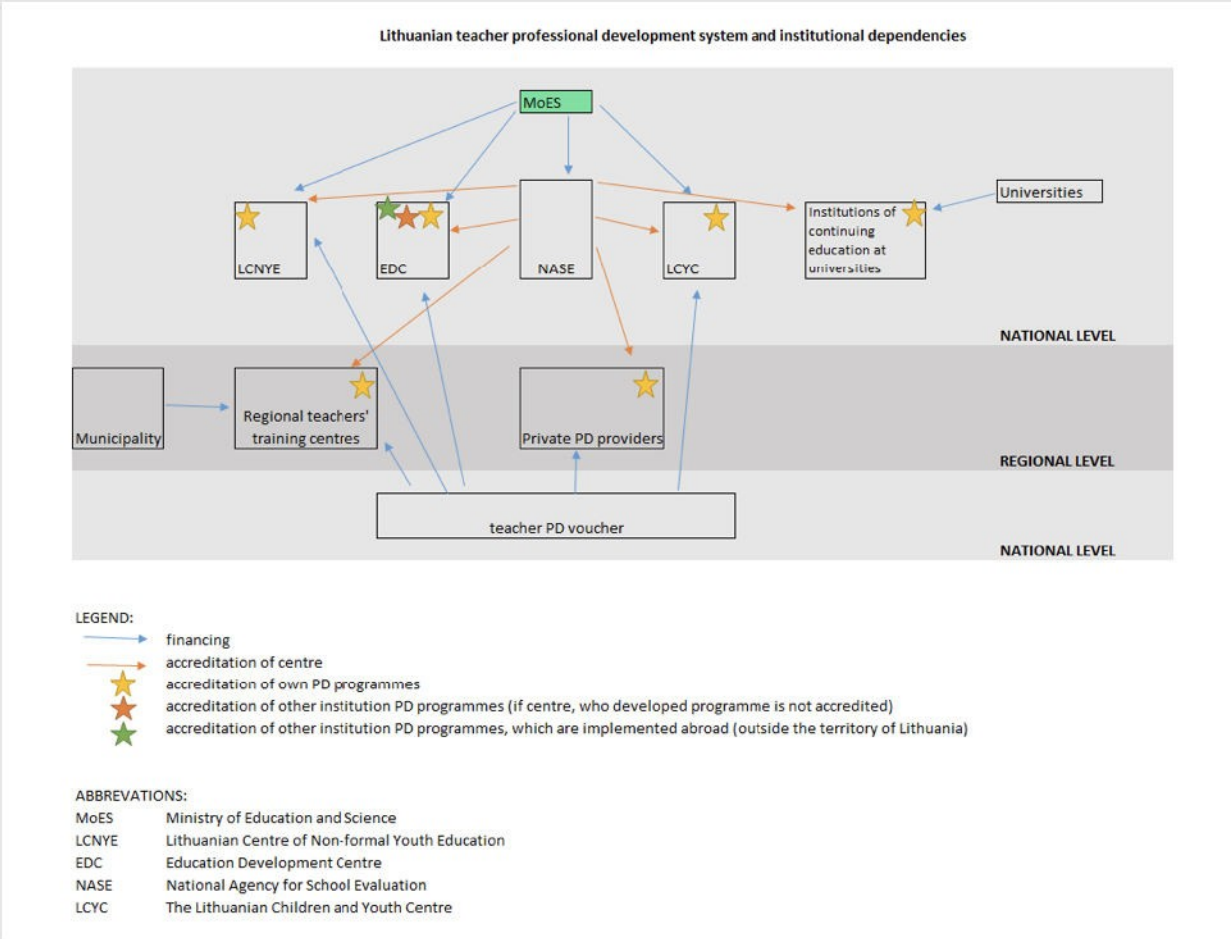


Figure 3: The structure of the Centre and finances

Regional level PD providers – regional teacher' training centres and private PD providers usually focus their CPD on the needs of the teachers in the region they operate in. Their operational activities are funded by the Municipality and Teacher PD voucher. Being a nationwide public institution, EDC cooperates with regional PD centres by sharing practices, taking part in discussion or working groups.
Consequently, EDC operates in a very classical CPD institutions' environment.

II.II Philosophy and Mission

Due to teacher CPD institutional transformations and EDC emergence as an institution of structural reforms, the centre has a wide mission. The purpose of EDC is to implement national professional development and general education programmes and policies; to provide methodological materials for schools and pre- school, primary and general education teachers; to accredit professional development programmes and monitor their implementation and teachers' professional growth; to coordinate activities of education advisors (consultants) in the field of ICT, programme evaluation; to provide professional development and other support for specialists, who work with special needs students.

II.III Networking as a Crucial Issue of a PD Centre

As a national level PD provider, which is closely linked to education policy implementation, EDC joins and participates in various international

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

cooperation initiatives coordinated by European SchoolNet, STEM PD Network and others. These initiatives EDC is involved in are take a shape of international project activities. For example in 2016 EDC was partner or coordinator of 8 international projects:

- `STEM capacity building',
- `European Network of STEM Professional Development Centres',
- `Scientix 3',
- `Media and information literacy education',
- `MENTEP - MENtoring Technology Enhanced Pedagogy',
- `Innovative Teacher - Motivated Student: Collaborative Problem Solving',
- `Teachers Professional Competences Common framework' and
- `M.A.R.C.H. – `Make Science Real in Schools'.

Joining international colleagues is an important source of new ideas and a channel to transmit experience and insights to partners abroad.

III Activities

The activities of the Education Development Centre fall into five areas:

- Development and implementation of preschool, primary, general education content;
- Methodological support for teachers, professional development and coordination of education advisors' (consultants) activities;
- In-service teacher training and quality assurance (evaluation and accreditation of teacher professional development programmes);
- Organization and coordination of expert evaluation of textbooks and other teaching/learning tools;
- Initiation and implementation of education innovations during national and international projects.

IV The Foundation of EDC Activities

The foundation of CPD activities provided by EDC consists of three ideas: development and implementation of curriculum innovation, according to the learning needs of society; development of effective and teacher-oriented PD; development of strategic partnerships and sustainable collaboration networks for innovative, up-to-date CPD. As a result, the most typical CPD offers focus on pedagogical content knowledge transmission for in-service teachers.

Specific Aspects

V Political Dependency

The political dependency of EDC stems directly from the fact that it is affiliate to the Ministry of Education and Science of the Republic of Lithuania. However, it does not necessarily mean that CPD provision solely takes into consideration national education policy guidelines. EDC is independent to design CPD according to teacher community needs, too.

VI Interdependence of Initial Teacher Education and Activities

The main target group of CPD provided by EDC are in-service teachers. Not being a university EDC does not provide courses specifically designed for the future teachers (i.e. students at universities). However, for the last three years EDC has been cooperating with the Ministry of Education and Science in order to provide professional development opportunities and support for young teachers' recent graduates, who started working in schools and who have been working there up to five years.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

VII Quality Assurance

All CPD programmes run by EDC are accredited according to professional development programmes' procedure description approved by the Minister of Education and Science. The description defines quality criteria for professional development programmes. Among these are: PD priorities set by the Ministry and developed or acquired competences defined in teacher competence descriptions.

VIII Interdependence of Research and Practice

EDC has formalized cooperation with few universities by signing long-term cooperation agreements; however, in most cases it is a common interest in specific or actual themes and problems that determines the need for short-term cooperation.

Miscellaneous

IX Conclusions and Recommendations

EDC is settled in the PD-providers system as a unique institution, which has undergone a wide organizational consolidation. Being interdependent with the Ministry of Education and Science it is exposed to education policy changes, new initiatives or changing priorities. Main challenges for EDC in the field of professional development are:

- Renewal of a general education curriculum, dissemination and activities related to teacher competence development;
- Implementation of IT in primary education;
- STEM implementation and national STEM network coordination;
- Media and information literacy improvement in schools;
- Integration of financial literacy in schools;

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

- Professional development related to health, sexuality and preparation to family life education;
- Competences' development for inclusive education;

Implementation of training courses devoted

5.2 Enkäter

5.2.1 Enkät 1

STEM PD Net Questionnaire

General information

Information for data usage

Your information will be used for research purposes in the course of the project only. The data will be matched to the various centres and will not be passed on to third parties.

Structure of the questionnaire

Dear members of the network of PD-centres,

we developed this questionnaire to identify and show the differences and similarities of the centres in our network. Therefore, the questionnaire is structured in five parts:

1. **Contact information**: We need your contact information
2. **Structure of the centre**: We are interested in the structure of your centre (how did your organization evolve, how does your financial situation look like and which subjects do you focus on).
3. **Situation in your country**: We would like to connect this knowledge to the educational system of your country.
4. **Mission of your centre and your activities**: We want to hear more about your activities and missions.
5. **Major challenges and best practice-examples**: We want to learn from your major challenges and best-practice examples.

The questionnaire includes questions you answer by ticking the brackets or by adding a number. Additionally, you will find the opportunity for open answers in a chart or a cell. You can expand all cells and charts – there is no limit of characters.

Contact information

- Name of the centre:

- Address of the centre:

- Homepage (if existing, also English website):

- Contact person for queries:

Structure of the centre

S1: We would like to know which school subjects are addressed by your centre.

- Which school-subjects are addressed by your centre (please mark with a cross)?
  ( )Science ( )Technologies ( )Engineering ( )Mathematics ( )other:

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

S2: We would like to know more about the presence, history and future of your centre. Please tell us the date of the establishment of your centre and since when it exists in this form.

1. Since when does the centre exist?

2. Since about when does it exist in this form?

3. Please mark the expected duration of your centre with a cross:

( )permanently ( )temporary, for a certain period of time ( )unclear

- If temporary: is an extension possible? ( )yes ( )no
- If temporary: how long is the duration of the centre planned?

4. Is the centre still in a phase of development? ( )yes ( )no
5. In which context was the centre developed?

6. Is the centre part of a university? ( )yes ( )no
   - If no: please continue with S3
7. Is the centre fully integrated in the university? ( )yes ( )no

S3: We would like to know more about the cooperation / collaborations of your centre and how they look like.

1. Are there any additional cooperation / collaborations (actual stable/permanent) with other institutions (e.g. universities, companies, foundations, research institutions, PD-centres, educational authorities etc.)? ( )yes ( )no
   - If no: please continue with S4
2. Please mark with whom you cooperate / collaborate:

( )National universities ( )International universities ( )Companies ( )Foundations ( )research institutions ( )PD-centre ( )educational authorities ( )other:

3. Please describe briefly up to three cooperation / collaborations which you regard as most important:

S4: We would like to know more roughly about the budget of your centre.

1. Do you have your own budget? ( )yes ( )no
   - If no: please continue with S5
2. How much budget (in euro) do you roughly have per year?

()less than 100 000 ( )up to 500 000 ( )up to 1 000 000 ( )more than 1 000 000

3. Please fill out the chart:

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

Sources of the money	Rough per-centage of the whole sum
University	%
Educational ministries	%
Third party funds from the economy	%
Centre's intake (participant fees, publishing, …)	%

What is the money spend on?	Rough per-centage of the whole sum
Staff	%
PD initiatives	%
Materials (development)	%
Other:	%

Other:	%

S5: We would like to know more about the number of your staff.

1. Who works for your centre? Please fill out the chart:

Staff of your centre	Number of full time equivalent staff
Academics as researcher	
Academics as facilitator	
Non academics	
Other:	

S6: We would like to know more about the role research plays in your centre.

1. Does your centre do research? ( )yes ( )no
   - If no: please continue with S7.
2. Does research play a minor role, an equal or a major role in your centre? ( )minor ( )equal ( )major
3. Is research done by individuals or by groups? ( )individuals ( )groups
4. Please describe how research influences the work of your centre:

5. Please list some references of typical publications of your centre (if they are neither English or German please add keyword about the content of the publications)

S7: We would like to know more about the role PhD-programs play for your centre.

1. Does your centre offer a PhD-program? ( )yes ( )no
   - If no: please continue with Si1.
2. Please give a brief description of your PhD-program.

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

Situation in your country

Si1: We would like to know more about the existence of Professional Development Centres in your country.

1. Are there further STEM-centres in your country? ( )yes ( )no
   - If no: please continue with Si2
   - If yes: please list exemplary other centres:

Name of other centres	Homepage (in English or German) or short description of the centre

Si2: We would like to know more about the professional development and education in your country.

1. Please fill out the chart:

Profession	Typical education (university degree, vocational training, nothing, …)	Typically used professional development (regular courses, working in Professional Learning Communities, nothing, …)	How many of these people do you reach per year (give an estimation) by offering what kind of PD format (e.g. courses, professional learning communities, conferences, materials for lessons, …)
Nursery school teacher			
In-service-teacher			
Facilitator for in-service-teacher			
Facilitator for pre-service-teacher			
School-leaders			
Other:			

Mission of your centre and your activities

M1: We would like to know more about the mission of you centre.

1. Please tell us about the main goals of your centre:

M2: We would like to know more about the characteristics of your activities.

1. Please describe briefly what main ideas your institution pursues in its offers. (list the three most important ones)

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

2. In how far are the following types of knowledge covered in your Professional Development-offers (please mark the applicable with a cross and try to give an estimation of their frequency)?

Types of knowledge	Percentages of your offers that focus on this type of knowledge
( ) CK (content knowledge)	
( ) PCK (pedagogical content knowledge)	
( ) PK (pedagogical knowledge)	

3. Please list typical activities (e.g. a 3-day long course about chance; a conference for teachers about the teaching of climate, …):

4. Are the offers always designed by your centre? ( )yes ( )no
- If yes: please continue with MC1.
- If no: Please describe who designs your offers (e.g. teachers in cooperation with the centre, …):

Major challenges and best-practice examples

MC1: We would like to know more about your challenges.

1. Please list major challenges your centre faces:

MC2: We would like to know more about your success.

2. Please list best-practice examples of your centre:

3. Are they documented? ( )yes ( )no

If yes: Please list where we can find them:

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union

5.2.2 Enkät 2

QUESTIONNAIRE: The Profiles of the PD-centres

Questionnaire to all project partners to get more details on the top 4 main categories of the first questionnaire.

The questions which answers we would like to know are the following:

- Is there an annual job calendar with regularly upcoming and discussed task?
- What are the standard tasks in your centres?
    - Preparing and running CP courses?
        - What are the precise steps?
        - Who is responsible? Who is the initiator?
        - Who is checking quality standards?
        - What is done in advance for a 'job'?
        - What is done after the measure resp. job?
    - Reviewing and evaluating jobs for other institutions?
- Is your centre integrated into curriculum discussions and developments?
- Does there exist some private communication between your centre and individuals? Does individual counselling is happening? Often?

- Addressees:
    - Are you addressing students (pupils)?
    - Are you responsible for math resp. science fairs and exhibition?

- Cooperation with learned societies:
    - Are you asked to be present at annual conferences of the learned societies?
    - How intensive is the cooperation with the learned society in your country?

- Support for the employees by the centre its own:
    - … for the scientific development of the employees?
    - … to visit international conferences?
    - … to publish in research papers
    - Is there an internal public discussion of joint scientific papers? Jour fixe?

- Facilities:
    - Do you have internal access to educational journals within your centre? Or do you have to use the library of a university?
    - Business cards of your institution

- Public relations work
    - Chance to introduce yourself and your work
    - Is there an annual report to the outside world of your centre?
    - Invitation to other events

ICSE International Centre for STEM Education
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
Co-funded by the Erasmus+ Programme of the European Union